ABUNDANCE AND DISTRIBUTION OF THE QUEEN MAUD GULF CARIBOU HERD, 1986-98.

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ABSTRACT

It was uncertain as to whether the barren-ground caribou (*Rangifer tarandus groenlandicus)* wintering around Bathurst Inlet, Nunavut, in the late 1990s belonged to the Bathurst or another herd, although the commercial tags were assigned to the Bathurst herd. To determine the herd identity, we fitted five cows east of Bathurst Inlet, Nunavut, with satellite collars in April1996. This report summarizes the seasonal distribution of the five satellite-collared cows from April 1996 to June 1998. We also report aerial surveys to delimit calving distribution in 1986 and 1996. The collared cows calved along the Queen Maud Gulf in 1996, 1997 and 1998, and spent the summers mostly in the Queen Maud Gulf Migratory Bird Sanctuary. The fall and spring migration of the herd is through and south of the Thelon Game Sanctuary, and the winter range extends into the Northwest Territories where the tundra merges with the taiga. In 1986 we estimated that 11 265 caribou were on the calving grounds, and in 1996 we estimated 83 134 caribou, which extrapolates to about 200 000 caribou in the herd that is seasonally hunted by people from Gjoa Haven, Umingmaktok, Cambridge Bay and Lutsel K'e. The Queen Maud Gulf herd's traditional calving ground overlaps with the Bathurst herd's traditional (but not current) calving grounds, the southern wintering ranges overlap with the ranges of the Beverly and Bathurst herds, and the northern winter ranges overlap with the Dolphin and Union herd's mainland winter ranges. In 1996, the Queen Maud Gulf caribou herd was the fourth largest herd of barren-ground caribou shared between the Northwest Territories and Nunavut.

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INTRODUCTION

In some years barren-ground caribou (*Rangifer tarandus groenlandicus*) winter in the central Arctic mainland area of Bathurst Inlet and Kent Peninsula (Kelsall 1968, Gunn *et al.* 1997a). However, in the 1990s, arctic-island caribou from Victoria Island (Dolphin and Union herd) have progressively replaced those barren-ground caribou that previously wintered on the Kent Peninsula (Figure 1) and south of Elu Inlet toward Umingmaktok (Gunn *et al.* 1997a). Because of a concern with the harvest of the Dolphin and Union herd, the Kitikmeot Hunters and Trappers Association recommended that commercial harvest of arctic-island caribou be discontinued (KHTA Annual General Meeting, July 1994). Consequently, hunters with commercial caribou tags for the Cambridge Bay meat plant (Kitikmeot Foods Ltd.) were obligated to travel further south to hunt barren-ground caribou under the commercial quota assigned to the Bathurst herd. The critical assumption has been that barren-ground caribou wintering on the mainland between Bathurst Inlet and the Ellice River were a tundra wintering segment of the Bathurst herd.

However, hunters have suggested that the caribou wintering around Bathurst Inlet travel further east to calve. In addition, although 1995 spring snow melt and caribou migration were late, in June we found cows and newborn calves moving east toward Queen Maud Gulf at the same time that we saw caribou calving west of Bathurst Inlet (Gunn 1996).

Based on an extensive survey between 4 and 11 May 1983 to determine pre-calving distribution and abundance of caribou in the Queen Maud Gulf area, Heard *et al.* (1987) suggested the likely existence of a herd distinct from the Bathurst herd. The authors suggested that the 33 000 ± 5100 caribou estimated between the Perry River and Adelaide Peninsula were either a separate population or a segment of the Bathurst herd.

We suspected that the caribou were a separate herd based on finding a calving ground west of Adelaide Peninsula during an aerial survey of Adelaide Peninsula and east of Chantrey Inlet in June 1986 (this report). However we lacked confirmation or an understanding of the

seasonal movements, which left unresolved the management issue of herd identity of the caribou wintering east of Bathurst Inlet and whether we should assign the commercial harvest to another herd or the Bathurst herd. Failure to determine which herd the caribou belong to could lead to loss of opportunities for hunters from Umingmaktok and Cambridge Bay or changes in population size remaining undetected.

Mining exploration is underway east and south of Bathurst Inlet and baseline studies describe seasonal changes in caribou numbers (Ross 1997, Rescan Environmental Services Ltd 1999). The herd designation of those caribou will be necessary to assess implications of any development of the properties.

Conventionally, caribou populations (herds) are delineated on the basis of the return of pregnant cows to a traditional calving ground (Thomas 1969). Monitoring movements of caribou that winter east of Bathurst Inlet would allow us to determine which calving grounds they use and to compare their rutting distribution to the Bathurst herd. Using calving distribution to define herds would be strengthened if we knew that cows that calved together also bred together. As we were unsure as to the extent of the movements, we used satellite collars. Satellite telemetry has unlimited range and allows us to monitor movements with no disturbance.

Our first objective was to determine seasonal movements for caribou cows east of Bathurst Inlet using satellite telemetry. Our second objective was to determine to which herd the caribou wintering east of Bathurst Inlet belonged (based on their return to a calving ground). As well as describing the results of this research in the report, we have also included other information that we have compiled on the caribou east of Bathurst Inlet.

METHODS

Satellite-collaring in April 1996

We used five refurbished ST 10 collars (Telonics Inc. Arizona, U.S.A.) that, complete with battery and VHF transmitter, weighed about 1200g. The transmitter duty cycles were programmed to transmit 6h on and 114h off during the year.

We based our field operations out of Umingmaktok and searched for caribou in the vicinity of Bathurst Inlet using an Aviat A-1 Husky. From the air, we scrutinized groups for adult female barren-ground caribou with hard antlers accompanied by short yearlings. We distinguished between barren-ground caribou and arctic-island caribou based on overall body size (arctic-island caribou are noticeably smaller), configuration of the head (length of the muzzle relative to overall head length is shorter in arctic-island caribou), and pelage colour (arctic-island caribou are conspicuously lighter with a light brown back and white flanks, belly, and lower legs). Upon locating suitable groups of caribou, we radioed the location back to a helicopter-based capture crew (Outbound Aviation Ltd). The two-person capture crew (pilot and net-gunner) used a Hughes 500 and fired either a hand-held or skid-mounted net gun to capture caribou cows. The helicopter landed close to the cow in the net after a successful shot and the net-gunner used a blindfold on the cow while he removed the net and fitted the collar. To minimize handling time, we only took fecal samples and took no body measurements.

In May 1998, we retrieved transmitters from the three cows that had died and recaptured the other two cows to remove the collars. We took skin biopsy samples from under the collars, fixed them in buffered formalin and sent them to the Western College of Veterinary Medicine for pathological examination.

Calving Distribution and Abundance in June 1986

In June 1986, we used a fixed-wing Helio-Courier aircraft on wheel skis based at Gjoa Haven. Survey altitude was 150 m above ground level, airspeed 160 km/h and the transect width 1.0 km on either side of the aircraft. To cover the largest area possible with our flying time, we opted not to do reconnaissance but instead systematically covered the area

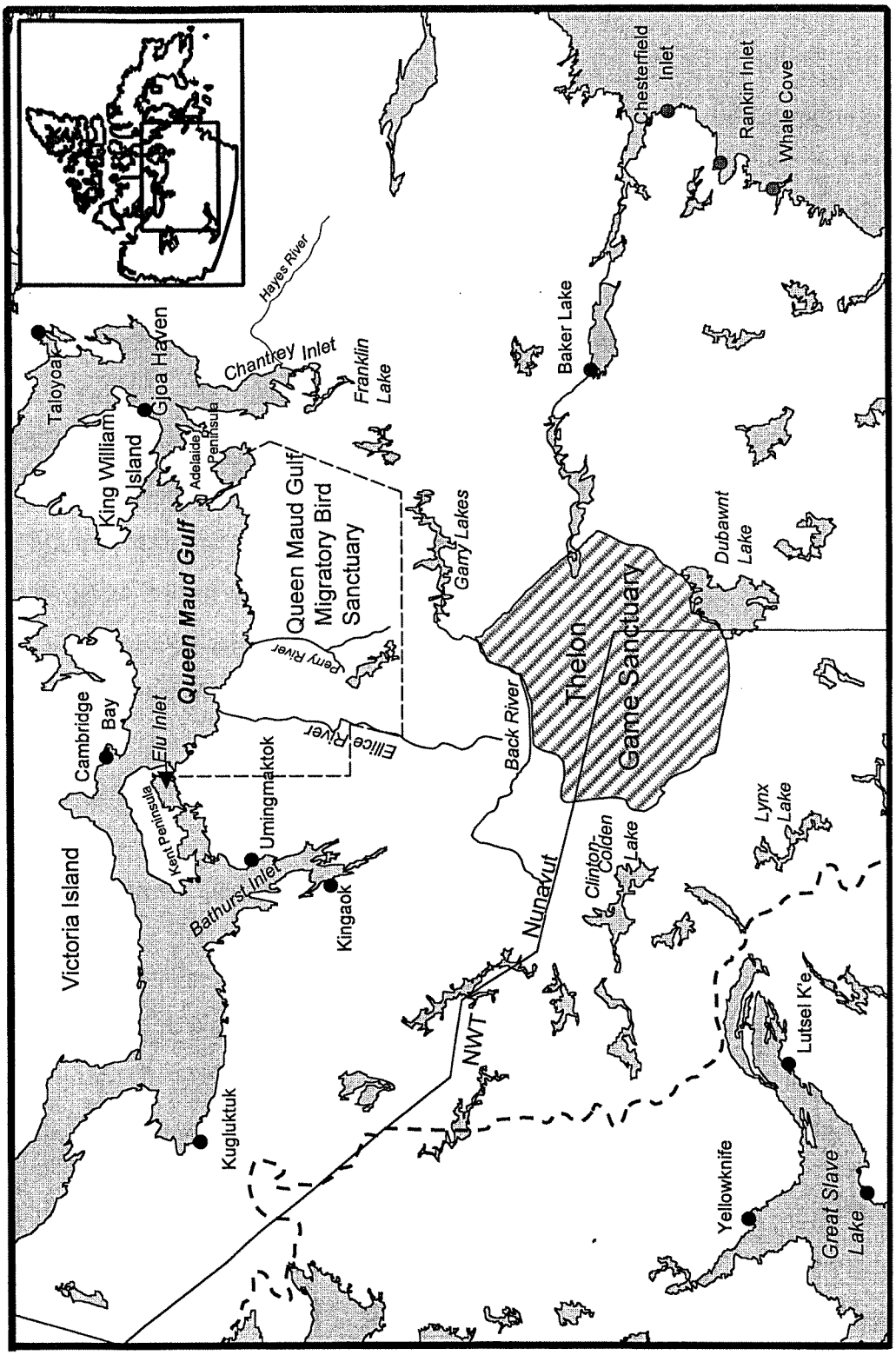

Figure 1. Study area for the satellite-collared Queen Maud Gulf caribou cows.

(Stratum II) west of Adelaide Peninsula using transects 9.6 km apart (20% cover) between 6 and 8 June 1986. We then resurveyed this area as Stratum III at a higher coverage (27%) between 11 and 12 June 1986 to determine the extent of calving and estimate abundance.

Calving Distribution and Abundance in June 1996

In June 1996 we flew systematic reconnaissance as part of the survey for the Bathurst herd calving ground (Gunn *et al.* 1997b). We used a fixed-wing Helio-Courier aircraft on tundra tires based at a field camp east of Bathurst Inlet. Survey altitude was 120 m above ground level, airspeed 160 km/h and the transect width 0.8 km on either side of the aircraft. We flew four east-west transects as far as the Simpson River between 6 and 8 June 1996 to determine if there was a discontinuity in calving distribution between east and west of Bathurst Inlet. We then flew systematic transects between 12 and 13 June 1996 to determine the eastern extent of Queen Maud Gulf calving and to estimate abundance. Six east - west transects were flown between 106° and 98° W. Transect length was variable and ranged from 49 km to 352 km. Transect lines 3, 4 and 5 were flown over 2 days.

Data Analyses

We received location data from Service Argos and transferred them into a database (DBase3). We used Dbase5 to calculate distances between locations and used Microsoft Excel to graph rates of movement. We plotted location data and examined seasonal range use using SPANS software. Two collars, #80 and #83, transmitted intermittently, and the data for these two cows were not included in most analyses.

We used calendar months for most analyses for convenience of standardised time periods for comparisons. However, we recognize that ecological processes have their own seasonality independent of calendar months so we graphed mean daily rates of movement to define seasons (precalving, calving, rutting). We used the date of increased movement during May or June as the beginning of pre-calving and summed the minimum straight-line distances moved from this date to the assumed calving date (period of minimal change in daily movement). The increase in mean daily movements was the beginning of post-calving,

which we then arbitrarily terminated at the end of July. We mapped August, September and October movements and used the period of minimal rate of movement during winter months to map the winter distribution of the cows (late November to early April).

Location data were not used for analyses if the location class (quality index) was A or B (Appendix B) because of its uncertainty. We used quality indices of 0 to 3 for our analyses. We calculated minimum (straight-line) distances moved between locations at 5-day intervals. Sigmastat was used for the comparisons of total distance moved monthly between individuals and between years (ANOVA). This resulted in unequal variance so the data was transformed to $\log_{10}$ for analysis. We also compared mean distances between collared cows during different seasons to determine if cows were closer together during calving and rutting.

Distances traveled for three cows, starting from calving locations and continuing as they traveled throughout the seasons, were measured and plotted to compare the annual pattern of movement.

We used Jolly's (1969) Method 2 to calculate a population estimate from the numbers of caribou (excluding calves) counted on transect (Appendix A).

RESULTS

Capture and Collaring

We caught and collared 5 adult cows on 16 and 21 April 1996 (Figure 2). We found arctic-island caribou (Dolphin and Union herd) on Kent Peninsula and in the vicinity of Umingmaktok. Only when we were as far east as 105°W did we find barren-ground caribou in large numbers moving northeast in groups of 10s and 100s. The caribou were mostly antlered cows, yearlings and juveniles. Mean chase time was 60 ± 8.7 sec (SE) and handling time averaged 7 ± 0.5 min (SE). We observed one injury to a caribou during the capture – cow #83 suffered a superficial cut to the perianal area.

Location data were received continuously for three of the five collared cows from April 1996 to May 1998. Locations were not received consistently every 5 days (Appendices B and E) and the location's accuracy varied (Appendix B). Location class A and B were too unreliable to be used. Two transmitters (#84 and #85) had only 11% and 6% of their total locations as A or B. By comparison, the other three transmitters had 21-31% of their locations as unusable A or B.

Seasonal Movements and Distribution

We have two consecutive years of data on seasonal movements for three of the five satellite-collared cows and those three cows annually had similar seasonal patterns of movement rates and traveled similar distances (Appendices C,D and E). The three cows traveled 1692 ± 266 km (SE) in 1996 and 2001 ± 68 km (SE) in 1997. The timing of their annual movements (Table 1) varied except for immediately before the rut, based on spikes in the daily rates of travel (Appendix D). The rate of movement during migrations was 3 - 4 times the rate of movement during winter. The maximum distances travelled between calving and furthest fall locations are 380-660 km (Table 2). In winter, cow #84 travelled furthest south from her calving area (Figures 3, 4 and 5) and in spring she had the fastest rate of travel (Table 2).

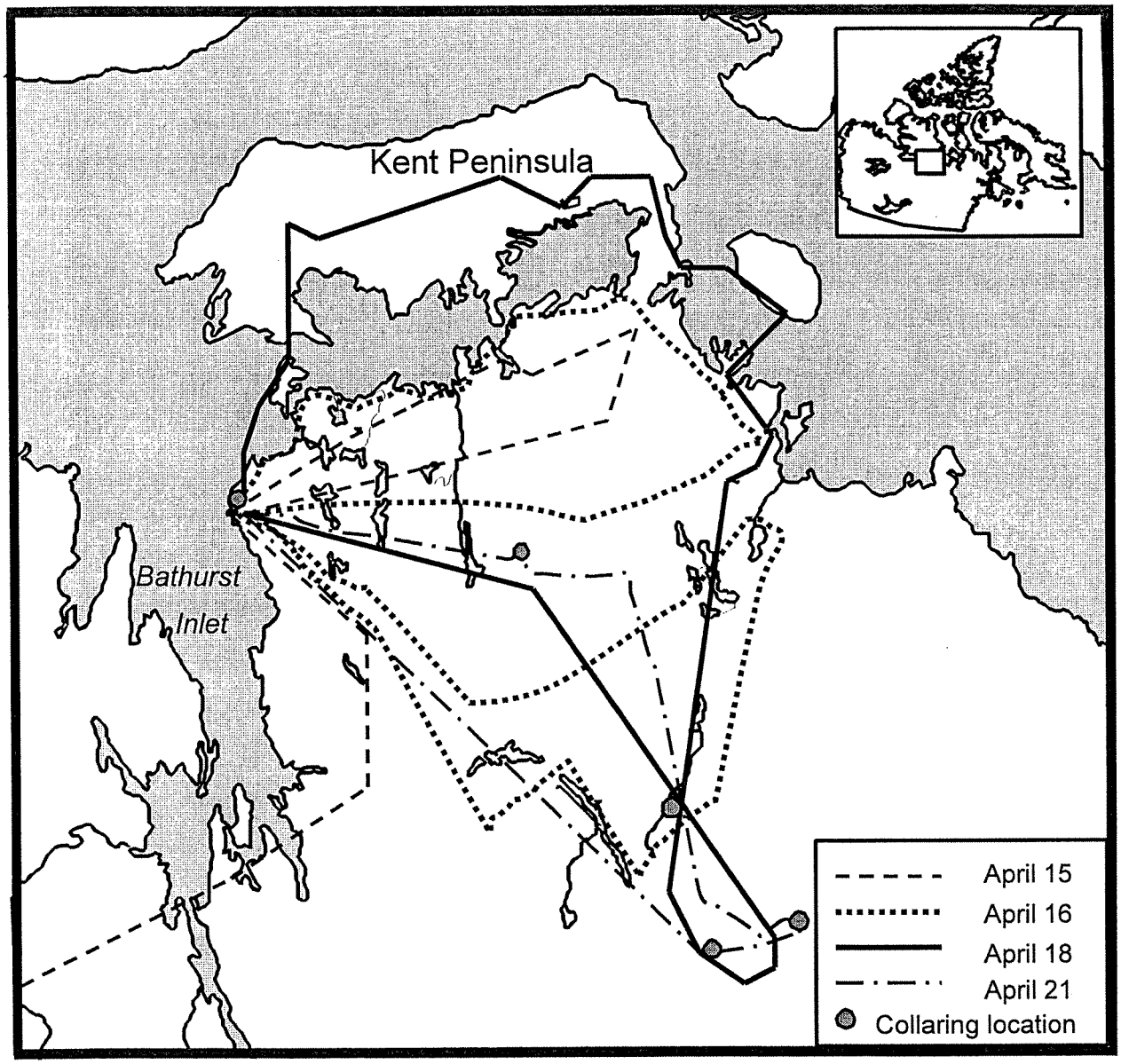

Figure 2. Flightlines and locations near Bathurst Inlet where caribou were fitted with satellite transmitters, April 1996.

Table 1. Dates of peaks in mean total annual distance (km) moved by satellite-collared Queen Maud Gulf cows based on straight-line distances averaged over 5-day periods, 1996-98.

Mean daily rates	Pre-rut		Summer		Spring migration		
	1996	1997	1996	1997	1996	1997	1998
#82	4 Oct	9 Oct	10 July	5 July	26 May	17 May	27 May
#84	3 Oct	8 Oct	15 July	5-15 July	1 June	16-26 April	12 May
#85	3 Oct	8 Oct	5 July	25 July	26 April	6 May	28 Mar

The collared cows concentrated along the coast of Queen Maud Gulf within the Migratory Bird Sanctuary at calving (Figure 3) and dispersed inland during summer (Figure 6). By the time of the rut in October, the cows had traveled south and were within or in the vicinity of the Thelon Game Sanctuary (Figures 1 and 4). The cows moved northwest after the rut in 1996 to winter on the barrens between Clinton-Colden Lake and the south end of Bathurst Inlet, northwest of the Thelon Game Sanctuary (Figure 5). During the following winter, the cows were further southeast than in 1996/97 and were either within or south of the Thelon Game Sanctuary and as far as the treeline south of Lynx Lake (Figure 5).

We inferred time of calving during June when the mean daily rate of movement was lowest (Table 2) and was preceded by at least a twofold reduction from the previous 5-day period (Appendix D).

Table 2. Dates, mean daily rates of movements and distance moved for satellite-collared caribou during spring migration, calving, summer, fall, rut and winter, Queen Maud Gulf area, Nunavut/NWT, 1996 and 1997.

	Dates	No. days	Mean rate of movement ± SD (km/day)	Distance moved (km)
Season	cow #82			
spring	Apr 22 – Jun 04 1996 Apr 06 – Jun 05 1997 Mar 27 – May 27 1998	44 61 62	6.6 ± 1.1 5.1 ± 2.4 9.6 ± 7.4	315.0 323.5 707.5
calving	Jun 05 – Jun 16 1996 Jun 05 – Jun 15 1997	12 11	1.8 ± 0.1 2.3 ± 1.5	9.0 18.3
post-calving	July 1 – 30 1996 July 1 – 31 1997	30 31	18.8 ± 2.8 15.7 ± 5.9	471.2 460.7
summer	Aug 1 – 29 1996 Aug 1 – 30 1997	29 30	2.9 ± 0.9 4.9 ± 1.9	89.8 152.4
September	Sep 1- 28 1996 Sep 1 –29 1997	28 29	8.8 ± 1.2 5.2 ± 1.9	220.9 162.2
October (rut)	Oct 1-28 1996 Oct 1-28 1997	28 28	13.0 ± 2.8 13.0 ± 4.4	364.8 438.2
winter	Nov 23 1996 – Apr 06 1997 Nov 22 1997 – Mar07 1998	135 106	2.6 ± 1.3 3.2 ± 2.5	388.5 377.3
Season	cow #83			
spring	May 16 – Jun 10 1996	56	7.1 ± 5.7	185.4
calving	Jun 15 – Jun 30 1996	16	1.4 ± 0.4	22.9
Season	cow #84			
spring	Apr 21 – May 26 1996 Apr 16 – Jun 05 1997 Apr 16 – May 31 1998	36 51 46	7.9 ± 4.3 8.3 ± 3.6 13.2 ± 10.2	316.7 480.7 608.6
calving	Jun 05 – Jun 15 1996 Jun 10 – Jun 20 1997	11 11	1.5 ± 0.1 2.3 ± 0.6	14.9 22.4
post-calving	July 1 – 30 1996 July 1 – 30 1997	30 30	9.8 ± 3.4 13.4 ± 1.6	295.1 493.8
summer	Aug 1 – 29 1996 Aug 1 – 24 1997	29 24	10.5 ± 3.4 4.2 ± 2.8	177.1 83.8
September	Sep 1- 28 1996 Sep 1 –28 1997	28 28	7.1 ± 2.4 10.9 ± 2.9	214.3 328.6
October (rut)	Oct 1-23 1996 Oct 1-30 1997	23 30	17.8 ± 3.0 14.8 ± 3.2	496.8 442.8
winter	Nov 22 1996 – Apr 11 1997 Nov 27 1997 – Apr 11 1998	141 136	2.1 ± 1.2 3.1 ± 1.9	287.5 389.5

Table 2 (cont).

