DISTRIBUTION AND ABUNDANCE OF CARIBOU ON THE NORTHEAST MAINLAND, NWT IN MAY 1995

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ABSTRACT

We surveyed the northeastern mainland, Northwest Territories (342 000 sq. km.) between 16 and 27 May 1995. We estimated that there were 72 395 $\pm$ 7857 caribou (0.23 $\pm$ 0.03 caribou/km^2) in the study area. The survey was designed to be similar to a pre-calving survey in May 1983. The estimate for 1995 is significantly less than the 1983 estimate (Heard *et. al.* 1987), with the reduction spread unevenly across the survey area. This suggests that some herds have either declined in size or undergone major shifts in distribution between 1983 and 1995.

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INTRODUCTION

The tundra-dwelling caribou (*Rangifer tarandus)* on the northeastern mainland, Northwest Territories are a mainstay for Inuit from seven communities in the area (342 000 km^2) (Figure 1). Unlike the Bathurst, Beverly and Qamanirjuaq caribou herds which occupy most of the central and eastern mainland, caribou of the northeast mainland do not migrate between calving areas on the tundra and winter ranges within the boreal forest, but inhabit the tundra year round. The scarcity of muskox east of the Queen Maud Gulf increases the importance of caribou in this area as a source of meat.

The only attempt to census caribou over the entire northeast mainland was in May 1983 when Heard *et al.* (1987) flew an extensive survey at low coverage (5%); they estimated 120 000 $\pm$ 13 900 caribou. Previously three herds (Melville Peninsula, Wager and Lorillard) had been recognised and individually surveyed (Calef and Heard 1981, Heard *et al.* 1981). High caribou densities seen in the May 1983 survey coincided with the calving grounds of those three herds and a fourth area of high density in the Queen Maud Gulf area led Heard *et al.* (1987) to suggest that there was a fourth herd. A subsequent survey in the Queen Maud Gulf in 1986 delimited a calving ground for a herd of about 40 000 caribou (Gunn and Fournier 2000).

In the 1980s, hunters in the eastern Kitikmeot reported increases in caribou wintering around their communities. Given the lack of information on the number of herds and their seasonal movements, the first step was to carry out surveys during early June to locate calving grounds and to follow up on traditional knowledge of where caribou calved. Those surveys revealed calving on the Arrowsmith Lowlands, Simpson Peninsula and Keith Bay and satellite telemetry revealed overlapping winter distributions with caribou returning to different calving grounds (Gunn and Fournier 2000).

Reports of caribou shifting their winter distribution are frequent for both the tundra and taiga. Seen from the perspective of hunters, those shifts cause shortfalls in