	Dates	No. days	Mean rate of movement ± SD (km/day)	Distance moved (km)
Season	**cow #85**			
spring	Apr 16 – May 26 1996 Apr 16 – May 31 1997 Mar 12 – May 26 1996	40 45 76	5.2 ± 1.4 5.1 ± 1.0 9.1 ± 9.1	209.8 254.4 657.7
calving	Jun 05 – Jun 20 1996 Jun 05 – Jun 15 1997	16 11	1.8 ± 0.9 1.6 ± 0.8	23.7 20.4
post-calving	July 1 – 30 1996 July 1 – 31 1997	30 31	17.5 ± 3.8 14.3 ± 1.7	525.4 428.2
summer	Aug 1 – 29 1996 Aug 1 – 29 1997	29 29	5.9 ± 2.9 5.1 ± 0.9	177.1 162.8
September	Sep 1- 28 1996 Sep 1 –28 1997	28 28	6.5 ± 1.9 8.5 ± 2.8	14.9 22.4
October (rut)	Oct 1-28 1996 Oct 1-28 1997	28 28	15.8 ± 4.7 16.5 ± 4.1	472.6 373.1
winter	Nov 22 1996 – Apr 11 1997 Nov 27 1997 – Mar 22 1998	141 116	3.0 ± 1.6 2.8 ± 2.0	432.7 308.8

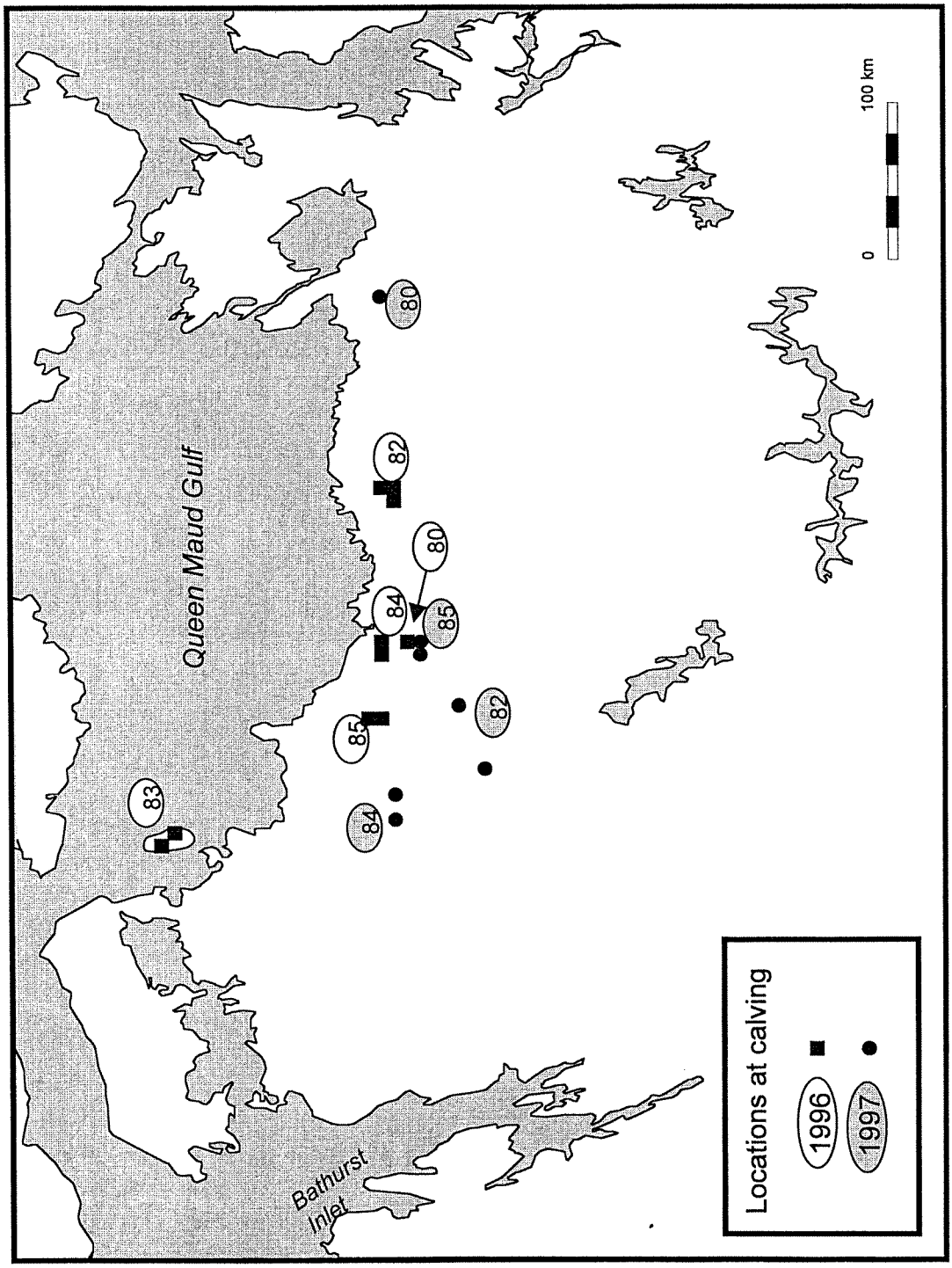

Figure 3. Locations during calving in June 1996 and 1997 for caribou cows fitted with satellite transmitters, Queen Maud Gulf area, Nunavut/NWT.

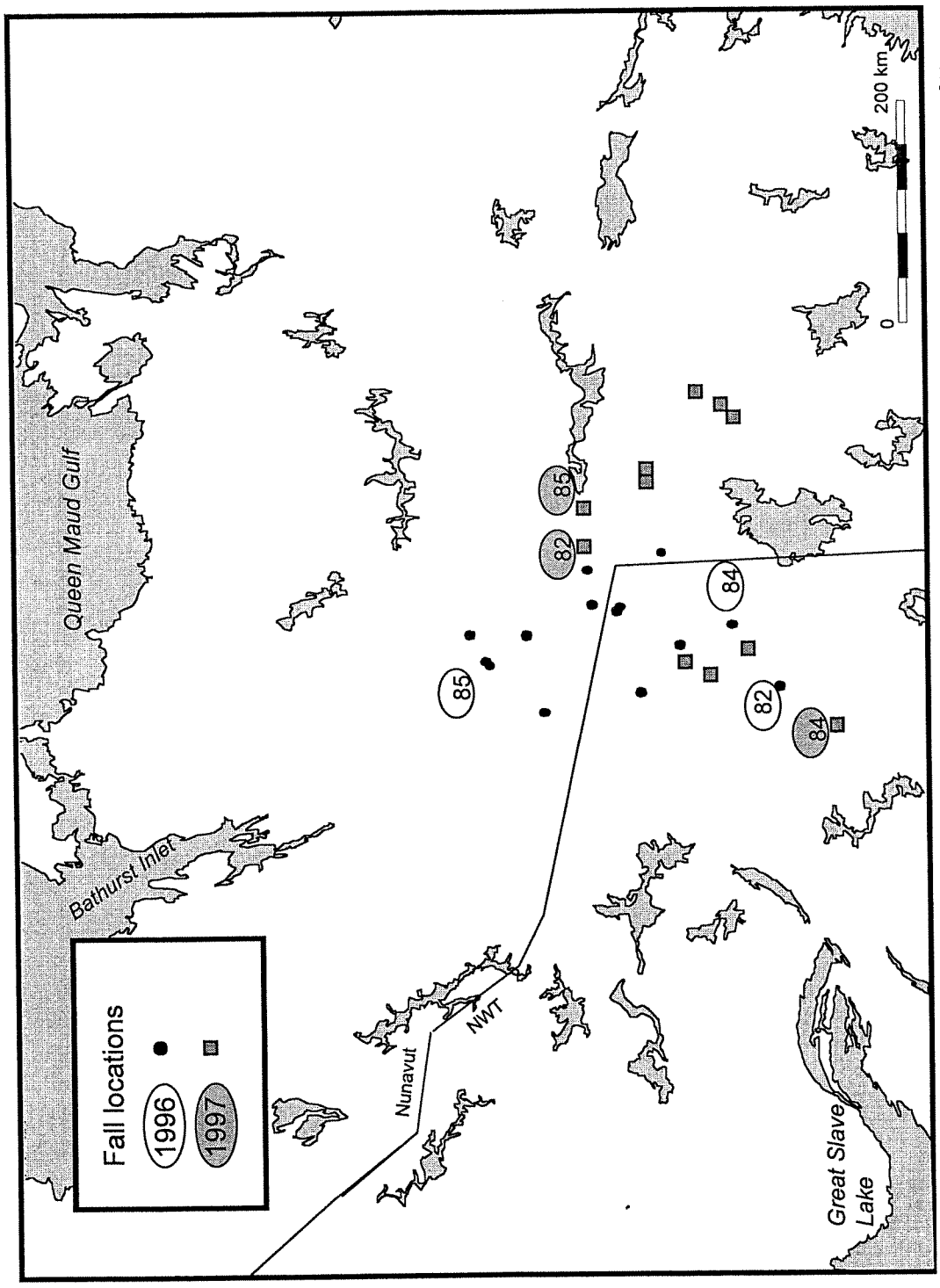

Figure 4. Locations in October 1996 and 1997 for caribou cows fitted with satellite transmitters, Queen Maud Gulf area, Nunavut/NWT.

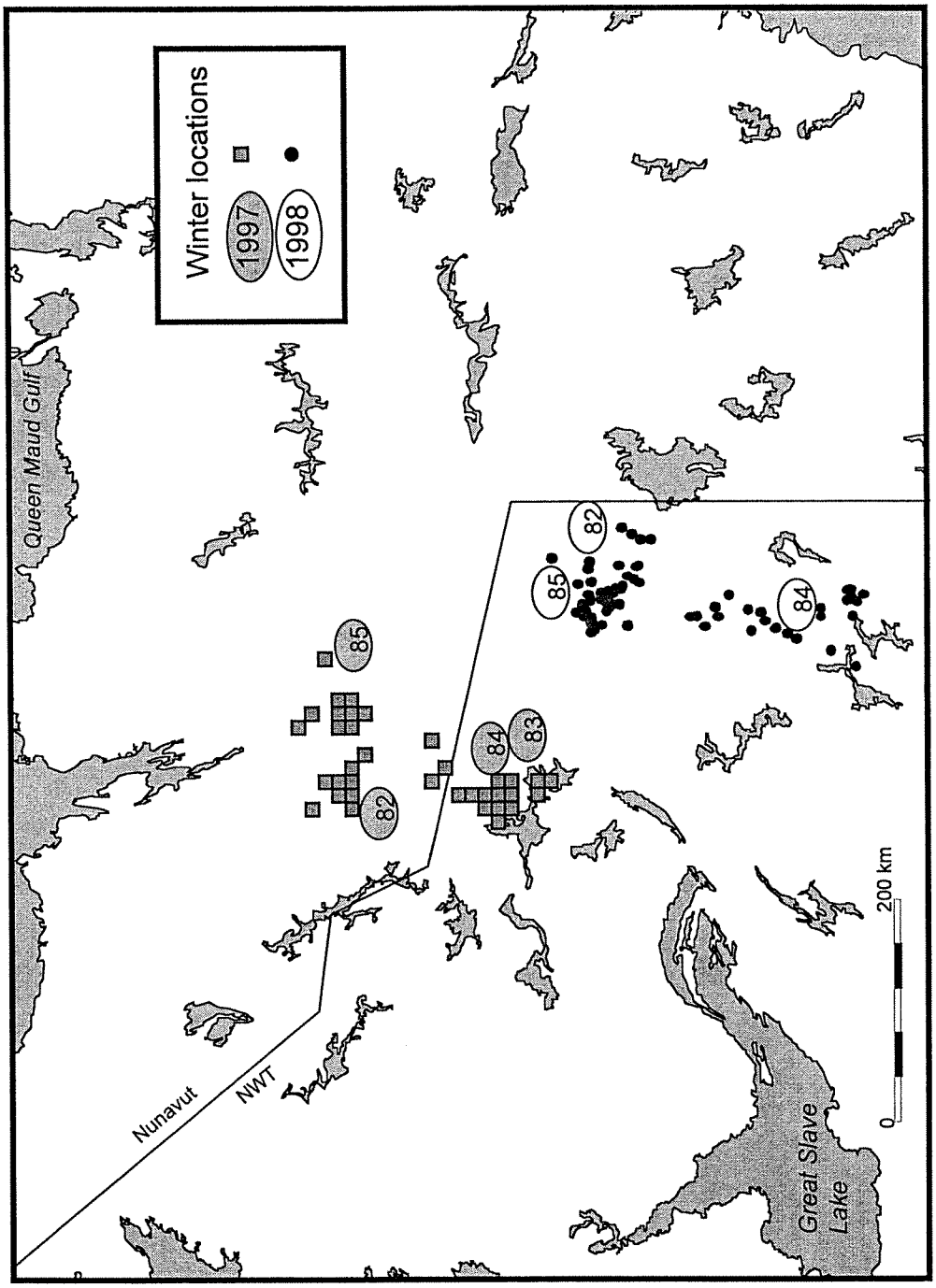

Figure 5. Locations in winter 1997 and 1998 for caribou cows fitted with satellite transmitters, Queen Maud Gulf area, Nunavut/NWT.

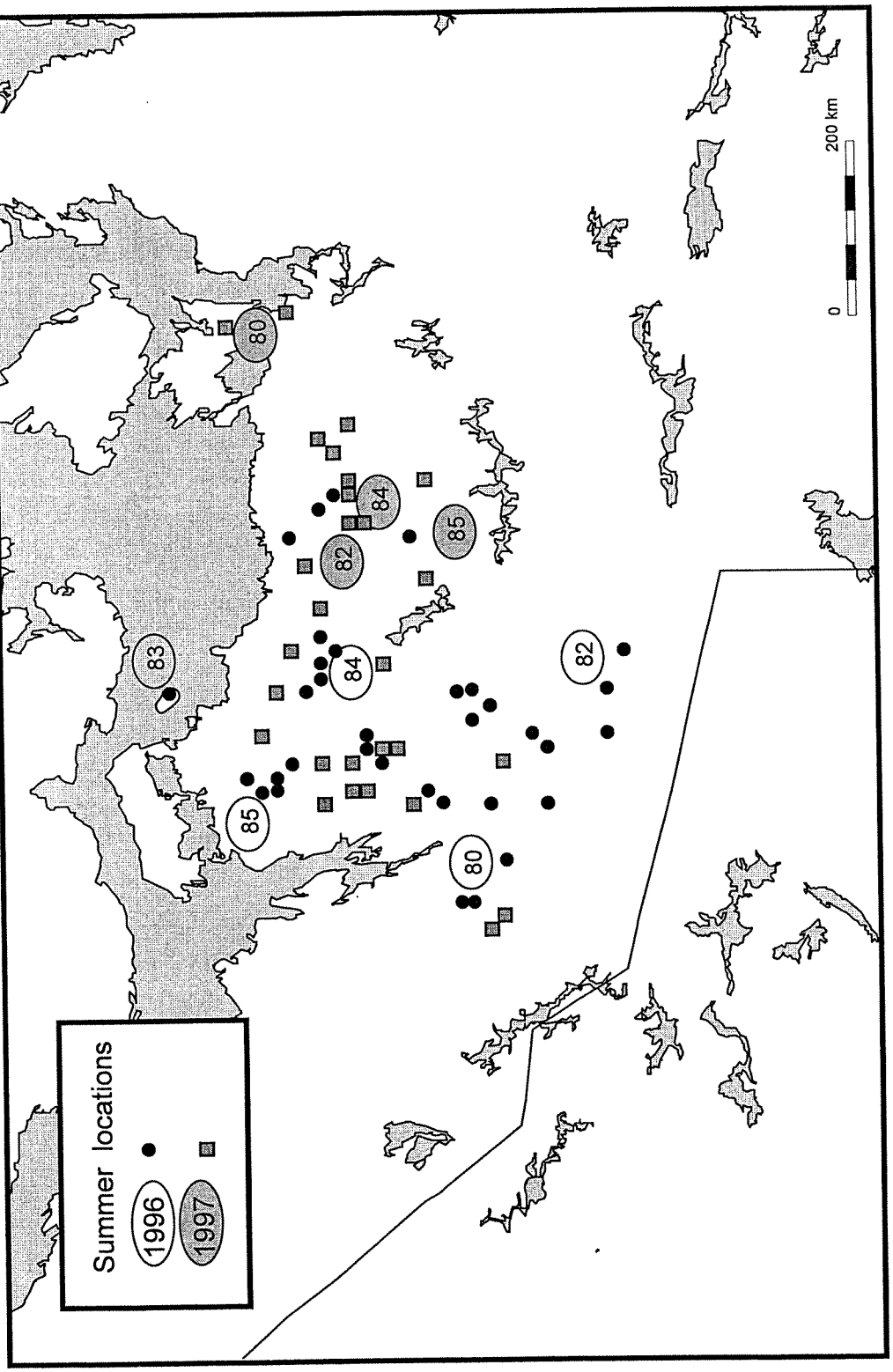

Figure 6. Locations in summer 1996 and 1997 for caribou cows fitted with satellite transmitters, Queen Maud Gulf area, Nunavut/NWT.

When we calculated mean monthly distances moved by all collared cows for 1996-98, we found that the highest mean monthly distances occurred in July and October (Table 3). The lowest distances moved were from December to February. This is further illustrated in Appendix C, showing individual seasonal movements. We compared the monthly distances moved between individual cows during 1996-97 and 1997-98 and did not find any significant differences between the cows' movements (1996-97: F=0.15, P=0.86; 1997-98: F=0.33, P=0.72). We also found no significant difference between years for monthly distances travelled (F=0.18, P=0.97).

Table 3. Mean monthly distances (km ± S.E.) traveled by Queen Maud Gulf collared cows, 1996-98.

Month	Mean distance	Month	Mean distance
January	71.5 ± 9.8	**July**	419.6 ± 38.2
February	65.7 ± 4.9	**August**	140.5 ± 17.4
March	108.9 ± 25.2	**September**	237.2 ± 31.7
April	222.4 ± 25.2	**October**	431.4 ± 21.6
May	227.2 ± 24.6	**November**	225.6 ± 13.4
June	132.5 ± 20.7	**December**	84.6 ± 10.6

Satellite-collared Caribou Calving Areas

The collared cows returned to the Queen Maud Gulf Migratory Bird Sanctuary to calve in 1996 and 1997, but there was an average of approximately 130 km distance between the two suspected calving sites for two consecutive years (Table 4). However, the date of calving was estimated from the movement data and not from visual observations.

Table 4. Distance between calving locations, 1996 and 1997, for satellite collared Queen Maud Gulf caribou.

Cow #	Suspected calving date 1996	Suspected calving date 1997	Distance between calving locations 1996 and 1997(km).
80	June 5	June 11	174.9
82	June 3	June 3	147.9
84	June 7	June 7	69.8
85	June 3	June 12	38.8

We calculated and compared the total straight-line annual movements from calving in 1996 to calving in 1997 for cows #82, #84, and #85 (Appendix E). The patterns of annual movements following calving were similar among cows, although cow #84 traveled further from its calving area in 1997 (Figure 4,5).

The collared cows were closer together during calving and rutting than during summer and winter (Table 5), although the sample is for only three cows.

Table 5. Mean distance between satellite-collared cows during the rut and other seasons during the year.

Mean distance between cows (km±S.E)	
calving (June)	
1996	88 ± 17.3
1997	130 ± 33.3
rut (mid-October)	
1996	71 ± 27.1
1997	125 ± 14.6
summer (July/August)	
1996	119 ± 24.1
1997	216 ± 60.4
winter (Nov – Apr)	
1997	140 ± 22.0
1998	162 ± 33.3

Calving Distribution and Abundance in June 1986

Calving had started by 5 June, as during a single ferry flight along the coast, we saw 14 cows with four newborn calves on the small islands along the coast of Queen Maud Gulf. In Stratum III, we estimated 10 576 ± 1615 (SE) caribou (Table 6), which were mostly cows and calves.

Between 11 and 12 June, we recorded a broad band of calving caribou from west of Tahirjuaq Lake along the coast to the mouth of the Simpson River (Figure 7). The eastern boundary of the calving area based on cow-calf observations was within the area covered by east-west transects. North-south transects determined the western boundary, and although weather was poor, we found only one cow-calf pair west of the Simpson River even though we continued flying along transects further west. We determined the southern boundary from finding only one cow-calf pair on the last east-west transect line flown. There was no discontinuity in distribution of the caribou calving on the islands off the coast of Queen Maud

Gulf and the mainland. Weather during the survey was broken cloud with sunny breaks, which helped make the caribou more conspicuous against the patchy snow. The melt was underway and bare ground was 20-60%.

Table 6. Analysis of data from transect surveys, Queen Maud Gulf area, NWT, June 1986 and 1996.

		1986 St. II	1986 St. III	1996
Maximum no. of transects	N	80	35	81
No. transects surveyed	n	18	14	6
Stratum area, km^2	Z	11 560	7 320	21 901
Transect area, km^2	z	2 400	1 976	1144
Caribou counted	y	143	2 855	4 453
Caribou/km^2	R	0.06	1.44	3.90
Population estimate	Y	689	10 576	83 134
Population variance	VarY	34 121	2 608 794	143 214 172
Standard error	SE Y	185	1 615	5 298
Coefficient of variation	CV	0.29	0.15	0.14

Calving Distribution and Abundance, 12-13 June 1996

We conducted reconnaissance flights over the Queen Maud Gulf area in conjunction with a Bathurst calving ground survey to determine the boundaries of the calving area. The east-west boundaries were determined by flying for approximately 10 km after the last caribou was seen on transect (Figure 8). We found the five satellite-collared cows within the coastal calving ground.

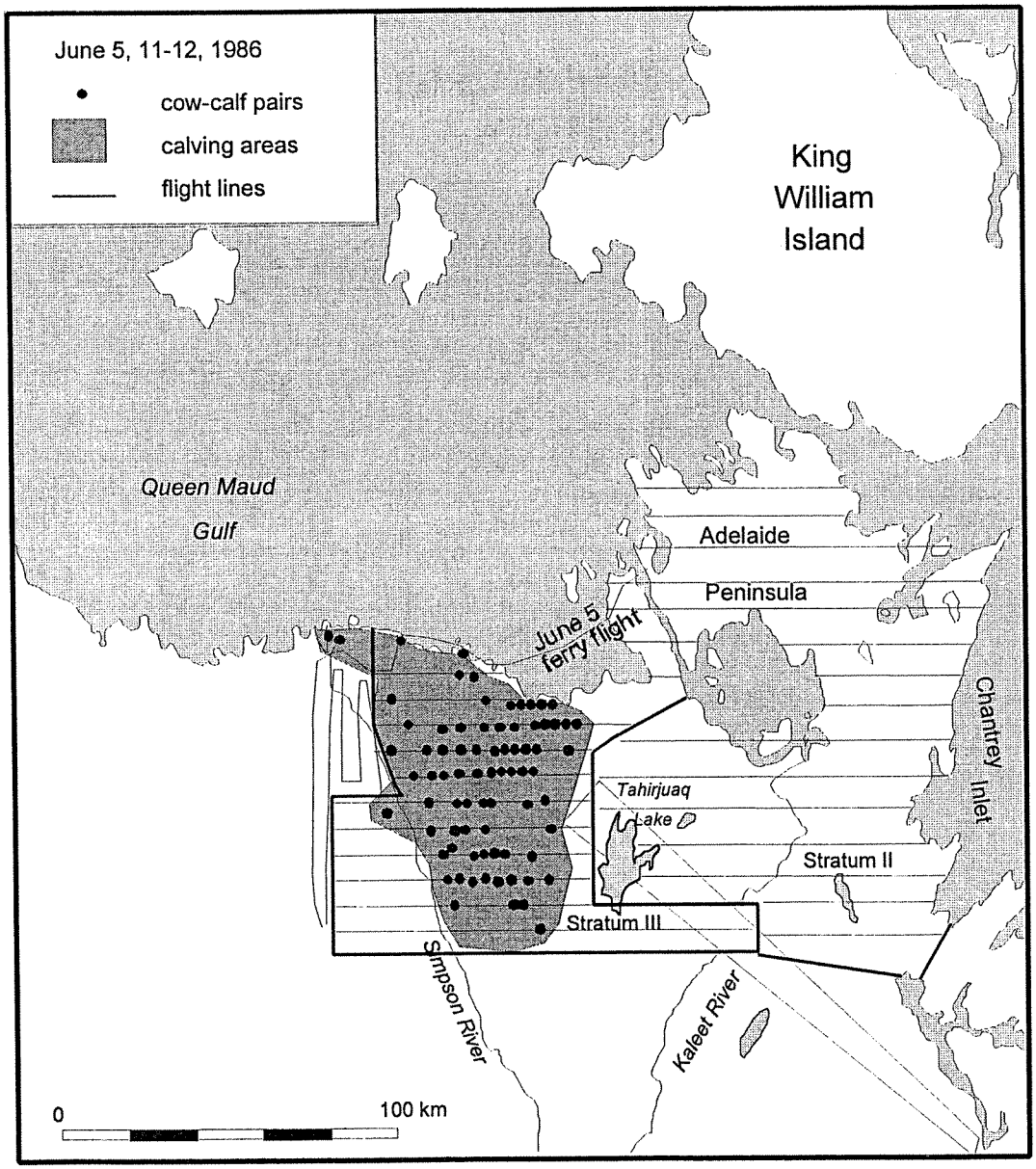

Figure 7. Flightlines and cow-calf observations during an aerial survey of the calving grounds for the Queen Maud gulf herd, June 1986.

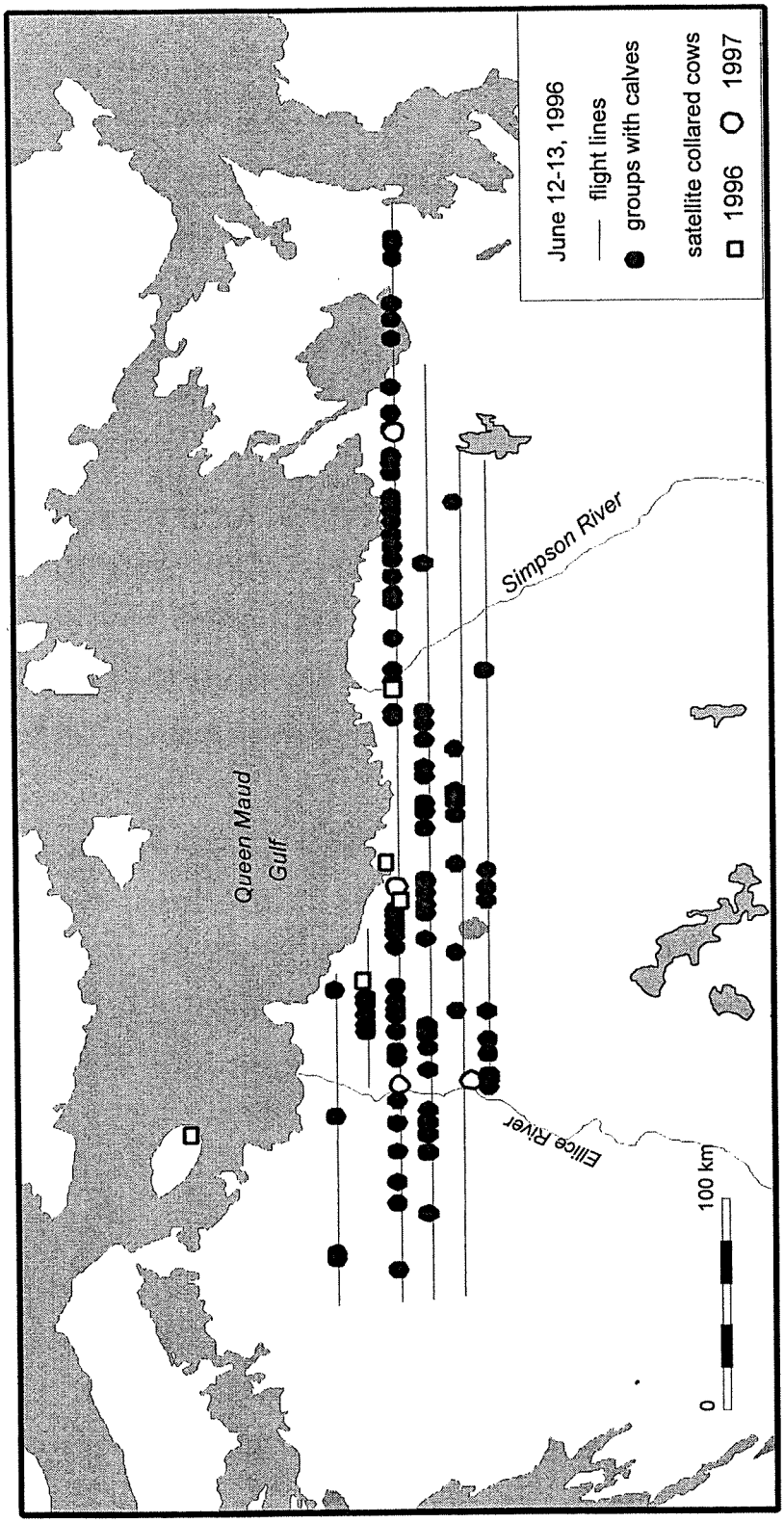

Figure 8. Flightlines and cow-calf observations during an aerial survey of the calving grounds for the Queen Maud Gulf herd, 12-13 June 1996.

DISCUSSION

Our results identify the caribou cows wintering east of Bathurst Inlet as belonging to a previously undescribed herd, although its existence was suspected. We follow convention in applying the name of a landscape feature at the calving grounds to the herd (Thomas 1969). The Queen Maud Gulf parallels the coastal calving grounds and we use that name in this report (Illiulik is the Inuktitut name). Based on the three satellite collars transmitting between 1996 and 1998 and two aerial surveys in 1986 and 1996, the herd calves in and immediately west of the Queen Maud Gulf Migratory Bird Sanctuary (Figure 9), and postcalving and summer distribution is west and southwest of the calving grounds (Figure 6). The winter range is extending further south-east into the Northwest Territories and possibly changing from wintering on the tundra to wintering in the taiga-tundra transition zone (Figure 5). The extrapolated estimates suggest that the herd increased in size between 1986 and 1996, and in 1996 the herd was the fourth largest barren-ground herd in Nunavut/NWT (after the Qamanirjuaq, Beverly and Bathurst herds), as it may have numbered about 200 000 .

Justification for considering caribou in the Queen Maud Gulf area as a separate herd depends first on compiling evidence for the seasonal presence of caribou in the area and then on determining to which herd those caribou belong or do not belong. Evidence for caribou in the area east of Bathurst Inlet and Queen Maud Gulf area comes from historic sources and aerial surveys. The historic information was summarised from local informants and is recorded in the Nunavut Atlas. The central part of the area covered by the map sheet (66N, 1:250 000 scale National Topographic Series) for Ogden Bay, (essentially the Queen Maud Gulf Migratory Bird Sanctuary) may be used by small numbers of caribou for calving. The Atlas also refers to the Ogden Bay map as being year-round range for a resident caribou population of up to 10 000. The northern portion was thought to be used for the summer and southern portion for the winter. MacAlpine Lake was used as a water crossing. Elders from Baker Lake identified the area between Ian Calder Lake and Franklin Lake as a calving area in the past (R. Decker pers. comm. 1986).

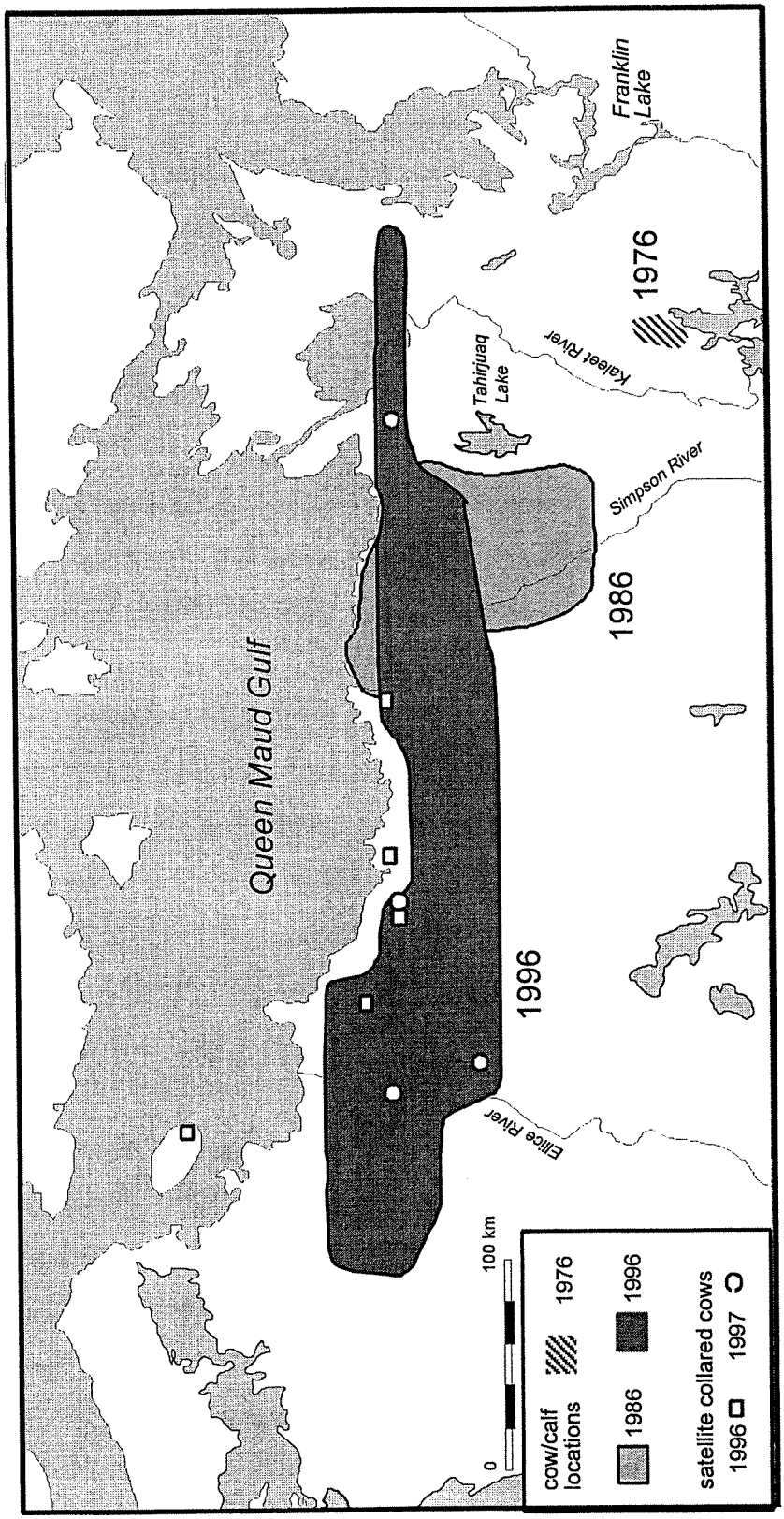

Figure 9. Calving grounds for the Queen Maud Gulf herd 1986-96 based on aerial surveys and satellite-collared cows.

Aerial surveys for caribou from the 1960s to the 1980s concentrated on the Bluenose, Bathurst, Beverly and Qamanirjuaq herds, and the Queen Maud Gulf area was not included. Summer aerial surveys for geese recorded only few caribou (T. W. Barry pers. comm. 1984) although observations of muskoxen were included (summarised in Gunn and Case 1984). R. Decker (pers. comm. 1986) speculated that the Queen Maud Gulf coast was a calving area based on Gavin (1945, in Gunn and Case 1984) and sightings of groups of postcalving caribou in July 1982 and again in July 1983.

Surveys collecting baseline information for the proposed Polar Gas pipeline in the early 1970s covered the pipeline's potential route and covered the area south and east of Adelaide Peninsula. Fischer and Duncan (1976) flew aerial transect surveys from Hayes River to Baker Lake in May 1975, and Fischer *et al.* (1977) also covered the area from 4 to 15 June 1976 and reported a small concentration of cow-calf pairs west of Franklin Lake.

The surveys and information for the 1950s through to the 1970s had suggested that caribou numbers in the Queen Maud Gulf area were low. By the early 1980s, hunters from Gjoa Haven were reporting increasing caribou numbers on Adelaide Peninsula. Heard *et al.*'s (1987) precalving survey in May 1983 revealed large numbers of caribou in the area. Buckland *et al.* (in prep.) also found concentrations of caribou in the Queen Maud Gulf area in May 1995. Those concentrations are close to the areas that we recorded as calving areas in 1986 and 1996, as described in this report.

In April 1986, during snowmachine surveys, we had seen 100s of barren-ground caribou on Kent Peninsula although at that time we considered them to be a tundra-wintering segment of the Bathurst herd (Gunn *et al.* 1997a). By the early 1990s, arctic-island caribou migrating over the sea-ice from Victoria Island were replacing the barren-ground caribou wintering north-east of Bathurst Inlet (Gunn *et al.* 1997a). This was also evident during surveys flown between 1996 and 1998 east of Bathurst Inlet to collect baseline environmental data for the Hope Bay Belt area (Ross 1997, Rescan Environmental Services Ltd 1999). The surveys sampled caribou distribution north east of Bathurst Inlet area using east-west transects 4-km

apart, 30-km long, covering an area from the coast to 70-100 km inland. Most of the caribou seen in November 1996 were barren-ground caribou, but in February 1997 most were arctic-island caribou from Victoria Island. However, the following February (1998), all 188 caribou seen were barren-ground caribou, although arctic-island caribou migrated from Victoria Island into the Hope Bay survey area in December 1998 (Rescan Environmental Services Ltd 1999).

Prior to the 1990s, the Bathurst herd calved east of Bathurst Inlet but surveys revealed a progressive shift to the west (Figure 10). In June 1995, cows and calves were observed during a systematic survey both east and west of Bathurst Inlet; most cows were west of the Inlet and the cows east of the Inlet were mostly moving east (Gunn 1996). Based on 1° longitudinal zones, distribution of cows and calves was continuous on either side of Bathurst Inlet. However, within those longitudinal zones, there was a discontinuity in calving distribution (minimum 40 km) along the east coast of Bathurst Inlet. This was also apparent in June 1996 when we surveyed east and west of Bathurst Inlet (Gunn *et al.* 1997b). We observed cows and calves on both sides of the inlet with a gap along the east coast of Bathurst Inlet. In 1997 and 1998, calving was again recorded on both sides of Bathurst Inlet but the distribution was not mapped extensively enough to determine whether it was continuous (Ross 1997, Rescan Environmental Services Ltd 1999, West Kitikmeot Slave Society Study unpubl. data).

The surveys between 1995 and 1998 suggest that caribou were calving both west and east of Bathurst Inlet and that, at least in 1996, the calving distribution was discontinuous, forming two distinct annual calving grounds. Other evidence for two distinct annual calving grounds is the location of collared cows from the Bathurst herd. All (9-14) satellite-collared Bathurst cows calved west of Bathurst Inlet between 1996 and 1999 (Gunn *et al.* 1997b, unpubl. information) compared to cows collared east of the Inlet, which calved east of the Inlet in 1996 and 1997.

The definition of a caribou herd is conventionally based on the return of pregnant cows to a traditional calving ground. The three collared cows were in the area covered by the calving

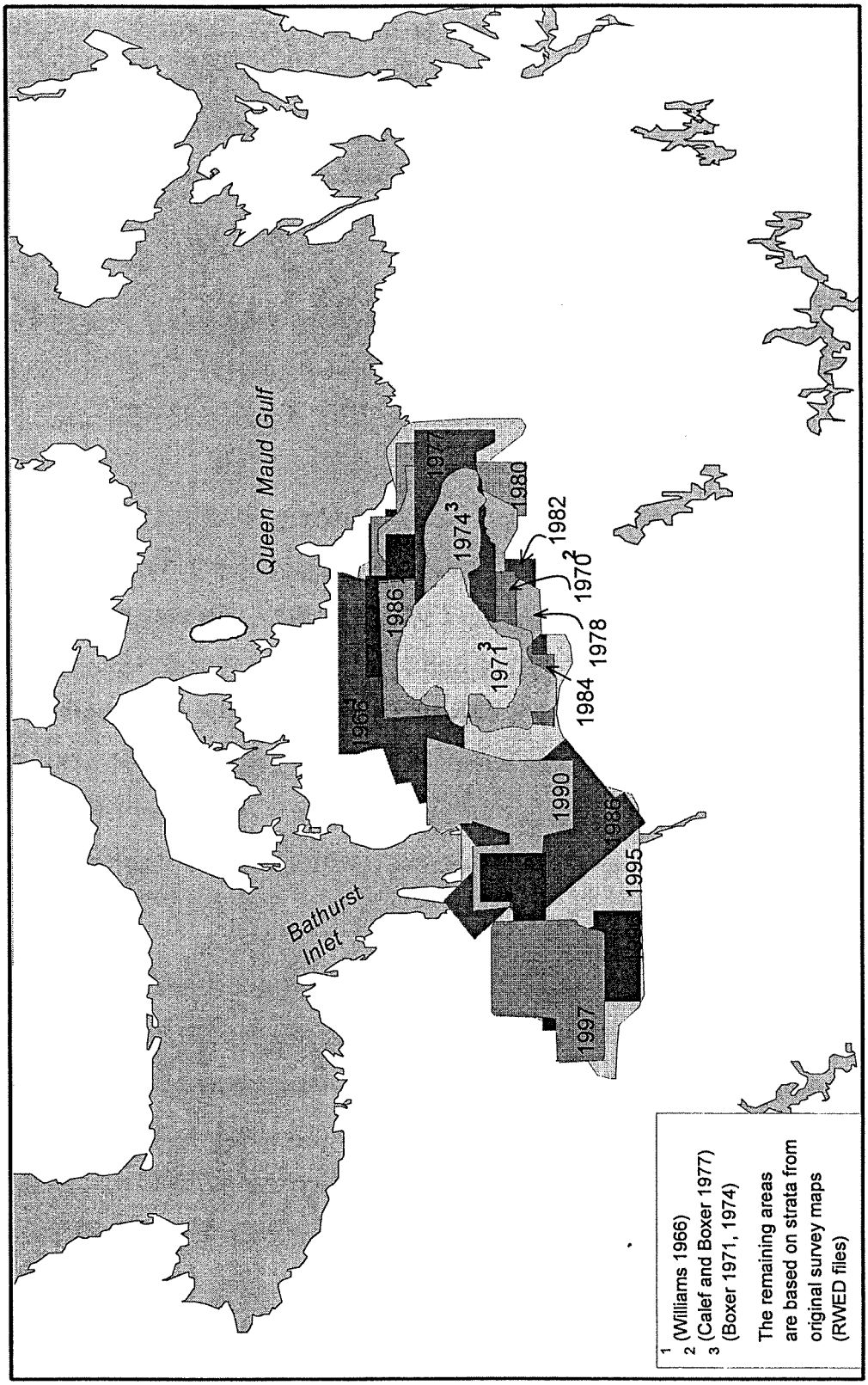

Figure 10. Calving grounds for the Bathurst herd 1966-97, based on aerial surveys and satellite-collared cows (Sutherland and Gunn 1996).

ground aerial survey in June 1996, which overlapped with the 1986 calving ground (Figure 9). The collared cows were assumed to have calved based on their movement patterns but we did not verify calving by visual observations.

The survey information described above and locations of the Bathurst satellite-collared cows suggest that the three cows collared east of the Inlet in April 1996 should not be assigned to the Bathurst herd. This is strengthened by the distribution of collared cows in October (which includes the rut) east of Great Slave Lake in the Thelon Game Sanctuary, which was separate from the distribution of the Bathurst collared cows (Figures 4 and 11), although the Bathurst herd did winter southeast of Great Slave Lake in winter 1997 (Figure 12). We do not have exact information on the timing of the peak and duration of the rut for either the Bathurst herd or the Queen Maud Gulf caribou, but it may differ by a few days since the calf:cow ratios in 1996 suggest that peak calving was later for the Queen Maud Gulf caribou. The distribution of the collared cows makes it a likelihood but not a certainty that distribution during the rut did not overlap since we did not survey to establish the distribution of other caribou.

The Queen Maud Gulf herd's distinction from the Beverly herd is based on geographically separate calving grounds (Figure 13). The Beverly herd's annual calving ground has a rotational shift with a high degree of overlap (Gunn and Sutherland 1997b). The calving grounds mapped between 1957 and 1994 (Figure 14) are south of the Queen Maud Gulf Migratory Bird Sanctuary (Figure 15). Overlap during the rut is unlikely, as the Beverly herd's known rutting areas are along and south of the treeline (Beverly and Qamanirjuaq Caribou Management Board 1999, Gunn 1984). Overlap during the winter is possible but information for the Beverly herd's distribution during the 1990s is mostly lacking.

Our definition of herds based on calving grounds is pragmatic and if those herds are relatively stable populations over time, breeding within the herds should lead to genetic differences between herds. Genetic samples are available from the Bathurst herd (unpubl. data) but not for either the Beverly or Queen Maud Gulf herd. Describing genetic diversity as sampled through nuclear DNA would contribute to understanding distinction between herds, although defined criteria are needed for what constitutes distinctiveness from neighboring populations.