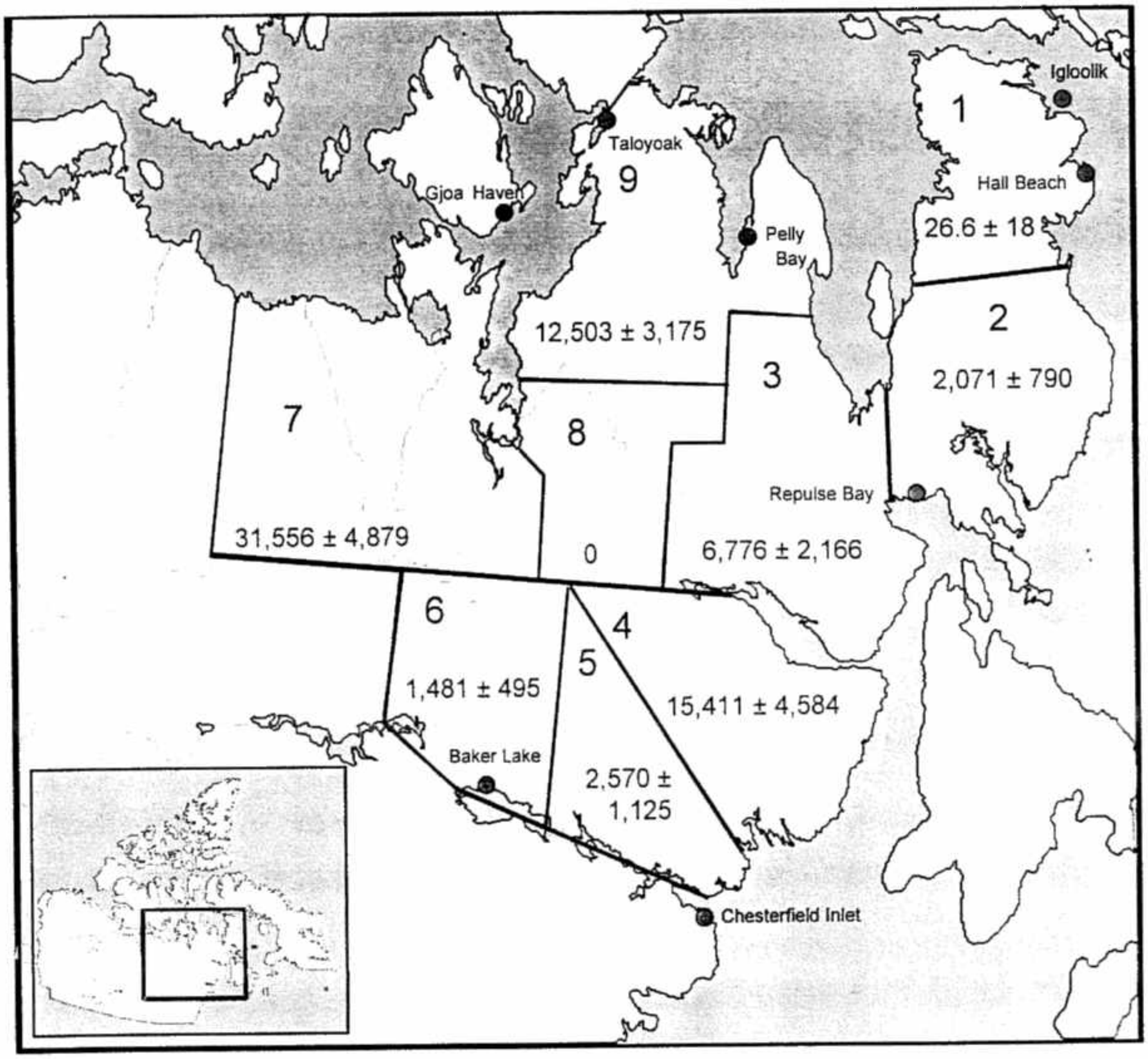

Figure 1. The survey area in northeastern Northwest Territories showing strata and caribou population estimates in May 1995.

the harvest if caribou have moved out of reach. From the perspective of biologists, reported changes in availability of caribou can represent either a shift in distribution or a population decline. The difference in perspectives is a function of a relative or absolute shortage of caribou.

In the 1980s, hunters reported that caribou were increasing in some areas of the northeast mainland. Hunters from Igloolik reported irregular movements of caribou between northern Melville Peninsula and northern Baffin Island, however the direction, timing and frequency of these movements vary from year to year, and there is no documented information (Ferguson and Vincent 1992).

More recently, in the early 1990s, hunters from Pelly Bay and Igloolik reported that caribou were less abundant than previous winters. People in the communities of Igloolik and Hall Beach do not believe that caribou have declined, but that they have moved out of the area. They think that more caribou have been leaving the Peninsula for Baffin Island. In 1996, hunters from Igloolik reported that caribou in one of their preferred hunting areas on north Baffin were dying or in poor condition (M. Ferguson, pers. comm.). Some residents of Repulse Bay and Baker Lake have indicated in recent years that they have been encountering more caribou which are sick and in poor condition (R. Mulders, pers. comm.)

Since the trend of a caribou population can change quickly and 11 years had passed since the previous survey, our objective was to determine whether or not the reported decline in abundance was due to a relative or absolute shortage of caribou. To assess distribution and trend, we duplicated Heard *et al's.* (1987) methods as closely as possible. This report describes our aerial survey for caribou on the northeast mainland in May 1995.