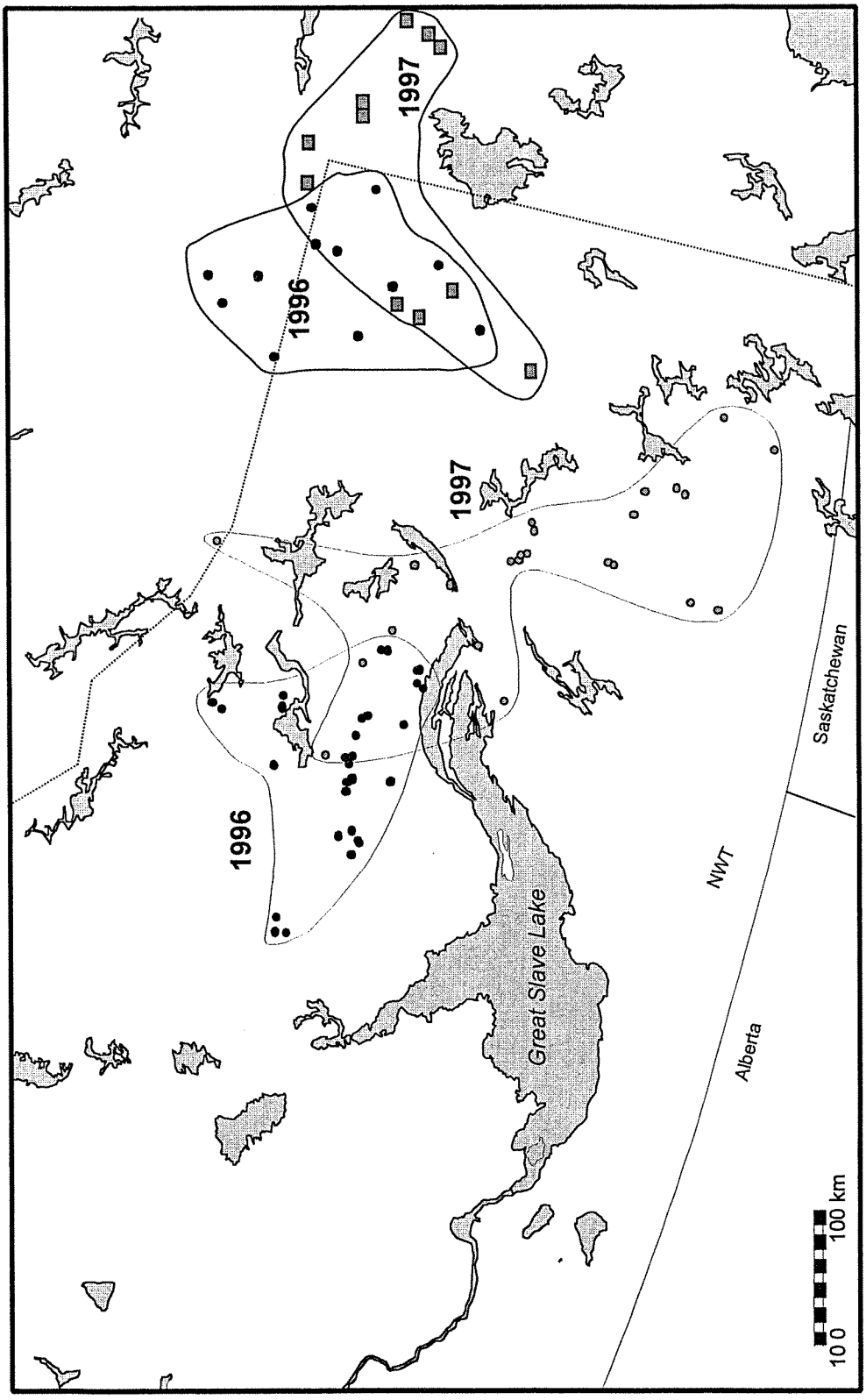

Figure 11. Distribution of satellite-collared cows from the Bathurst and Queen Maud Gulf caribou herds in October 1996 and 1997.

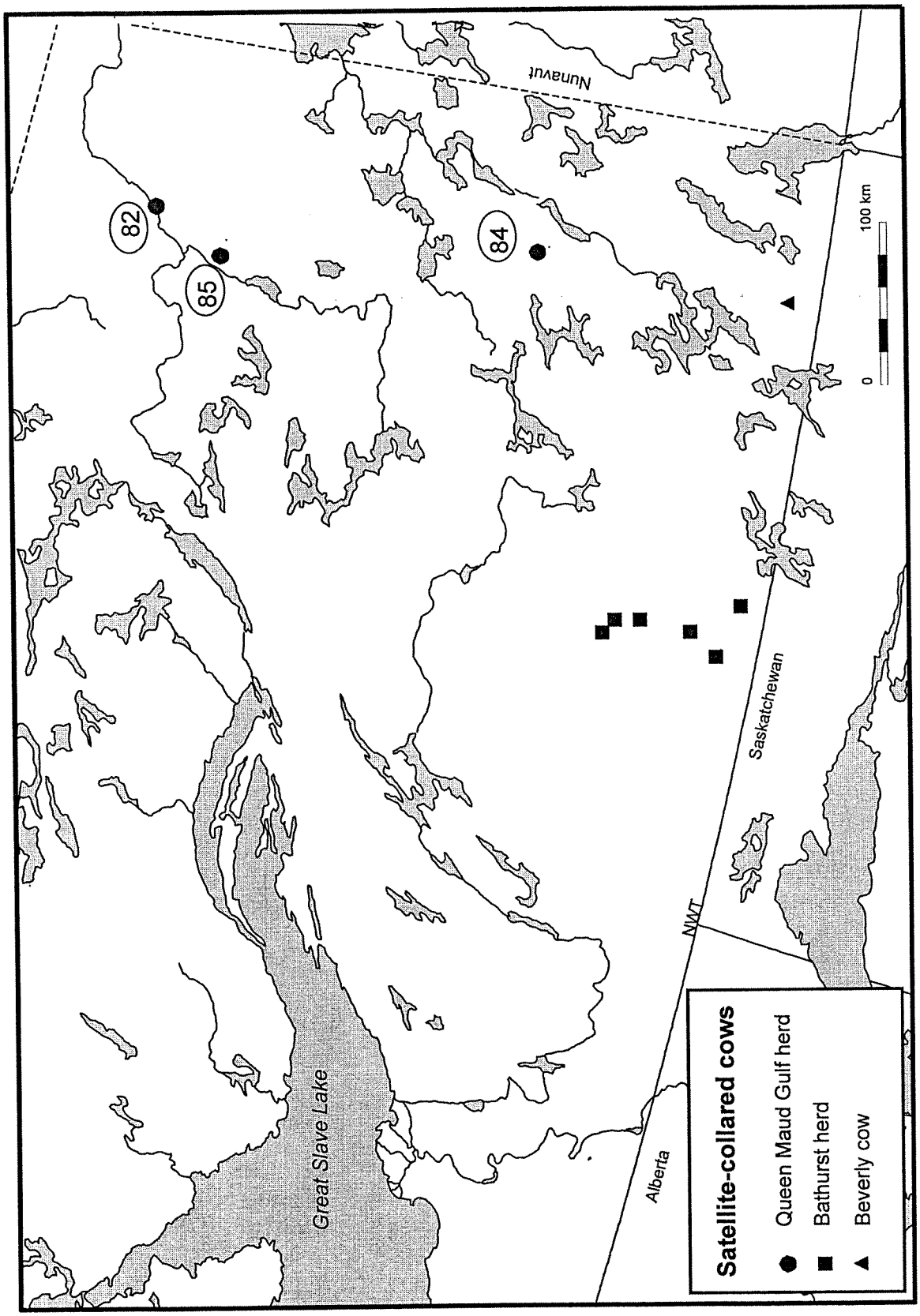

Figure 12. Locations of collared cows from the Bathurst herd, Queen Maud Gulf herd and Beverly herd 8 December 1997.

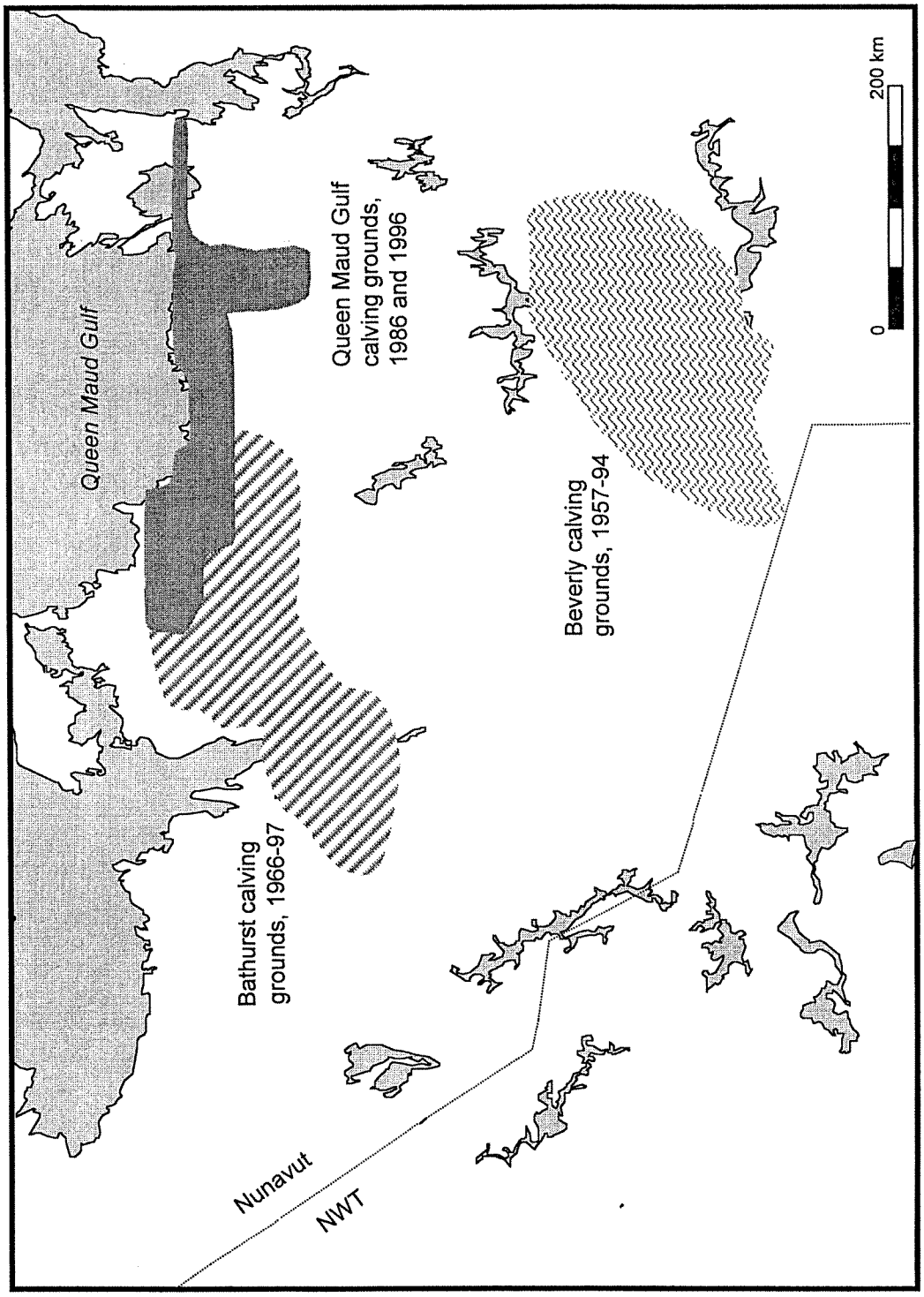

Figure 13. Calving grounds for the Queen Maud Gulf herd (1986-96), the Bathurst herd (1966-97) and Beverly herd (1957-94) based on aerial surveys and satellite-collared cows.

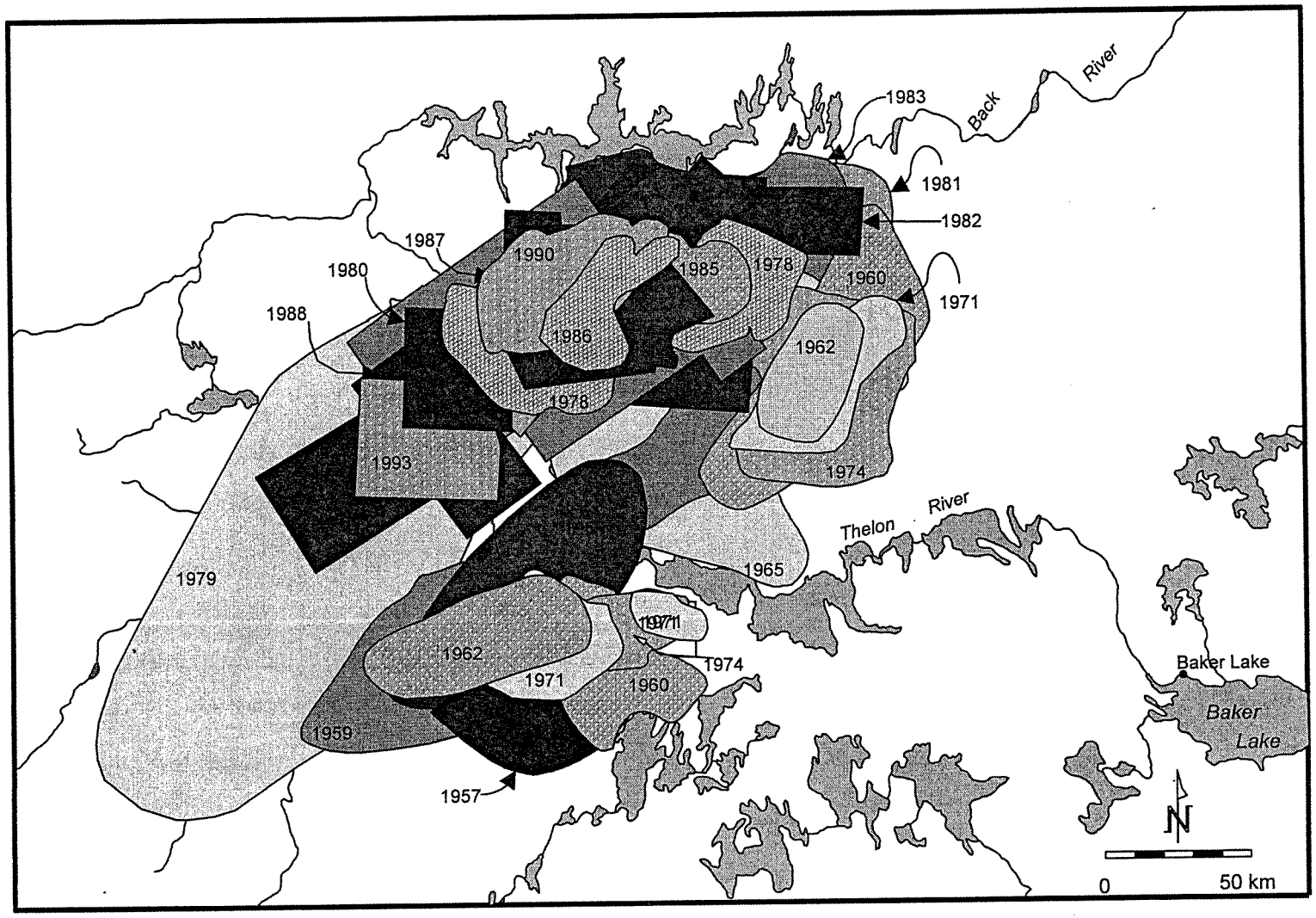

Figure 14. Superimposed annual calving grounds delimited during unsystematic and systematic reconnaissance surveys on the Beverly calving grounds, 1957-1994 (Gunn and Sutherland 1997b).

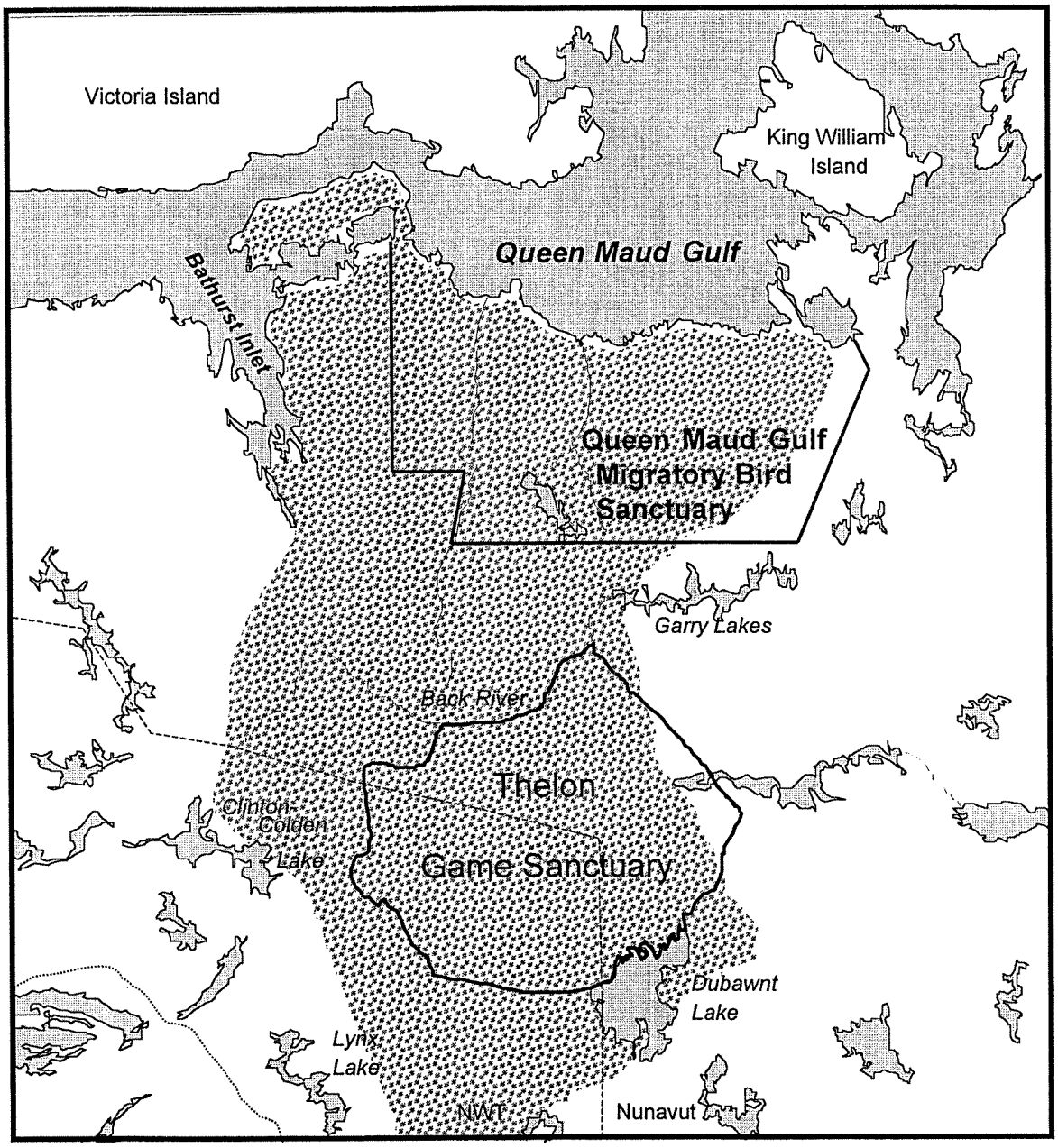

Figure 15. Queen Maud Gulf caribou herd range between 1996 and 1998, the Queen Maud Gulf Migratory Bird Sanctuary and the Thelon Game Sanctuary, Nunavut/NWT.

Abundance in 1986 and 1996

The two surveys in 1986 and 1996 were primarily to describe calving distribution but we have also used them to estimate the numbers of caribou, mostly cows and calves, in the areas. However, to extrapolate those estimates to population estimates is only a rough approximation. We did not undertake composition surveys in 1986 or 1996 to describe the sex and age classification of the caribou to determine the proportion of breeding females, which is required information to extrapolate to herd size (Heard 1985).

If, however, we assume that 64% of the caribou on the calving grounds are breeding females (similar to the Bathurst herd in 1996) then 6800 caribou on the calving grounds in 1986 were breeding females, and based on the observer bias determined from aerial photography, we could double that estimate as an approximation. Following Heard's (1985) method for estimating population size using the proportion of breeding females in the herd and pregnancy rates (based on information averaged from other NWT barren-ground herds), we can extrapolate to a population size of 32 000 caribou. This is within the range of numbers – (33 000 ± 5100 caribou) that Heard *et al.* (1987) estimated in the Queen Maud Gulf area in May 1983. A similar approximation based on the 1996 calving survey suggests that the herd may have numbered 200 000 but the coverage was only 6% and the survey was unstratified. However, the precalving survey in May 1995 estimated 31 556 ± 4879 caribou (Buckland *et al.* In Prep.).

Relationships between the Queen Maud Gulf herd and caribou herds to the east are unknown partly because uncertainty remains about the abundance and distribution of herds in the northeastern mainland. Gunn and Fournier (2000) summarise information on calving distribution for the area that suggests there are several herds but local and historic knowledge has not been compiled. Of particular interest are the caribou using Adelaide Peninsula; use of the area by collared cow #80 in July 1997 suggests that the caribou on the Adelaide Peninsula in summer are from the Queen Maud Gulf herd. Caribou historically summered on Adelaide Peninsula and King William Island (Appendix G).

The caribou share their summer habitat in the wetlands of the Queen Maud Gulf area (54 000 km^2) with many other herbivores. In 1996, there were 4255 ± 680 muskoxen (*Ovibos moschatus*) (J. Nishi unpubl. data.) and over a million geese. Gunn and Sutherland (1997a) described overlap in summer habitat use and diet (*Eriophorum* and other sedges). The collared cows moved extensively east-west in July (Tables 1 and 4) possibly in response to insect harassment. Other summer movements may be north-south, as in 1984 and 1992 when we observed caribou cows wading in shallow coastal waters during warm, calm weather in July (A. Gunn unpubl. information).

The annual range of the Queen Maud Gulf herd between at least 1996-98 overlaps with the Queen Maud Gulf Migratory Bird Sanctuary and the Thelon Game Sanctuary, although it is usually the Beverly herd that is associated with the Thelon Game Sanctuary (Figure 15). The ranges used in 1996-98 overlap with proposed mines (Windy Lake and Boston) on the calving and winter range east of Bathurst Inlet, are adjacent to the proposed George Lake property and are within 50-60 km of the proposed mines at Diavik and Kennedy Lake (Figure 16).

The changes in range use between herds in the central arctic mainland during the 1980s and 1990s include:

1) Dolphin and Union caribou have replaced Queen Maud Gulf caribou on the winter range on Kent Peninsula and northeast Bathurst Inlet.
2) Queen Maud Gulf caribou have replaced Bathurst herd caribou on the eastern traditional calving grounds.

Shifting occupation of winter range as numbers change is typical if not a characteristic of caribou, and those shifts have been recognised for decades (for example, Ferguson and Messier's 1997 compilation of Inuit knowledge). Where enough information is available, the shifting range patterns can be characterised as rotational within a traditional range of either winter (Russell *et al.* 1993) or calving grounds (Sutherland and Gunn 1996, Gunn and Sutherland 1997b). However, given the diversity of ecological conditions across the circumpolar distribution of caribou and reindeer, variations are to be expected.

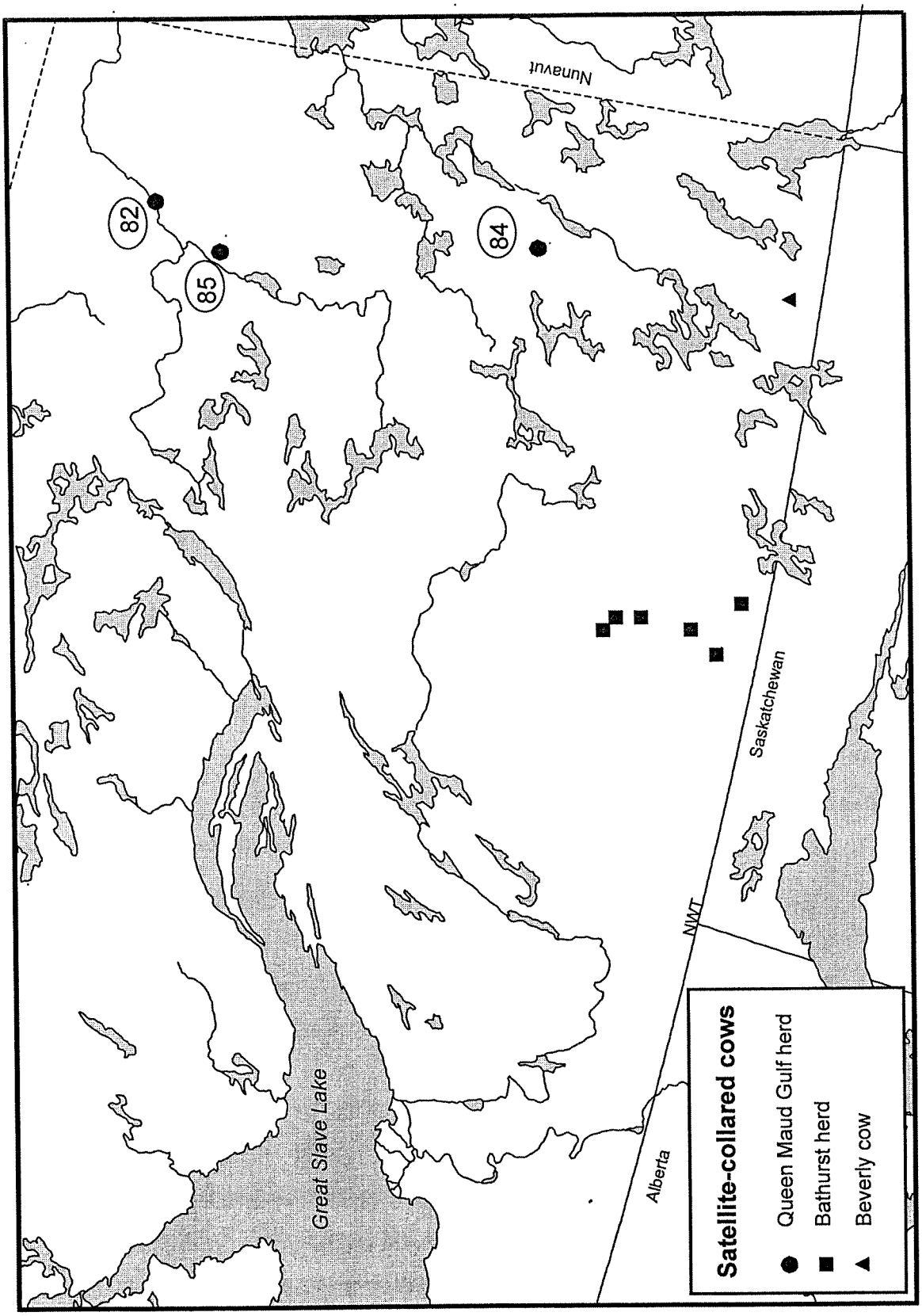

Figure 16. Locations of collared cows from the Bathurst herd, Queen Maud Gulf herd and Beverly herd December 8, 1997.

Describing caribou migratory behaviour and range use has lagged behind understanding of mechanisms for range use by other large gregarious herbivores such as geese, wildebeest (*Connochaetes taurinus*) and African buffalo (*Syncerus caffer*) (references in Drent and Van der Wal 1999). Those herbivores return to forage at patches at intervals from days to months depending on the weather (for example rainfall), how faecal return of nutrients affect plant growth and the presence of other herbivores. Timing of plant response to faecal fertilisation depends on the rate that soil organisms mineralise the faecal nitrogen and, for perennial grasses, the extent that they draw on stored nutrients for regrowth after being grazed (Jefferies 1999).

The frequency or even existence of 'rotational passage grazing' (McNaughton and Banyikwa 1995) has not been applied to caribou through studies of diet, range use or plant community responses. Jefferies *et al.* (1992) suggested that migratory caribou were not closely coupled to their forage since faecal deposition and the plants are not spatially coupled. However, the relationship may be occurring over a longer time scale and may be complicated by differences between how shrubs and lichens respond compared to perennial grasses – most of the work on herbivores and regrazing cycles have focused on grass-eating herbivores. The only published example of a possible regrazing cycle in caribou or reindeer is from Greenland (Thing and Clausen 1980). The regrazing caused *Poa pratensis* 'lawns', but for the calving wild reindeer those lawns increased the risk of bacterial disease. This raises the question of a trade-off between disease and parasite risk versus nutritional gain from new plant growth – faecal deposition supplies both the nutrients for plant growth and the risk of exposure to disease and parasites through faecal-based infection (van der Wal *et al.* In Press).

The likelihood that cyclic grazing (regrazing promoted by faecal fertilisation) applies to caribou and reindeer may depend on the importance of perennial grasses in the diet. A high proportion of perennial grasses available and in the diet would likely promote cyclic grazing and a greater frequency of return grazing bouts. This could explain both the fidelity to postcalving ranges for at least the Bluenose herds (J. Nagy unpubl. data) and the Bathurst

herd (unpubl. data) and also differences in fidelity to annual calving grounds. The Porcupine herd has greater overlap in annual calving grounds and a greater use of perennial grasses than does, for example, the Bathurst herd (Russell *et al.* 1993, Sutherland and Gunn 1996, Griffith *et al.* In Press).

Explanations for range shifts are likely more complex than a simple response to forage and may reflect the caribou's condition (state of forage earlier in the previous season) as much as the conditions (including predation) on the range presently occupied. For example, caribou in good condition may be more likely to move to further ranges and this might be consistent with Fleischman's (1990) suggestion "..it [range use] is inherent behaviour which costs little, results in benefits of several kinds and is elicited by social rather than environmental stimuli...". However, hypotheses such as cyclic grazing (McNaughton's grazing optimisation) can be tested and will contribute to predicting migratory behaviour and at least some range shifts.

Shifts in range size were the basis for the studies described in this report. The Queen Maud Gulf caribou herd has increased in size between at least 1986 and 1996, although uncertainty will remain about its exact size until an appropriately designed survey is undertaken to estimate herd size. The satellite collars, admittedly a small sample size, and historical observations suggest that the herd has increased its annual range since at least 1986. The satellite telemetry indicates that the caribou cows wintering east of Bathurst Inlet were part of the Queen Maud Gulf herd and Cambridge Bay's commercial quotas for the Bathurst herd could be applied to the Queen Maud Gulf herd.

We were only able to collar cows on the northwest distribution of the late winter range occupation in 1996. We suggest a better understanding of the entire annual range of the Queen Maud Gulf herd would be accomplished if more collars (ie. 10) are distributed more evenly across the winter distribution. In hindsight, more representative sampling across the entire winter distribution (as far east as the Ellice River and MacAlpine Lake) would improve this study and be more accurate at the larger spatial scale of the annual range of Queen Maud Gulf caribou.

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PERSONAL COMMUNICATIONS

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APPENDIX A. Caribou observations and transect areas for June 1986 and 1996 aerial survey, Queen Maud Gulf area, Nunavut/NWT.

Transect 1986 Date	Area km^2	On-transect Caribou	Calves
1 June 6	57.6	0	0
2	57.6	0	0
3	134.4	0	0
4	166.4	0	0
5	224.0	6	0
6	160.0	0	0
7	217.6	0	0
8	57.6	27	0
9	19.2	0	0
10	76.8	0	0
11 June 8	89.6	0	0
12	89.6	0	0
13	198.4	20	0
14	172.8	17	0
15	204.8	21	0
16	185.6	14	2
17	172.8	36	13
18	115.2	2	0
Totals	2400	143	15
33 June 11	128	67	13
34	102	177	114
35	147	144	116
36	141	780	754
37	128	129	92
38	134	202	159
39	160	89	85
46 June 12	166	357	313
47	141	444	427
48	147	346	314
49	160	19	15
50	256	17	3
51	83	39	31
52	83	45	39
Totals	1976	2855	2475

APPENDIX A (cont).

Transect 1996	Transect length (km)	Transect area (km^2)	On-transect Caribou	Calves
1	77.0	61.6	136	9
2	not flown			
3	77.5	62.0	198	8
4	78.0	62.4	154	15
5	78.3	62.6	41	0
6	52.5	42.0	27	1
7	74.0	59.2	127	55
8	113.0	90.4	871	123
9	113.0	90.4	498	100
10	114.0	91.2	387	18
11	115.0	92.0	316	17
12	148.0	118.4	717	164
13	148.0	118.4	536	60
14	149.0	119.2	329	2
15	128.0	102.4	116	1
Total	1542.6	1234.0	4453	573

APPENDIX B. Location accuracy associated with quality index codes for satellite transmitted locations.

quality index	location accuracy
3	<150 m
2	150-300 m
1	350-1000 m
0	>1000 m
A	3 hits received
B	2 hits received

Cow #80	quality index					
	A	B	0	1	2	3
Jan						
Feb						
Mar						
Apr				1		
May			2	1	2	
Jun	3		2	2	2	1
Jul		1	2	2		
Aug					1	1
Sep		1				
Oct						
Nov						
Dec						
total freq.	3	2	6	6	5	2

APPENDIX B (cont).

Cow #82	quality index					
	A	B	0	1	2	3
Jan	3	1	2	2		
Feb	2	2	1	3		
Mar	1		1	3		1
Apr	2		4	14		
May	2		5	8	3	
Jun	5	2	9	2	1	1
Jul	3		7	3		
Aug	4	2	6	5	1	
Sep	2		4	7	1	1
Oct	1		1	4	1	
Nov	2	1	1	1		
Dec	2		1	1	1	
total freq.	29	7	42	53	8	3

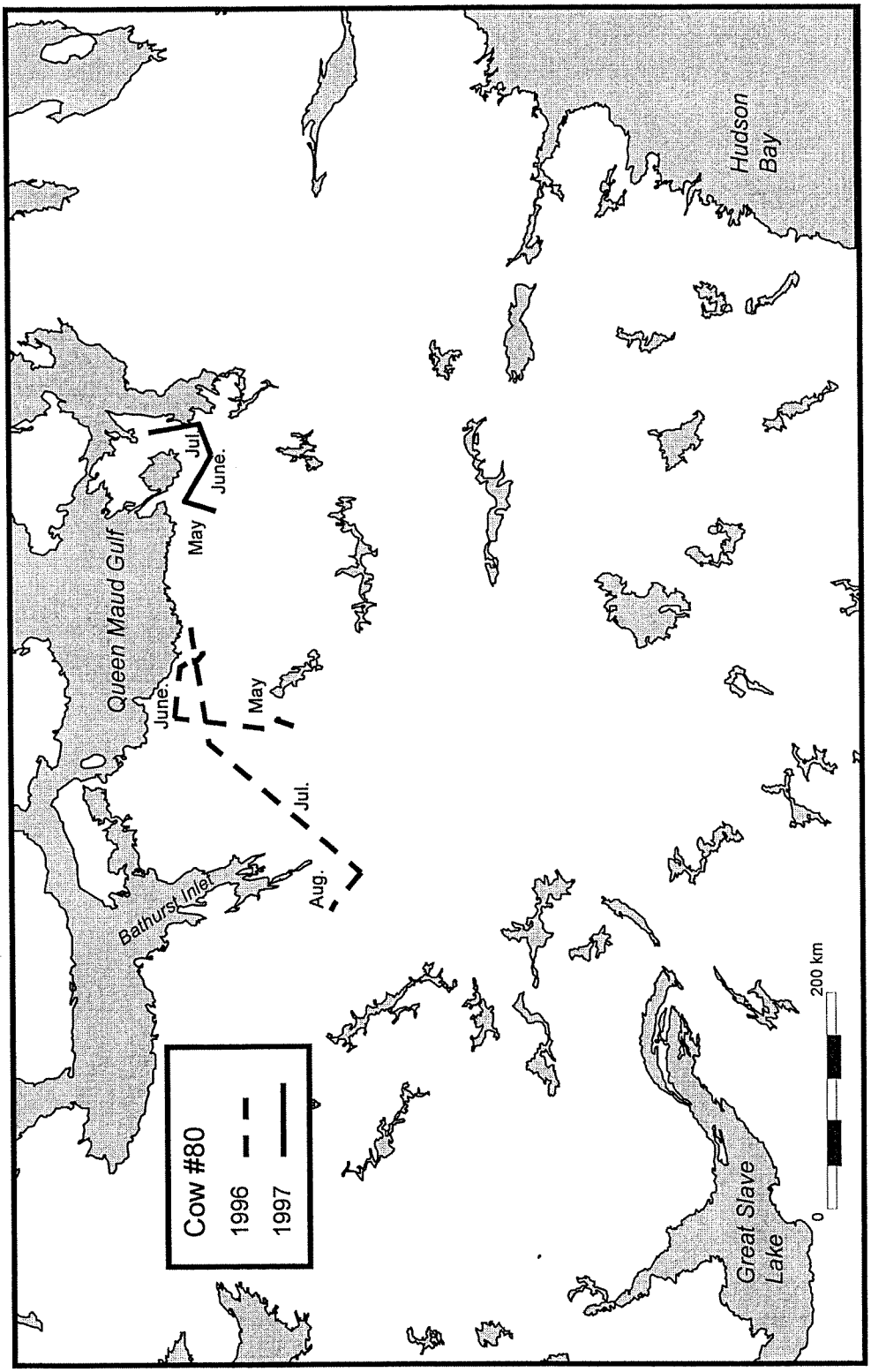
Cow #83	quality index					
	A	B	0	1	2	3
Jan		1	1	3	1	1
Feb	1		3	1	2	
Mar	2		2	3	1	
Apr	3	2	1	3		
May	3	1	3	8	1	
Jun	1	3	5	4	1	
Jul	2	2	1	2		
Aug	1		2	2		
Sep	2		1			1
Oct						
Nov	1	1	1		1	1
Dec	1		1		2	
total freq.	17	10	21	26	9	3

APPENDIX B (cont).

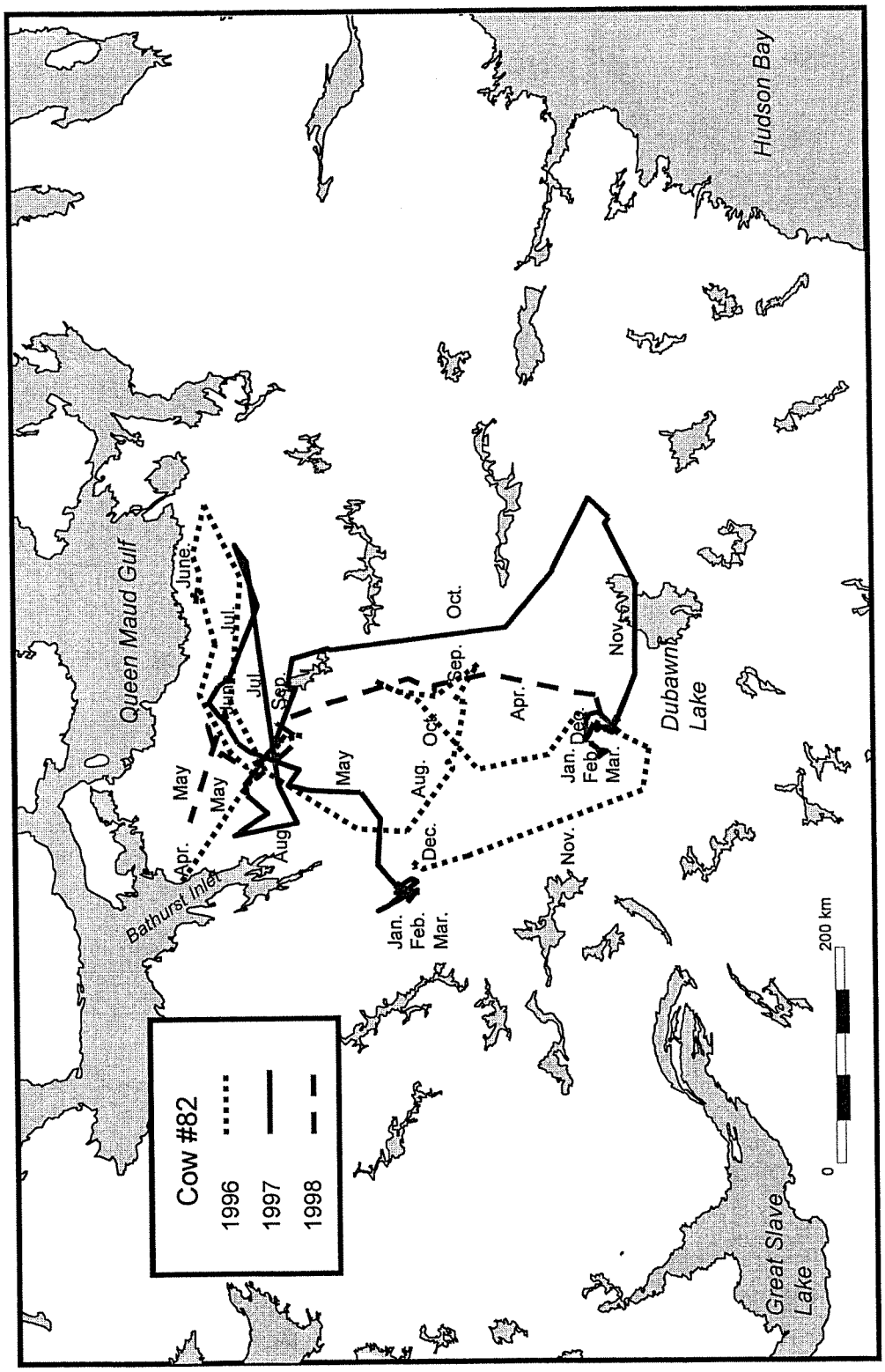
Cow #84	quality index					
	A	B	0	1	2	3
Jan			1	4	2	
Feb			3	2		
Mar	1			3	1	1
Apr			1	4	3	
May	1		1	9	2	1
Jun	1		2	5	2	2
Jul	2		2	5	3	
Aug	5		3	1	2	
Sep			2	3	5	2
Oct	1			3	2	
Nov				3	2	1
Dec				4	1	1
total freq.	11		15	46	25	8

Cow #85	quality index					
	A	B	0	1	2	3
Jan	1		1	3	2	
Feb			3	1	1	
Mar		1		5		
Apr				5	1	2
May	1			7	4	2
Jun	1		1	2	5	3
Jul				5	3	4
Aug	1			7	4	
Sep	1		1	6	2	1
Oct				1	3	1
Nov				2	4	
Dec				2	2	2
total freq.	5	1	6	46	31	15

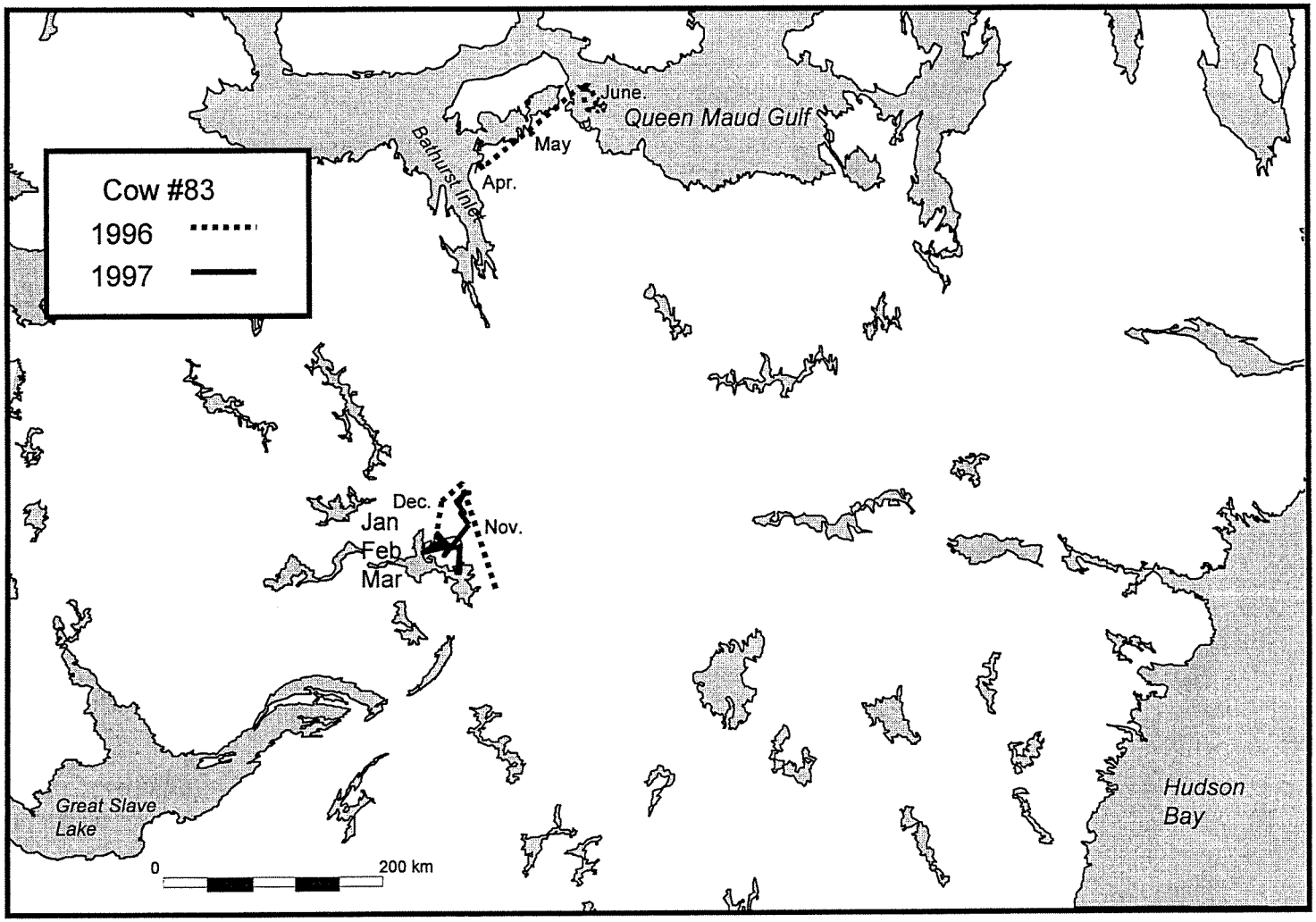
Appendix C. Maps of seasonal movements for individual collared caribou cows between 1996 and 1998, Queen Maud Gulf area, Nunavut/NWT.



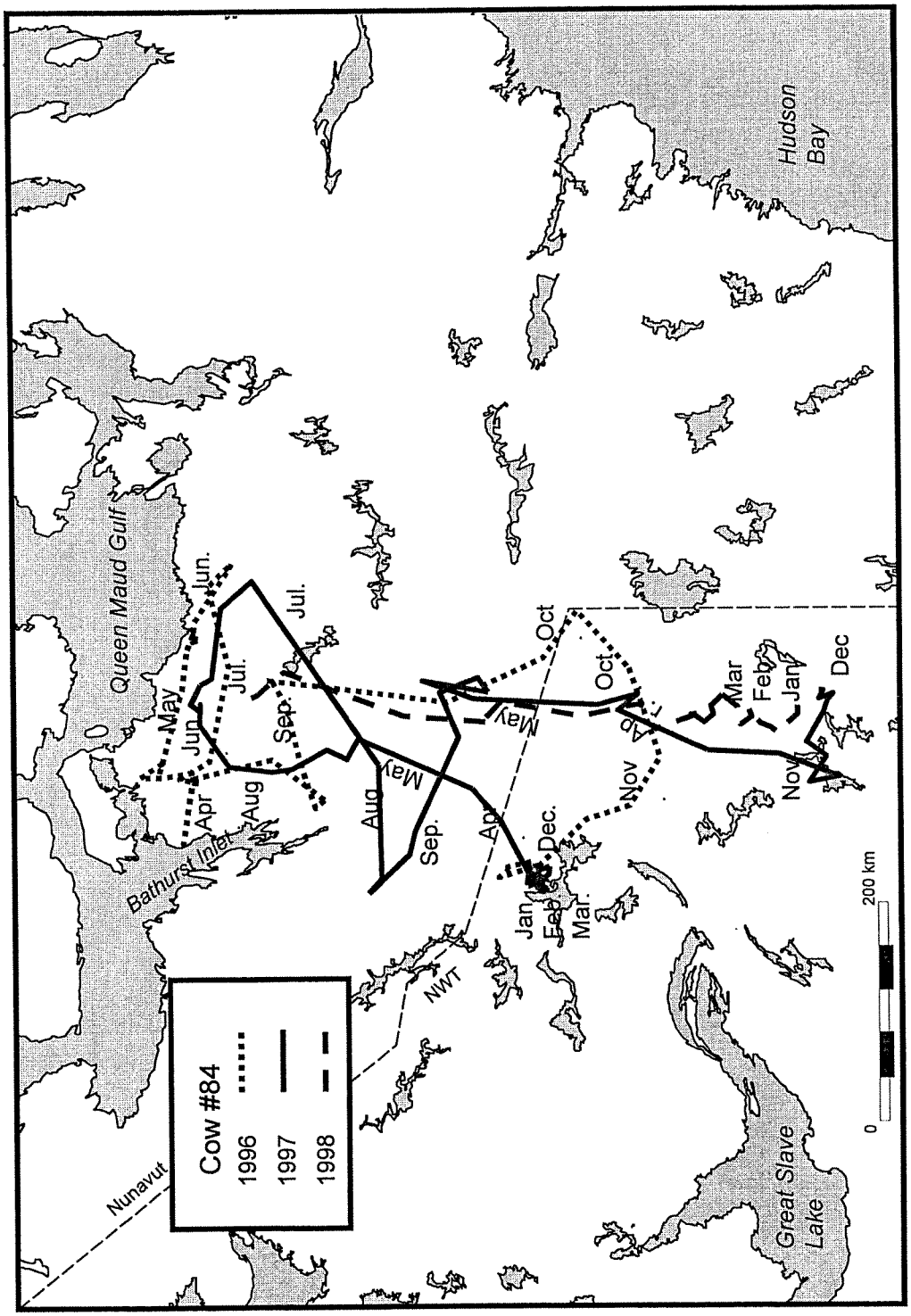
Appendix C. (cont'd.) Seasonal movements of cow #82.



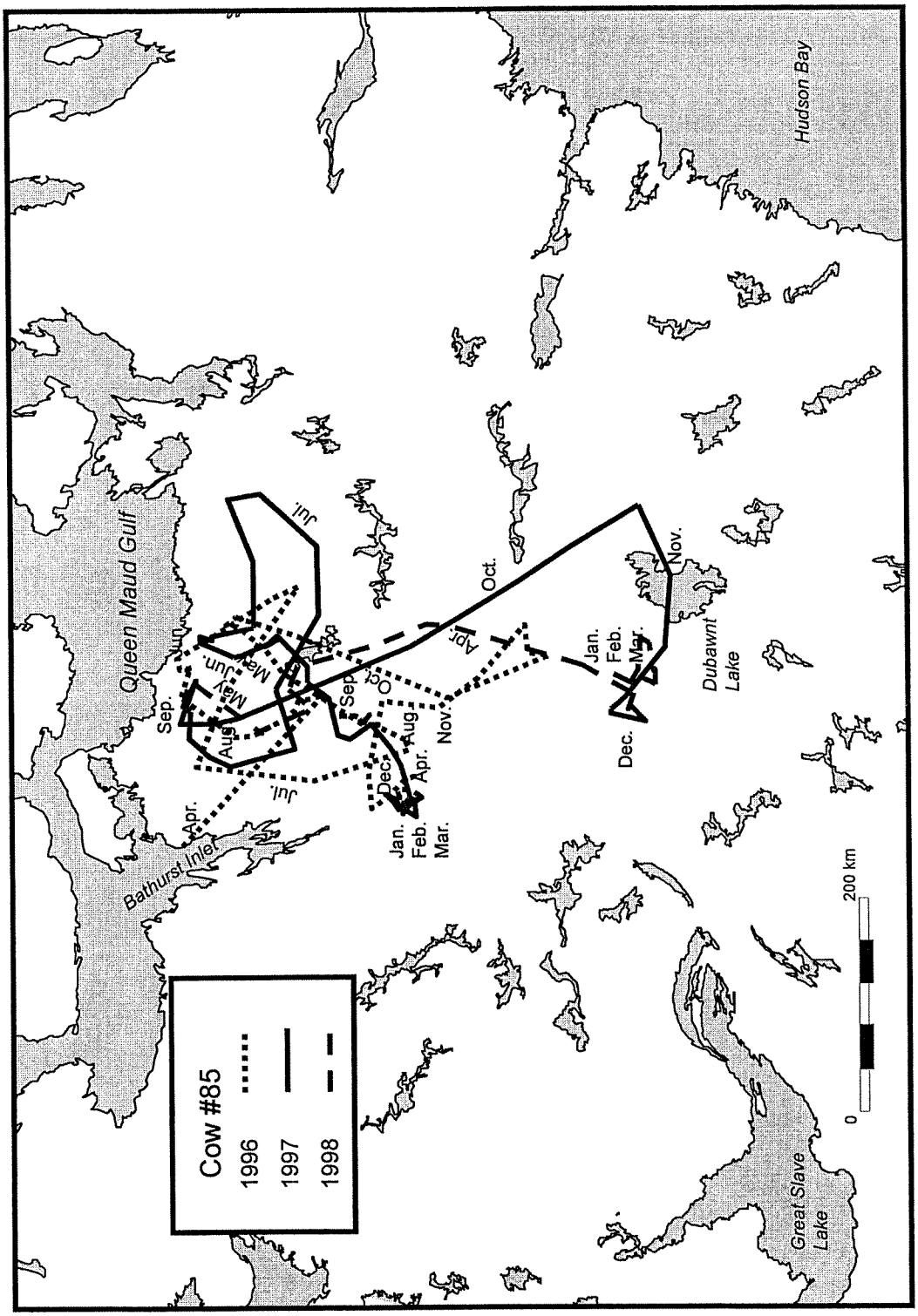
Appendix C. (cont'd.) Seasonal movements of cow #83.



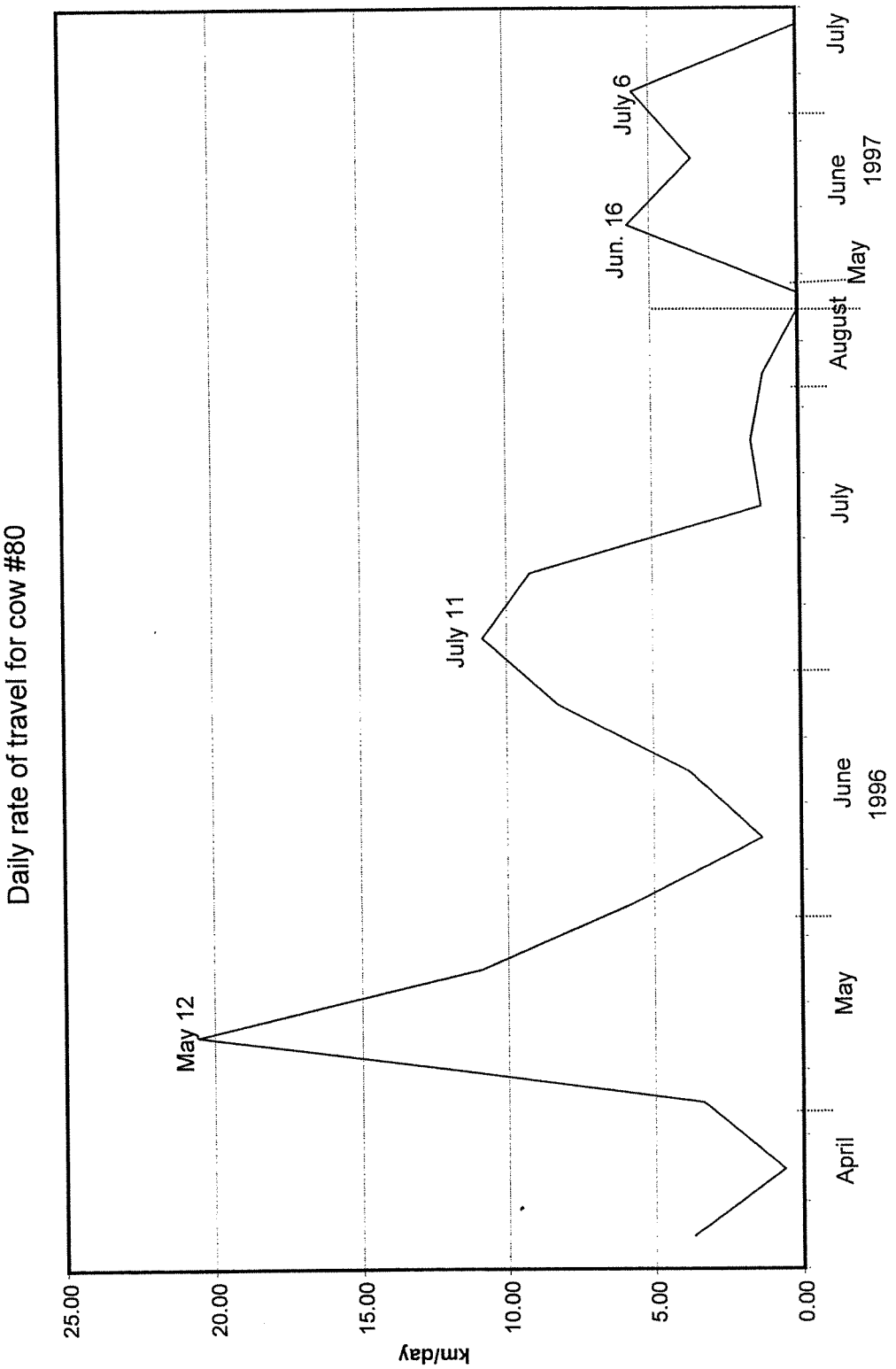
Appendix C. (cont'd.) Seasonal movements of cow #84.



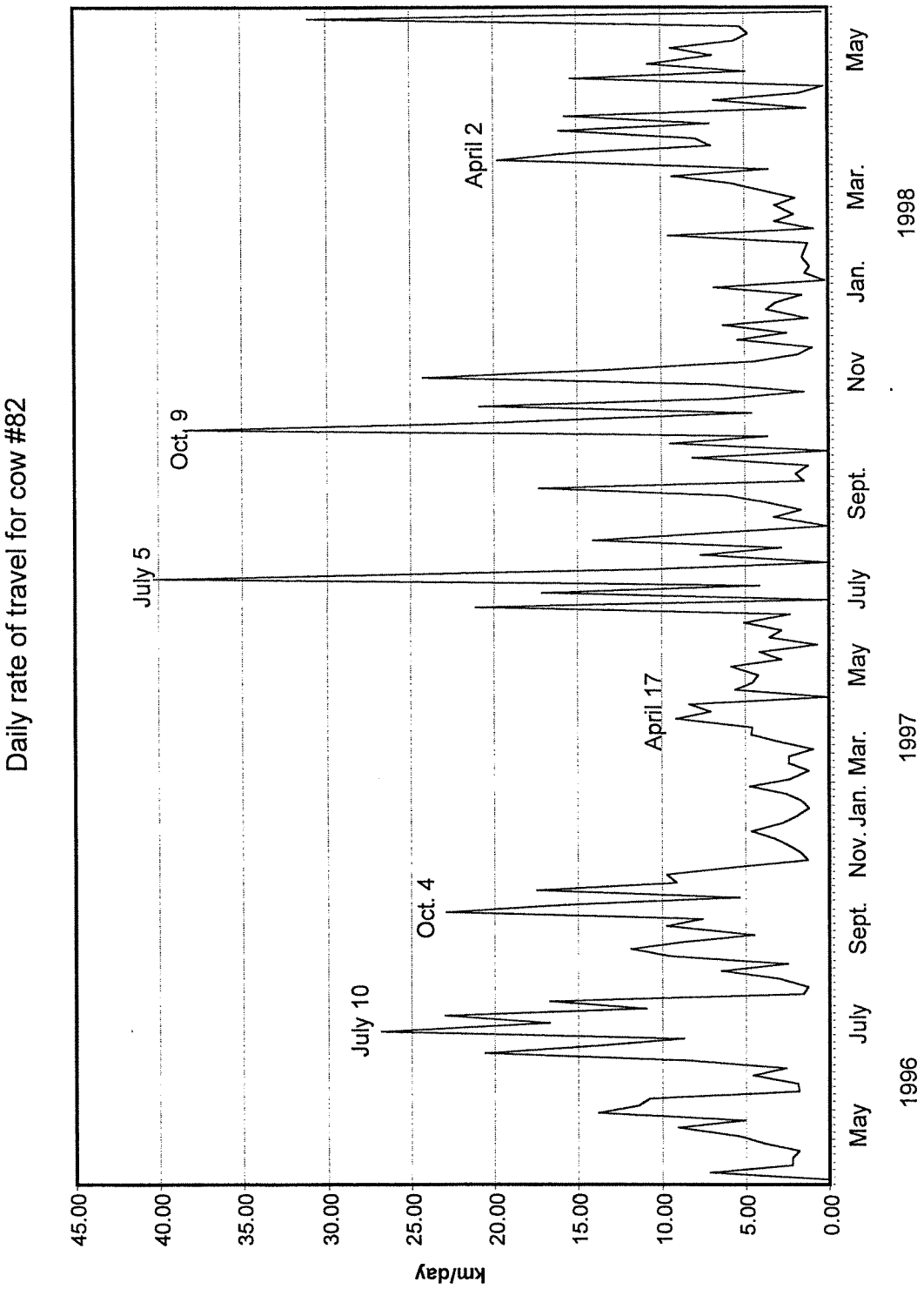
Appendix C. (cont'd.) Seasonal movements of cow #85.



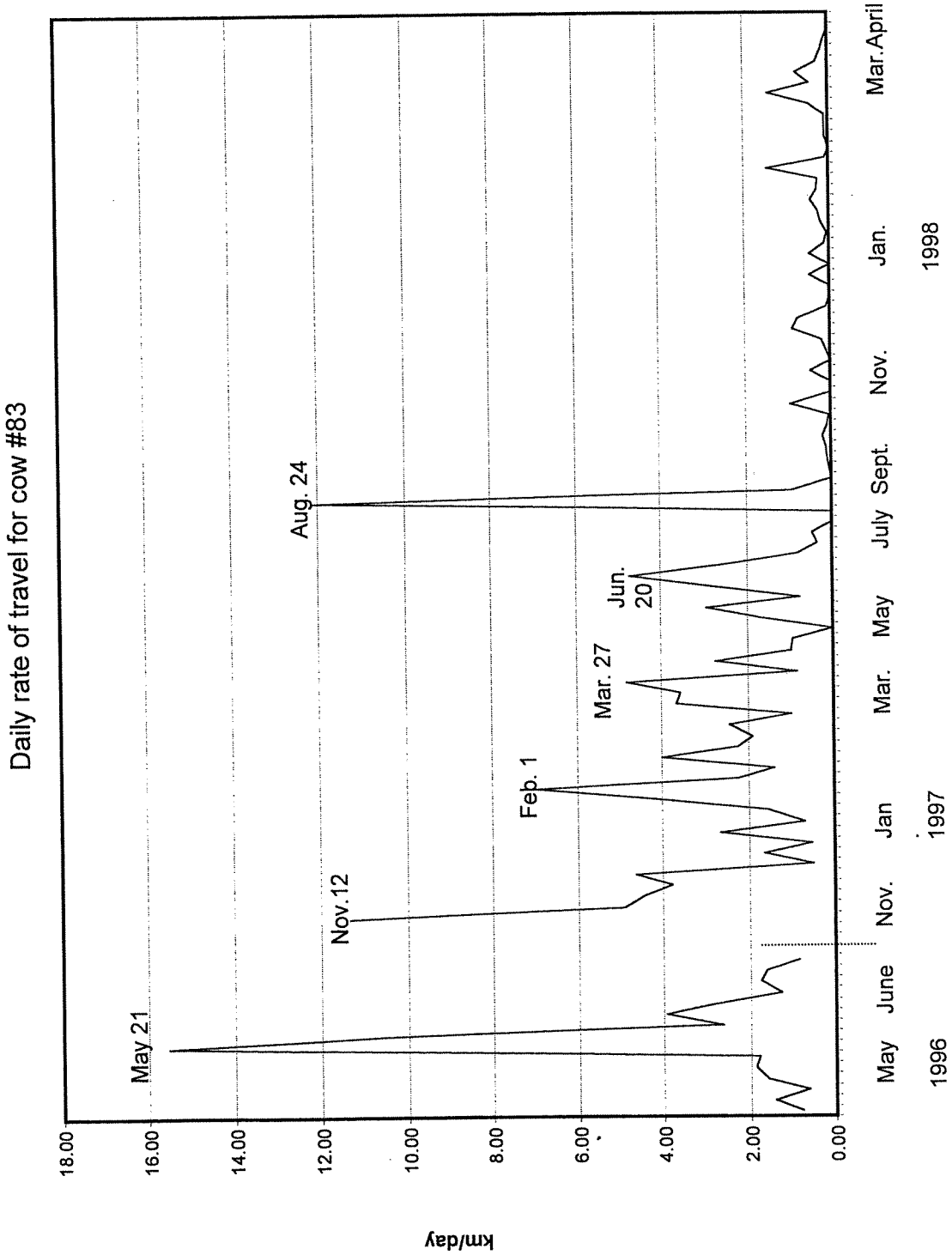
APPENDIX D. Daily rate of travel for individual satellite collared caribou cows in the Queen Maud Gulf area, 1996-98



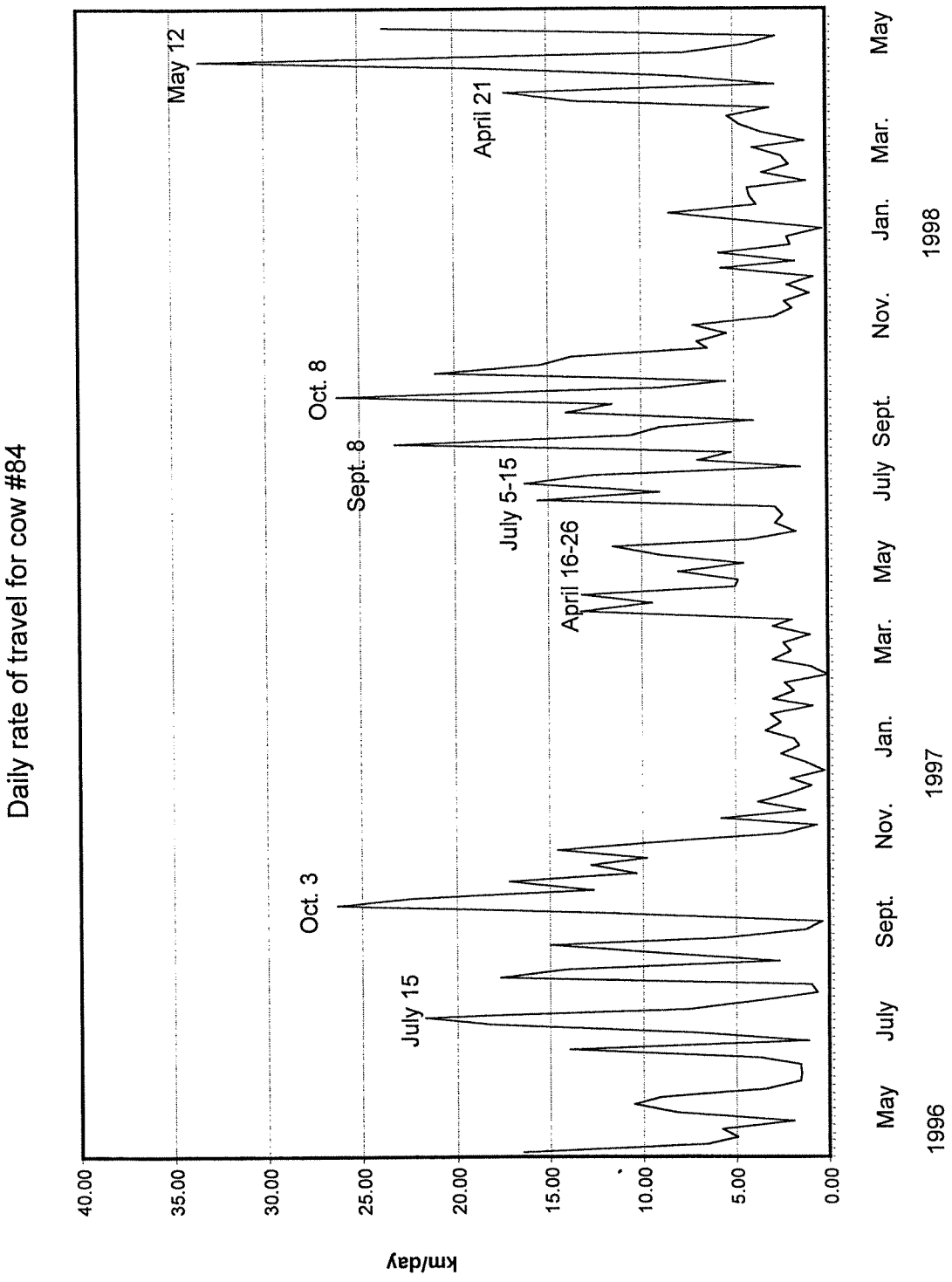
Appendix D. (cont'd)



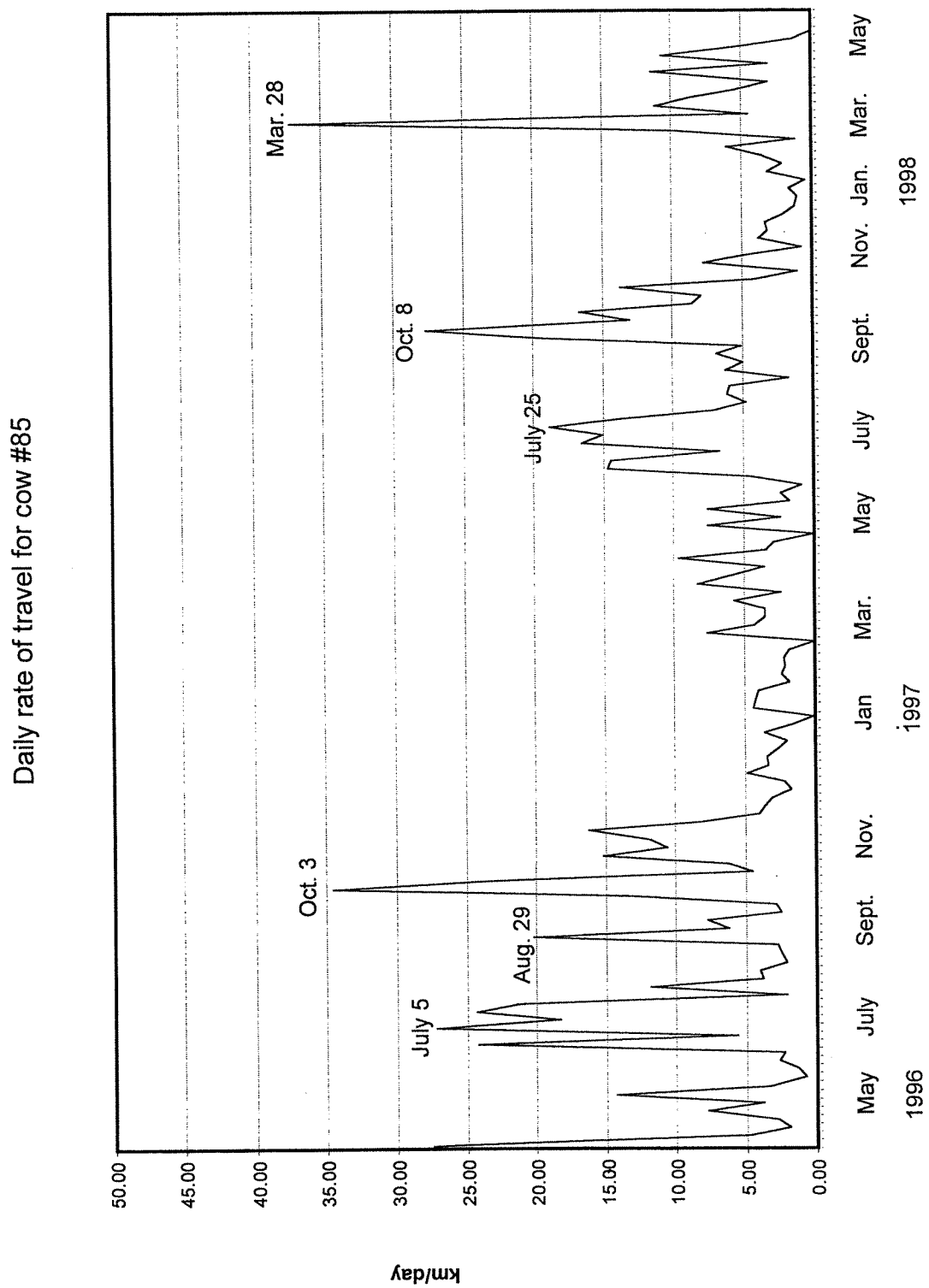
Appendix D. (cont'd)



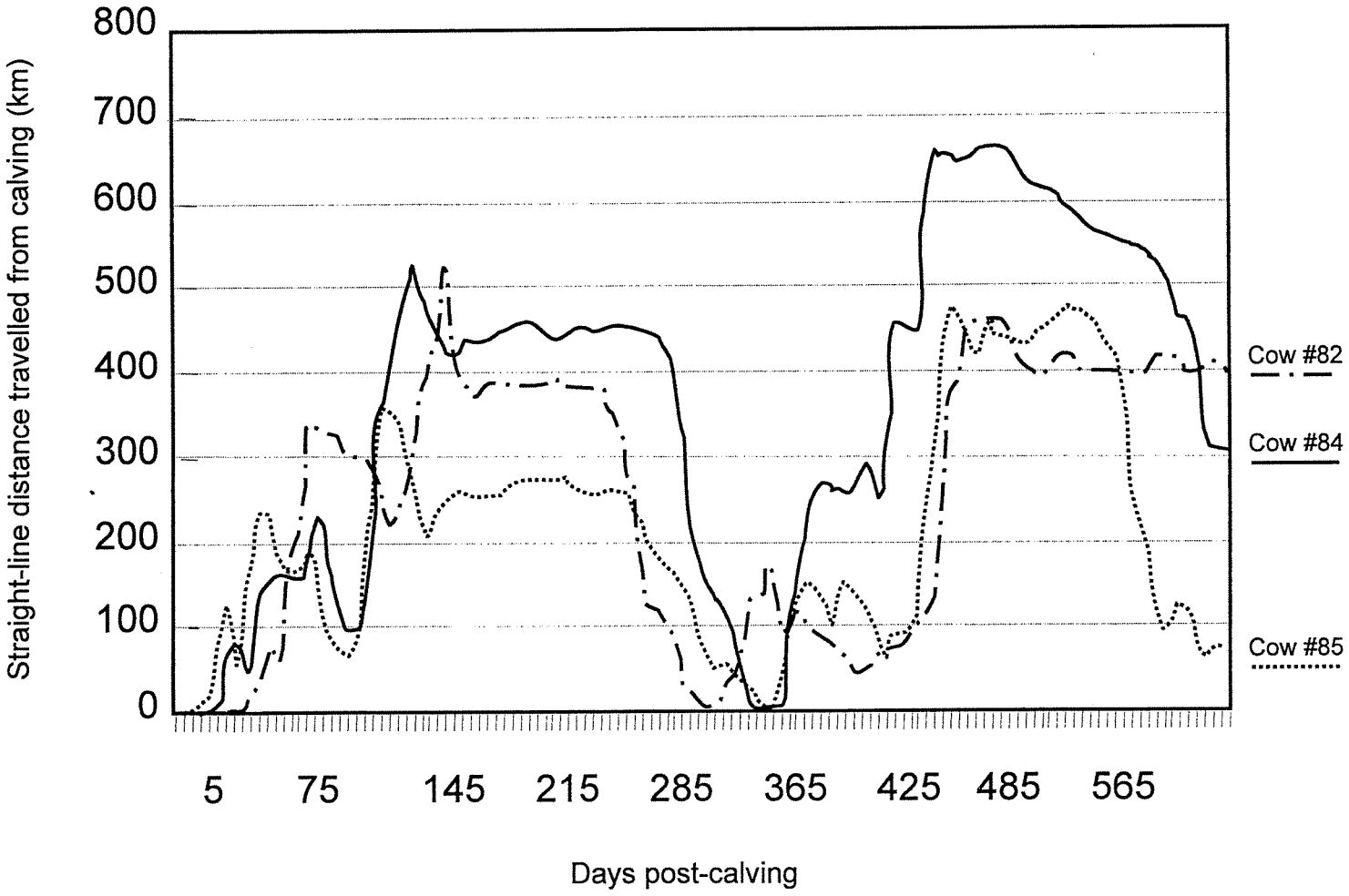
Appendix D. (cont'd)



Appendix D. (cont'd)



Appendix E. Straight-line distances travelled from calving for cows #82, #84, #85.



APPENDIX F. Satellite location data for the Queen Maud Gulf caribou.

PTT	CLASS	MONTH	YEAR	DAY	LAT	LONG	DISTANCE
80	1	4	1996	27	66.58	104.00	-
80	2	5	1996	2	66.74	103.87	18.69
80	1	5	1996	7	66.72	103.82	3.12
80	0	5	1996	12	66.83	104.09	17.02
80	2	5	1996	27	67.75	103.87	102.71
80	0	6	1996	1	67.70	102.58	54.64
80	2	6	1996	6	67.48	102.22	28.83
80	2	6	1996	16	67.55	102.48	13.52
80	1	6	1996	26	67.59	101.59	38.01
80	1	7	1996	11	67.41	104.47	124.13
80	1	7	1996	31	65.85	107.41	216.47
80	3	8	1996	5	66.10	108.22	46.00
80	2	8	1996	10	66.13	108.34	6.35
80	0	5	1997	12	67.30	98.70	442.62
80	0	6	1997	11	67.60	98.40	35.72
80	1	6	1997	16	67.60	98.40	0.00
80	3	6	1997	26	67.30	97.30	57.54
80	0	7	1997	6	67.40	96.50	36.01
80	0	7	1997	16	67.90	96.60	55.74

PTT	CLASS	MONTH	YEAR	DAY	LAT	LONG	DISTANCE
82	1	4	1996	21	67.69	107.92	-
82	0	4	1996	22	66.83	104.33	181.45
82	1	4	1996	26	66.58	104.19	28.46
82	1	5	1996	1	66.68	104.16	11.20
82	0	5	1996	2	66.68	104.21	2.20
82	2	5	1996	6	66.74	104.14	7.35
82	1	5	1996	11	66.84	104.50	19.30
82	0	5	1996	12	66.82	104.61	5.30
82	2	5	1996	16	67.11	104.98	36.03
82	1	5	1996	21	67.29	104.62	25.32
82	2	5	1996	26	67.59	103.20	69.13
82	1	5	1996	31	67.43	101.92	57.26
82	2	6	1996	5	67.56	100.71	53.47
82	0	6	1996	10	67.64	100.68	8.98
82	0	6	1996	15	67.56	100.60	9.52
82	0	6	1996	16	67.60	100.62	4.53
82	0	6	1996	21	67.62	100.92	12.90
82	1	6	1996	25	67.56	100.15	33.31
82	0	6	1996	26	67.63	99.70	20.59
82	1	6	1996	30	67.48	98.44	56.02

PTT	CLASS	MONTH	YEAR	DAY	LAT	LONG	DISTANCE
82	0	7	1996	10	67.16	100.29	86.91
82	1	7	1996	15	67.28	103.39	134.08
82	1	7	1996	20	66.92	105.09	83.72
82	0	7	1996	25	66.02	106.37	115.05
82	0	7	1996	30	65.53	106.35	54.48
82	1	8	1996	4	65.11	104.85	83.83
82	0	8	1996	9	65.16	104.73	7.90
82	0	8	1996	14	65.11	104.67	6.23
82	0	8	1996	24	65.04	104.03	30.98
82	1	8	1996	29	64.99	103.35	32.41
82	0	9	1996	3	65.10	103.32	12.31
82	0	9	1996	8	64.86	102.49	47.27
82	1	9	1996	18	65.29	103.23	59.05
82	1	9	1996	23	65.68	103.10	43.77
82	2	9	1996	28	65.86	102.89	22.19
82	1	10	1996	3	65.46	103.32	48.64
82	0	10	1996	4	65.41	103.43	7.53
82	1	10	1996	8	64.86	104.89	91.62
82	1	10	1996	13	64.17	104.49	79.05
82	2	10	1996	23	63.89	103.60	53.35
82	1	10	1996	28	63.17	104.32	87.63
82	1	11	1996	2	63.23	105.22	45.60
82	0	11	1996	23	64.92	106.86	204.06
82	2	12	1996	2	65.36	107.23	51.88
82	0	12	1996	12	65.46	107.08	13.10
82	1	12	1996	17	65.43	107.25	8.53
82	1	1	1997	1	65.48	108.03	36.45
82	1	1	1997	6	65.40	107.73	16.47
82	0	1	1997	16	65.75	108.29	46.65
82	0	1	1997	21	65.65	108.12	13.57
82	1	2	1997	10	65.41	107.53	38.08
82	1	2	1997	15	65.46	107.48	6.02
82	1	2	1997	20	65.52	107.58	8.11
82	0	2	1997	25	65.61	107.75	12.70
82	3	3	1997	2	65.40	107.80	23.46
82	1	3	1997	7	65.50	107.70	12.04
82	1	3	1997	17	65.60	107.80	12.03
82	1	3	1997	22	65.50	107.70	12.03
82	0	3	1997	27	65.60	107.60	12.03
82	1	4	1997	1	65.60	107.70	4.59
82	1	4	1997	6	65.50	107.90	14.43
82	1	4	1997	16	65.80	107.20	46.28
82	0	4	1997	17	65.80	107.10	4.56
82	0	4	1997	22	65.80	106.10	45.57
82	0	4	1997	27	66.00	105.50	35.16
82	1	5	1997	1	66.30	105.50	33.35

PTT	CLASS	MONTH	YEAR	DAY	LAT	LONG	DISTANCE
82	0	5	1997	2	66.30	105.50	0.00
82	1	5	1997	6	66.50	105.50	22.23
82	0	5	1997	11	66.70	105.40	22.67
82	0	5	1997	16	66.60	105.00	20.84
82	1	5	1997	26	67.10	104.60	58.27
82	1	5	1997	31	67.20	104.40	14.08
82	0	6	1997	5	67.30	104.00	20.48
82	0	6	1997	11	67.30	103.90	4.29
82	0	6	1997	15	67.40	103.70	14.03
82	0	6	1997	21	67.50	103.40	16.95
82	3	6	1997	25	67.40	103.00	20.36
82	0	7	1997	1	67.30	102.80	14.03
82	2	7	1997	5	67.00	101.00	84.55
82	0	7	1997	6	67.00	101.00	0.00
82	0	7	1997	10	67.20	99.50	68.59
82	1	7	1997	15	67.10	99.90	20.54
82	0	7	1997	31	66.80	105.40	241.62
82	1	8	1997	4	66.60	106.30	45.39
82	0	8	1997	5	66.60	106.30	0.00
82	1	8	1997	14	67.20	106.70	68.94
82	2	8	1997	24	67.00	106.30	28.17
82	0	8	1997	25	66.90	106.10	14.12
82	1	8	1997	29	67.10	105.70	28.22
82	0	8	1997	30	67.10	105.70	0.00
82	1	9	1997	3	67.13	105.41	12.97
82	0	9	1997	8	67.08	105.27	8.22
82	1	9	1997	18	66.91	104.57	35.80
82	1	9	1997	19	66.86	104.52	5.97
82	1	9	1997	23	66.64	103.04	69.40
82	1	9	1997	24	66.65	103.02	1.42
82	0	9	1997	28	66.72	103.01	7.79
82	3	9	1997	29	66.73	103.02	1.20
82	2	10	1997	3	66.67	102.30	32.35
82	1	10	1997	4	66.67	102.30	0.00
82	1	10	1997	8	66.34	102.10	37.74
82	1	10	1997	9	66.31	102.13	3.59
82	0	10	1997	14	64.59	101.68	192.33
82	1	10	1997	18	64.12	100.48	77.86
82	0	10	1997	19	64.11	100.39	4.51
82	0	10	1997	23	63.73	98.92	83.34
82	0	10	1997	28	63.53	99.37	31.43
82	0	11	1997	2	63.58	99.47	7.44
82	0	11	1997	13	63.30	100.81	73.52
82	1	11	1997	17	63.32	102.75	96.89
82	2	11	1997	22	63.54	103.99	66.33
82	1	11	1997	27	63.72	103.81	21.89
82	0	12	1997	3	63.76	104.01	10.80
82	1	12	1997	12	63.80	104.16	8.61
82	1	12	1997	17	63.80	103.61	26.99

PTT	CLASS	MONTH	YEAR	DAY	LAT	LONG	DISTANCE
82	0	12	1997	22	63.69	103.56	12.47
82	1	12	1997	27	63.48	103.98	31.25
82	1	12	1997	28	63.47	103.99	1.22
82	0	1	1998	7	63.69	104.54	36.58
82	2	1	1998	11	63.60	104.39	12.45
82	1	1	1998	16	63.67	104.39	7.78
82	0	1	1998	17	63.69	104.26	6.78
82	0	1	1998	27	63.68	104.28	1.49
82	0	1	1998	31	63.68	104.39	5.42
82	1	2	1998	5	63.66	104.49	5.41
82	1	2	1998	10	63.69	104.35	7.67
82	0	2	1998	16	63.75	104.25	8.29
82	2	2	1998	21	63.75	104.13	5.90
82	1	2	1998	25	63.47	103.69	37.97
82	3	3	1998	2	63.51	103.68	4.47
82	3	3	1998	7	63.57	103.97	15.84
82	0	3	1998	12	63.58	103.76	10.45
82	1	3	1998	17	63.70	103.93	15.76
82	0	3	1998	18	63.70	103.89	1.97
82	2	3	1998	22	63.56	103.87	15.59
82	0	3	1998	23	63.61	103.90	5.75
82	0	3	1998	27	63.71	103.18	37.21
82	0	4	1998	2	63.90	103.12	21.33
82	1	4	1998	7	64.77	102.70	98.81
82	1	4	1998	11	65.30	102.97	60.26
82	1	4	1998	12	65.30	103.12	6.97
82	0	4	1998	16	65.55	102.80	31.48
82	1	4	1998	21	66.24	103.31	80.12
82	0	4	1998	22	66.30	103.36	7.04
82	1	4	1998	26	66.83	103.85	62.77
82	2	4	1998	27	66.83	103.88	1.31
82	1	5	1998	1	66.63	104.23	27.03
82	1	5	1998	2	66.63	104.27	1.76
82	0	5	1998	7	66.62	104.28	1.20
82	0	5	1998	11	67.02	105.25	61.47
82	0	5	1998	12	67.03	105.14	4.90
82	1	5	1998	16	67.37	104.66	43.08
82	0	5	1998	17	67.40	104.80	6.85
82	1	5	1998	21	67.51	103.97	37.43
82	1	5	1998	22	67.46	103.99	5.62
82	0	5	1998	26	67.32	103.74	18.88
82	0	5	1998	27	67.33	103.62	5.26
82	3	5	1998	31	67.65	106.41	123.94
82	3	6	1998	1	67.66	106.38	1.69

PTT	CLASS	MONTH	YEAR	DAY	LAT	LONG	DISTANCE
83	1	4	1996	16	67.78	107.83	-
83	1	4	1996	26	67.85	107.81	7.83
83	1	5	1996	1	67.87	107.65	7.06
83	A	5	1996	2	67.76	108.15	24.29
83	1	5	1996	6	67.86	107.72	21.20
83	0	5	1996	11	67.80	107.62	7.88
83	1	5	1996	16	67.87	107.74	9.27
83	1	5	1996	21	67.87	107.53	8.79
83	1	5	1996	26	68.33	106.12	77.67
83	2	5	1996	31	68.63	105.13	52.36
83	1	6	1996	5	68.58	104.84	13.01
83	1	6	1996	10	68.47	104.46	19.72
83	0	6	1996	15	68.44	104.79	13.88
83	2	6	1996	20	68.41	104.66	6.27
83	B	6	1996	21	68.53	103.52	48.38
83	1	6	1996	25	68.48	104.57	43.13
83	0	6	1996	30	68.41	104.52	8.05
83	0	7	1996	10	68.48	104.43	8.61
83	A	7	1996	15	68.48	104.39	1.63
83	B	7	1996	20	68.42	104.39	6.67
83	3	11	1996	12	63.93	106.69	509.62
83	A	11	1996	17	64.36	107.70	68.43
83	2	11	1996	22	64.87	107.61	56.86
83	B	11	1996	27	64.94	106.50	52.91
83	0	11	1996	28	64.69	108.07	79.30
83	A	12	1996	2	64.38	107.88	35.64
83	2	12	1996	7	64.29	108.14	16.03
83	0	12	1996	12	64.27	107.75	18.95
83	2	12	1996	17	64.31	108.22	23.10
83	1	1	1997	1	64.26	108.12	7.36
83	3	1	1997	6	64.32	108.02	8.23
83	2	1	1997	11	64.34	107.99	2.65
83	1	1	1997	16	64.38	107.73	13.27
83	1	1	1997	26	64.37	107.59	6.82
83	B	1	1997	27	64.02	109.12	83.64
83	0	1	1997	31	64.31	107.51	84.39
83	0	2	1997	1	64.29	107.58	4.04
83	0	2	1997	5	64.04	107.53	27.90
83	1	2	1997	6	64.05	107.57	2.24
83	2	2	1997	10	64.10	107.56	5.58
83	0	2	1997	15	64.28	107.57	20.02
83	2	2	1997	20	64.29	107.80	11.15
83	A	2	1997	25	64.41	107.75	13.56
83	1	3	1997	2	64.40	108.10	16.85
83	2	3	1997	7	64.30	108.00	12.11
83	1	3	1997	12	64.30	108.10	4.82

PTT	CLASS	MONTH	YEAR	DAY	LAT	LONG	DISTANCE
83	0	3	1997	17	64.20	108.40	18.26
83	A	3	1997	22	64.30	107.70	35.59
83	A	3	1997	23	64.30	107.40	14.46
83	0	3	1997	27	64.30	107.70	14.46
83	1	3	1997	28	64.30	107.80	4.82
83	A	4	1997	1	64.30	107.80	0.00
83	A	4	1997	6	64.30	107.70	4.82
83	0	4	1997	11	64.20	107.90	14.73
83	B	4	1997	16	64.20	108.30	19.35
83	B	4	1997	21	64.30	107.60	35.59
83	1	4	1997	26	64.50	107.40	24.22
83	A	4	1997	27	64.50	107.40	0.00
83	A	5	1997	6	64.60	107.60	14.66
83	1	5	1997	11	64.60	107.60	0.00
83	0	5	1997	16	64.60	107.50	4.77
83	0	5	1997	17	64.60	107.50	0.00
83	A	5	1997	21	64.60	107.80	14.30
83	B	5	1997	22	64.70	107.40	22.05
83	1	5	1997	26	64.70	107.70	14.25
83	1	5	1997	31	64.80	107.50	14.61
83	B	6	1997	5	64.70	107.30	14.61
83	B	6	1997	10	64.80	107.50	14.61
83	0	6	1997	16	64.70	107.60	12.09
83	0	6	1997	20	64.80	107.60	11.12
83	1	6	1997	21	64.80	107.50	4.73
83	0	6	1997	26	64.70	107.60	12.09
83	A	6	1997	30	64.80	107.50	12.09
83	A	7	1997	5	64.80	107.50	0.00
83	1	7	1997	11	64.80	107.50	0.00
83	1	7	1997	25	64.80	107.60	4.73
83	B	7	1997	30	64.80	107.40	9.47
83	1	8	1997	4	64.80	107.50	4.73
83	1	8	1997	5	64.80	107.50	0.00
83	A	8	1997	14	64.80	107.50	0.00
83	0	8	1997	24	64.80	107.50	0.00
83	0	8	1997	25	64.70	107.60	12.09
83	3	9	1997	8	64.81	107.49	13.29
83	0	9	1997	18	64.81	107.49	0.00
83	A	9	1997	28	64.81	107.45	1.89
83	A	9	1997	29	64.80	107.45	1.11
83	2	10	1997	9	64.80	107.47	0.95
83	A	10	1997	13	64.80	107.47	0.00
83	2	10	1997	14	64.80	107.48	0.47
83	2	10	1997	18	64.80	107.49	0.47
83	3	10	1997	23	64.80	107.47	0.95
83	3	10	1997	28	64.80	107.48	0.47
83	A	11	1997	2	64.80	107.45	1.42

PTT	CLASS	MONTH	YEAR	DAY	LAT	LONG	DISTANCE
83	3	11	1997	12	64.80	107.46	0.47
83	3	11	1997	13	64.80	107.48	0.95
83	3	11	1997	18	64.80	107.48	0.00
83	3	11	1997	22	64.80	107.48	0.00
83	3	11	1997	23	64.80	107.47	0.47
83	3	11	1997	28	64.80	107.47	0.00
83	2	12	1997	3	64.80	107.48	0.47
83	B	12	1997	7	64.79	107.45	1.80
83	1	12	1997	8	64.80	107.50	2.62
83	A	12	1997	12	64.80	107.49	0.47
83	1	12	1997	13	64.81	107.41	3.95
83	3	12	1997	17	64.80	107.47	3.05
83	3	12	1997	22	64.80	107.46	0.47
83	3	12	1997	27	64.80	107.46	0.00
83	3	1	1998	1	64.80	107.46	0.00
83	3	1	1998	2	64.80	107.47	0.47
83	3	1	1998	6	64.80	107.47	0.00
83	3	1	1998	7	64.80	107.48	0.47
83	3	1	1998	11	64.80	107.47	0.47
83	2	1	1998	17	64.80	107.48	0.47
83	3	1	1998	22	64.80	107.50	0.95
83	2	1	1998	27	64.79	107.51	1.21
83	1	2	1998	5	64.81	107.44	3.99
83	2	2	1998	10	64.80	107.46	1.46
83	2	2	1998	15	64.81	107.45	1.21
83	2	2	1998	16	64.80	107.47	1.46
83	3	2	1998	21	64.80	107.48	0.47
83	2	2	1998	26	64.80	107.48	0.00
83	3	3	1998	3	64.80	107.47	0.47
83	3	3	1998	8	64.80	107.48	0.47
83	1	3	1998	13	64.80	107.49	0.47
83	3	3	1998	17	64.80	107.45	1.89
83	2	3	1998	18	64.80	107.48	1.42
83	0	3	1998	23	64.79	107.52	2.20
83	1	3	1998	27	64.80	107.46	3.05
83	2	4	1998	1	64.81	107.44	1.46
83	3	4	1998	12	64.80	107.47	1.80
83	2	4	1998	17	64.80	107.48	0.47
83	3	4	1998	22	64.80	107.48	0.00

PTT	CLASS	MONTH	YEAR	DAY	LAT	LONG	DISTANCE
84	2	4	1996	21	67.69	107.95	-
84	1	4	1996	26	67.64	106.01	33.21
84	1	5	1996	1	67.93	106.20	24.46
84	2	5	1996	6	68.15	106.21	28.79
84	2	5	1996	11	67.95	105.77	9.66
84	3	5	1996	16	67.96	106.00	40.68
84	1	5	1996	21	67.88	105.05	52.37

PTT	CLASS	MONTH	YEAR	DAY	LAT	LONG	DISTANCE
84	0	5	1996	26	67.78	103.83	45.37
84	1	5	1996	31	67.73	102.76	17.36
84	2	6	1996	5	67.67	102.38	7.60
84	0	6	1996	10	67.67	102.56	7.30
84	1	6	1996	15	67.61	102.49	7.88
84	1	6	1996	20	67.68	102.46	18.72
84	1	6	1996	25	67.66	102.02	69.75
84	1	6	1996	30	67.31	100.66	5.61
84	1	7	1996	5	67.29	100.54	35.90
84	0	7	1996	10	67.52	101.13	90.82
84	0	7	1996	15	67.33	103.20	108.22
84	1	7	1996	20	67.49	105.70	37.63
84	2	7	1996	25	67.77	106.20	19.20
84	1	7	1996	30	67.60	106.28	3.33
84	0	8	1996	4	67.63	106.28	5.06
84	0	8	1996	9	67.66	106.19	17.81
84	A	8	1996	14	67.61	106.59	10.90
84	A	8	1996	19	67.54	106.41	79.42
84	1	8	1996	24	66.90	105.59	70.48
84	2	8	1996	29	66.39	106.54	13.22
84	1	9	1996	3	66.47	106.76	45.25
84	2	9	1996	8	66.61	105.80	74.83
84	0	9	1996	13	66.79	104.16	28.04
84	2	9	1996	18	66.92	103.61	6.34
84	2	9	1996	23	66.97	103.54	1.71
84	3	9	1996	28	66.96	103.57	58.09
84	1	10	1996	3	66.44	103.70	131.98
84	2	10	1996	8	65.26	104.02	112.29
84	1	10	1996	13	64.35	102.99	63.23
84	2	10	1996	18	64.03	101.91	85.76
84	1	10	1996	23	63.52	103.22	103.70
84	A	10	1996	28	62.95	104.86	31.87
84	1	11	1996	2	63.20	105.17	63.86
84	1	11	1996	7	63.47	106.30	48.73
84	2	11	1996	12	63.88	106.65	72.80
84	1	11	1996	17	64.30	107.80	44.24
84	2	11	1996	22	64.67	108.14	12.69
84	3	11	1996	27	64.59	107.95	3.07
84	2	12	1996	2	64.60	107.89	28.96
84	1	12	1996	7	64.35	107.72	6.19
84	1	12	1996	12	64.33	107.84	18.98
84	1	12	1996	17	64.40	108.20	10.94
84	1	12	1996	22	64.33	108.04	4.41
84	3	12	1996	27	64.30	107.98	10.12
84	1	1	1997	1	64.22	108.08	1.11
84	2	1	1997	6	64.23	108.08	6.22
84	1	1	1997	11	64.19	108.17	12.69
84	1	1	1997	16	64.30	108.10	7.79

PTT	CLASS	MONTH	YEAR	DAY	LAT	LONG	DISTANCE
84	2	1	1997	21	64.31	108.26	9.15
84	0	1	1997	26	64.38	108.36	16.82
84	1	1	1997	31	64.38	108.01	12.57
84	1	2	1997	5	64.27	108.07	15.61
84	0	2	1997	10	64.25	108.39	4.05
84	0	2	1997	15	64.23	108.32	14.84
84	1	2	1997	20	64.36	108.25	9.28
84	0	2	1997	25	64.33	108.07	11.57
84	1	3	1997	2	64.30	108.30	0.00
84	3	3	1997	7	64.30	108.30	0.00
84	A	3	1997	12	64.30	108.30	4.82
84	2	3	1997	17	64.30	108.20	14.73
84	1	3	1997	22	64.20	108.00	9.68
84	1	3	1997	27	64.20	107.80	12.12
84	0	4	1997	1	64.30	107.90	4.82
84	2	4	1997	6	64.30	108.00	14.70
84	2	4	1997	11	64.40	108.20	9.61
84	1	4	1997	16	64.40	108.00	66.32
84	1	4	1997	21	64.70	106.80	46.97
84	1	4	1997	26	65.00	106.10	24.12
84	A	5	1997	1	65.20	105.90	108.22
84	1	5	1997	6	66.10	105.00	25.07
84	1	5	1997	11	66.20	105.50	23.96
84	1	5	1997	16	66.40	105.30	40.02
84	1	5	1997	21	66.70	105.80	22.66
84	1	5	1997	26	66.90	105.90	44.68
84	1	5	1997	31	67.30	105.80	57.54
84	1	6	1997	5	67.60	104.70	21.18
84	3	6	1997	10	67.60	104.20	8.47
84	3	6	1997	15	67.60	104.40	13.97
84	2	6	1997	20	67.70	104.20	27.95
84	A	6	1997	25	67.50	103.80	11.90
84	0	6	1997	30	67.60	103.70	13.99
84	2	7	1997	5	67.50	103.50	77.53
84	2	7	1997	10	67.40	101.70	44.92
84	1	7	1997	15	67.10	101.00	79.77
84	A	7	1997	20	66.40	100.60	122.67
84	A	7	1997	25	66.20	103.30	109.01
84	1	7	1997	30	65.90	105.60	80.30
84	A	8	1997	4	65.60	107.20	59.23
84	2	8	1997	9	65.80	108.40	14.36
84	A	8	1997	14	65.90	108.60	9.08
84	0	8	1997	24	65.90	108.80	33.72
84	A	8	1997	29	65.80	108.10	32.55
84	2	9	1997	3	65.55	107.73	25.71
84	1	9	1997	8	65.51	107.18	115.68
84	0	9	1997	13	65.14	104.85	52.86
84	3	9	1997	18	65.34	103.82	44.61

PTT	CLASS	MONTH	YEAR	DAY	LAT	LONG	DISTANCE
84	1	9	1997	23	64.97	103.45	19.69
84	2	9	1997	28	64.88	103.81	70.06
84	2	10	1997	3	65.50	103.54	57.72
84	1	10	1997	8	65.01	103.95	131.25
84	0	10	1997	13	63.83	104.04	45.08
84	1	10	1997	18	63.44	103.79	27.14
84	0	10	1997	23	63.62	104.16	104.87
84	1	10	1997	28	62.76	105.02	76.71
84	1	11	1997	2	62.07	105.01	68.68
84	0	11	1997	7	61.49	105.46	32.12
84	1	11	1997	12	61.77	105.61	34.82
84	1	11	1997	17	61.62	105.03	26.68
84	3	11	1997	22	61.82	104.75	35.72
84	0	11	1997	27	61.70	104.12	4.45
84	0	11	1997	27	61.66	104.12	14.13
84	1	12	1997	2	61.63	103.86	9.26
84	1	12	1997	7	61.58	103.72	11.08
84	1	12	1997	12	61.67	103.81	4.57
84	0	12	1997	17	61.71	103.83	10.56
84	1	12	1997	22	61.68	103.64	3.50
84	0	12	1997	27	61.71	103.66	28.19
84	3	1	1998	1	61.91	103.99	8.37
84	2	1	1998	6	61.91	104.15	28.92
84	1	1	1998	11	62.09	104.55	9.36
84	1	1	1998	16	62.16	104.45	10.64
84	1	1	1998	21	62.25	104.38	1.23
84	1	1	1998	26	62.26	104.39	19.74
84	0	1	1998	31	62.37	104.09	8.43
84	1	2	1998	1	62.34	104.24	14.81
84	0	2	1998	5	62.44	104.43	20.32
84	1	2	1998	10	62.47	104.04	21.17
84	0	2	1998	25	62.61	103.76	1.22
84	1	2	1998	25	62.62	103.77	5.11
84	0	3	1998	2	62.64	103.68	5.11
84	0	3	1998	2	62.62	103.77	17.31
84	0	3	1998	7	62.73	104.01	9.76
84	0	3	1998	12	62.70	104.19	14.41
84	0	3	1998	18	62.80	104.37	15.77
84	0	3	1998	22	62.94	104.32	6.93
84	0	3	1998	22	62.91	104.20	1.11
84	1	3	1998	23	62.92	104.20	13.84
84	0	3	1998	27	62.94	103.93	15.29
84	0	3	1998	27	62.87	104.19	46.38
84	1	4	1998	6	63.25	104.57	26.52
84	1	4	1998	11	63.45	104.28	14.99
84	1	4	1998	16	63.40	104.00	67.46
84	1	4	1998	21	63.99	104.32	85.96
84	1	4	1998	26	64.75	103.99	27.07

PTT	CLASS	MONTH	YEAR	DAY	LAT	LONG	DISTANCE
84	0	5	1998	6	64.83	104.53	9.39
84	1	5	1998	6	64.89	104.39	7.91
84	0	5	1998	7	64.83	104.48	94.61
84	0	5	1998	12	65.68	104.38	133.81
84	0	5	1998	16	66.81	103.35	38.15
84	1	5	1998	21	67.06	103.95	21.76
84	1	5	1998	26	67.23	104.20	13.39
84	1	5	1998	31	67.22	103.89	118.52

PTT	CLASS	MONTH	YEAR	DAY	LAT	LONG	DISTANCE
85	1	4	1996	21	67.69	107.98	-
85	1	4	1996	26	66.47	103.96	220.57
85	2	5	1996	1	66.68	104.08	23.94
85	1	5	1996	6	66.70	104.29	9.50
85	1	5	1996	11	66.79	104.51	13.90
85	2	5	1996	16	67.09	104.96	38.68
85	1	5	1996	21	67.26	105.04	19.21
85	3	5	1996	26	67.77	104.01	71.63
85	A	5	1996	31	67.74	103.33	28.81
85	3	6	1996	5	67.70	103.25	5.58
85	3	6	1996	10	67.72	103.32	3.70
85	2	6	1996	15	67.67	103.24	6.50
85	3	6	1996	20	67.79	103.29	13.51
85	1	6	1996	25	67.82	103.03	11.42
85	2	6	1996	30	66.91	101.46	121.42
85	1	7	1996	5	66.68	101.19	28.17
85	2	7	1996	10	67.36	103.80	136.16
85	1	7	1996	15	67.61	105.85	91.58
85	3	7	1996	20	66.52	106.07	121.54
85	2	7	1996	25	65.63	105.20	106.43
85	3	7	1996	30	65.67	104.99	10.60
85	1	8	1996	4	66.15	104.43	59.10
85	2	8	1996	9	66.32	104.42	18.90
85	2	8	1996	14	66.14	104.41	20.01
85	1	8	1996	19	66.08	104.59	10.50
85	1	8	1996	24	66.01	104.37	12.62
85	1	8	1996	29	66.08	104.62	13.71
85	2	9	1996	3	66.84	103.36	101.32
85	1	9	1996	8	67.00	102.78	30.91
85	1	9	1996	18	67.26	102.19	38.54
85	2	9	1996	23	67.37	102.14	12.41
85	1	9	1996	28	67.27	101.93	14.30
85	3	10	1996	3	66.71	102.40	65.52
85	2	10	1996	8	65.29	103.95	172.70
85	2	10	1996	13	64.33	102.91	117.51
85	2	10	1996	18	64.53	102.87	22.32
85	1	10	1996	23	64.56	102.22	31.23
85	2	10	1996	28	65.00	103.44	75.71

PTT	CLASS	MONTH	YEAR	DAY	LAT	LONG	DISTANCE
85	2	11	1996	2	65.37	104.16	53.10
85	1	11	1996	7	65.90	104.03	59.22
85	1	11	1996	12	66.01	105.80	81.10
85	2	11	1996	17	65.95	106.69	40.82
85	2	11	1996	22	65.81	106.41	20.10
85	2	11	1996	27	65.66	106.26	18.03
85	2	12	1996	2	65.65	105.93	15.16
85	1	12	1996	7	65.58	105.86	8.42
85	1	12	1996	12	65.67	105.96	11.01
85	3	12	1996	17	65.81	106.37	24.35
85	3	12	1996	22	65.66	106.40	16.73
85	2	12	1996	27	65.66	106.78	17.41
85	A	1	1997	1	65.50	106.63	19.08
85	1	1	1997	6	65.56	106.25	18.73
85	2	1	1997	11	65.49	106.38	9.82
85	1	1	1997	16	65.62	106.61	17.91
85	1	1	1997	21	65.66	106.76	8.19
85	0	1	1997	26	65.66	106.77	0.46
85	2	1	1997	31	65.56	106.36	21.86
85	0	2	1997	5	65.53	106.81	20.98
85	1	2	1997	10	65.69	106.61	20.02
85	0	2	1997	15	65.73	106.44	8.96
85	0	2	1997	20	65.83	106.35	11.85
85	2	2	1997	25	65.76	106.51	10.66
85	1	3	1997	2	65.70	106.70	10.95
85	B	3	1997	7	65.70	106.60	4.57
85	1	3	1997	12	65.60	106.40	14.41
85	1	3	1997	17	65.60	106.40	0.00
85	1	3	1997	22	65.70	105.60	38.32
85	1	3	1997	27	65.80	105.20	21.38
85	1	4	1997	1	65.90	104.90	17.60
85	1	4	1997	6	66.00	104.60	17.56
85	1	4	1997	11	66.20	105.00	28.62
85	3	4	1997	16	66.30	104.90	11.98
85	2	4	1997	21	66.40	104.00	41.65
85	3	4	1997	26	66.60	103.60	28.44
85	1	5	1997	1	66.60	103.20	17.66
85	1	5	1997	6	66.90	102.40	48.42
85	2	5	1997	11	67.00	102.70	17.15
85	1	5	1997	16	66.90	102.50	14.12
85	1	5	1997	21	66.90	102.50	0.00
85	2	5	1997	26	67.20	102.90	37.59
85	3	5	1997	31	67.30	103.00	11.92
85	2	6	1997	5	67.60	102.60	37.46
85	2	6	1997	10	67.60	102.40	8.47
85	2	6	1997	15	67.50	102.50	11.90
85	1	6	1997	20	67.50	102.40	4.25
85	A	6	1997	25	67.30	102.00	28.04

PTT	CLASS	MONTH	YEAR	DAY	LAT	LONG	DISTANCE
85	0	6	1997	30	67.10	102.20	23.84
85	3	7	1997	5	67.10	100.50	73.54
85	1	7	1997	10	67.30	98.90	72.42
85	1	7	1997	15	67.00	98.80	33.63
85	3	7	1997	20	66.50	100.20	82.84
85	1	7	1997	25	66.50	101.90	75.35
85	2	7	1997	30	66.90	103.80	94.64
85	2	8	1997	4	66.70	105.30	69.35
85	A	8	1997	9	67.00	105.50	34.48
85	1	8	1997	14	67.30	105.80	35.78
85	2	8	1997	19	67.50	105.60	23.82
85	1	8	1997	24	67.70	105.10	30.71
85	1	8	1997	29	67.70	104.40	29.53
85	3	9	1997	3	67.76	104.27	8.63
85	1	9	1997	8	67.65	103.60	30.79
85	A	9	1997	13	67.61	103.39	9.94
85	1	9	1997	18	67.78	104.72	59.21
85	1	9	1997	23	67.47	104.70	34.47
85	0	9	1997	28	67.25	104.56	25.18
85	1	10	1997	8	65.65	102.71	195.91
85	0	10	1997	13	64.59	101.16	138.34
85	2	10	1997	18	64.10	100.41	65.35
85	0	10	1997	28	63.45	99.55	83.70
85	B	10	1997	28	63.34	98.99	30.44
85	1	11	1997	7	63.17	101.15	109.69
85	2	11	1997	17	63.23	102.73	79.47
85	0	11	1997	22	63.60	103.84	68.86
85	2	11	1997	27	63.73	104.14	20.68
85	2	12	1997	2	63.74	104.24	5.04
85	1	12	1997	7	63.40	104.40	38.62
85	1	12	1997	12	63.55	104.07	23.38
85	0	12	1997	17	63.57	104.13	3.71
85	2	12	1997	22	63.52	103.76	19.15
85	B	12	1997	27	63.79	103.65	30.50
85	1	1	1998	6	63.72	103.32	17.99
85	2	1	1998	16	63.45	103.63	33.70
85	1	1	1998	21	63.41	103.45	9.99
85	1	1	1998	26	63.36	103.51	6.31
85	1	1	1998	31	63.32	103.56	5.10
85	1	2	1998	10	63.33	103.23	16.51
85	1	2	1998	15	63.34	103.27	2.28
85	1	2	1998	25	63.38	102.64	31.72
85	1	3	1998	2	63.46	102.52	10.71
85	2	3	1998	12	63.48	103.24	35.82
85	1	3	1998	17	63.61	103.77	29.96
85	1	3	1998	22	63.56	103.74	5.75
85	0	3	1998	28	64.01	103.12	58.56
85	0	4	1998	1	65.29	102.19	149.01

PTT	CLASS	MONTH	YEAR	DAY	LAT	LONG	DISTANCE
85	0	4	1998	6	65.49	102.17	22.25
85	1	4	1998	11	65.95	102.66	55.83
85	1	4	1998	21	66.70	103.22	87.04
85	1	4	1998	26	66.78	103.80	26.97
85	3	5	1998	6	66.56	104.23	30.93
85	1	5	1998	11	67.02	104.82	57.30
85	0	5	1998	12	67.02	104.89	3.04
85	0	5	1998	21	67.71	103.55	95.76
85	0	5	1998	26	67.74	104.22	28.43
85	3	5	1998	26	67.74	104.12	4.21
85	3	5	1998	31	67.75	103.96	6.83

APPENDIX G. Compilation of historical information on caribou, Adelaide Peninsula and Queen Maud Gulf area.

The fragmentary historical accounts describes the existence, then the disappearance by the 1930s of a migratory caribou population that summered on King William Island and wintered on the mainland (Macpherson and Manning 1959, Freeman 1976, Klutschak 1987). Macpherson and Manning (1959) compiled the historical references to caribou in the area. The most detailed account of the caribou is from Klutschak (1987).

Klutschak (1987) traveled with the Inuit across from Repulse Bay in 1878 and spent the summer on King William Island and Adelaide Peninsula. Klutschak's (1987) observations in 1879 were in the pre-trading era although not pre-contact as the patterns of movements of the people had already been influenced by the explorational activities of the Europeans. Those changes in the distribution and movements of the people probably scarcely modified hunting patterns as the introduction of firearms and trapping had not yet occurred.

Klutschak (1987) from his travels to Cape Felix and along the west coast describes the migration of the caribou to King William Island in May. He mentions that caribou calved on in the interior of the island and moved to the coast in July and August. The numbers of caribou gathered on the south coast in late September led Klutschak (1987) to call southeastern King William Island "...A caribou hunter's Eldorado". The Netsilingmiut hunted caribou in August in the interior of Adelaide Peninsula using inukshuks to guide the caribou so they could be chased into large lakes and hunted from kayaks. In September the caribou that had gathered near the coast of Adelaide Peninsula in large numbers moved away. The Netsilingmiut moved across to southern King William Island to hunt the caribou as the caribou there waited for the straits to freeze over. Rasmussen (1927) also observes the fall hunt of caribou crossing from King William Island but he also commented on hunters leaving King William Island to hunt for calves further south (possibly Adelaide Peninsula in spring).

Klutschak's (1987) description of the caribou movements and the hunting of them in 1879 is similar to the descriptions compiled by Freeman (1976) for the area. When the use of firearms became widespread after the establishment of trading post near Peabody Point in 1923, hunting patterns changed. Hunters with firearms could hunt caribou year round instead of painstakingly stalking with bow and arrow in summer or ambushing caribou during river crossings.

By the 1920s and 1930s, the migration of caribou to King William Island dwindled, then stopped and a more widespread decrease in caribou numbers was apparent (Freeman 1976). A clue to a possible cause of the decline can be found in Klutschak's (1987:117-119) description of the effect of using rifles during the fall crossing of the caribou to the mainland and his comment that, "... Never had the hunting efforts of the indigenous residents been so productive as this fall."

Weather may have compounded the effect of firearms in triggering of the decline of the caribou. Amundsen (in Macpherson and Manning 1959) noted that caribou were numerous and fat in the fall of 1903 but scarce and thin in the fall of 1904 in the vicinity of Gjoa Haven. The failure of the caribou to cross caused destitution of the Inuit on the island in the winter of 1924-25 (Hoare in Macpherson and Manning 1959). Rasmussen (1927) referred to a severe winter causing starvation of the Inuit in the early 1920s.

If the failure of the caribou to cross in 1924 was only the result of the introduction of firearms, it happened quickly, as Rasmussen (1927) does not remark that firearms were in common use. Alternatively, the stopping of the migration was not as abrupt as Hoare and Burwash (in Macpherson and Manning 1959) were led to believe. Gilder (in Macpherson and Manning 1959) notes that by 1932, caribou were scarce on King William Island and the seasonal migrations to and from the island had almost stopped. Caribou hunting became combined with winter trapping or summer fishing after the 1920s. The caribou were hunted over an extensive area along the mainland coast and inland west to the Ellice River; south to the Back River or even the Garry Lake area; east to Pelly and Committee Bays and northeast on the Boothia Peninsula (Freeman 1976).

By the 1960s, people had concentrated in the settlement of Gjoa Haven and a less extensive area was hunted. Caribou were hunted mostly on Adelaide Peninsula, south to Franklin Lake and from around the Back River to Hayes River area (Freeman 1976).

Ken Lambert, Wildlife Office in Gjoa Haven interviewed an elder, Sabastian Aaluk
Born in 1920, who provided these comments summarised below in 1985._"When five or six years old – people already hunting with rifles. He also feels that because of rifles (and the island was small) the caribou became less in number. During that time, the animals stayed all year round on the island. After the rifles came, there were lots caribou and musk-ox shot. Only the Inuit were doing the shooting. By using rifles, people had more meat than before".

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