METHODS

In May 1995 we used the same survey area (Figure 1), stratification and methods as Heard *et al.* (1987). Heard *et al.* (1987) divided the survey area into 9 strata for logistical reasons and based on previous information on caribou distribution. The survey effort was not proportional to caribou density but was intended to be uniform between strata. Coverage was set at about 5% based on transects spaced approximately 32.5 km apart. The transects were a 0.8 km strip on either side of the aircraft and were orientated perpendicular to the major rivers and coasts to avoid a sampling bias if the caribou were concentrated along drainages and in the lowlands.

We used three survey aircraft: two Cessna 337s (pre-1974 models with large rear windows) and a Helio-Courier on wheel-skis. Each survey crew had a right and left observer both seated in the rear and the pilot navigated and plotted observation numbers on 1:250 000 topographic maps. If space permitted, a fourth person navigated from the right front seat. The right observer recorded the sightings for both observers by location number in a field notebook. Some observers also used tape recorders to record observations for some of the transects.

Boundaries for the inside and outside of the transect were calculated (Norton-Griffiths 1978) and marked. Markers were black dowels taped to the wing struts (Cessnas) and red tape fastened to a rope which was tied from an eye bolt on the wing to the fuselage (the Helio-Courier does not have wing struts). We checked the markers by flying at survey altitude over an object measured 0.8km from the runway end markers on an airstrip. When flying along the transects, the aircraft altitude was 224 m above ground level and the airspeed was 160 km/h (Helio-Courier) or 210km/h (Cessna).

We used a census data program based on Jolly's (1969) Method 2 estimate for unequal-sized sample units (the transects vary in length) to calculate a population estimate from the numbers of caribou counted on transect. The probability that the caribou population had significantly decreased since 1983 (H_o: $T_1 > T_2$) was tested using a one-tailed Student's t-test (Zar 1984). The probability of a Type I and Type II error was set at 0.1 and 0.2 , respectively and the consequential difference of interest was set at 25% of the 1983 estimate (30 000). Within each survey aircraft, differences between the right and left observer's counts were tested for significance with a Wilcoxon matched-pairs signed ranks test (SigmaStat for Windows, Jandel Scientific Software 1994).

RESULTS

In May 1995 we counted 3357 caribou on 14 686 km^2 of strip transects, for an overall estimate of 72 395 ± 7857 (S.E.) caribou. The coefficient of variation was 0.11. Mean density was 0.23 $\pm$ 0.03 caribou/km^2. Sampling intensity averaged 4.3%, with 67 transects flown of a possible 1347 transects. In stratum VIII (Hayes River), coverage was only 2.1%, as only 3 of 5 transects were flown due to poor weather (Table 1, Figure 1, Appendix A). The estimated number of caribou varied among strata from 27 to 31,556 (Table 1). Highest densities occurred in the Queen Maud, Lorillard and Taloyoak strata.

Survey aircraft were based in Repulse Bay, Baker Lake and Gjoa Haven; after the Cessna 337 finished its survey at Repulse, it replaced the Cessna 337 at Baker Lake and completed that portion of the survey that had been held up in poor weather. The three aircraft required a total of 152 hours to complete the survey. The Baker Lake crew flew 21.3 h on transect and 33.5 h off-transect; at Repulse Bay transect and off-transect hours flown totalled 13.3 and 31.4, respectively. At Gjoa Haven, we flew 16.5 h on transect and 36.1 h off transect. All three aircraft originated from Norman Wells and positioning and depositioning times were 14.4 h (Baker Lake), 16.1 h (Repulse Bay) and 20.5 h (Gjoa Haven) (these hours are included in the off-transect hours given above).

Weather that would influence the conspicuousness of the caribou against the background varied (Appendix B). On overcast days, caribou were relatively inconspicuous against the snow. Snow and low ceilings caused frequent interruptions to the survey.

Group sizes ranged from 1 to 90 and weighted mean group size (n = 499) was 6.7 $\pm$ 0.83 (S.E.) (Table 2). We saw no newborn calves.

Table 1. Estimated numbers of caribou by stratum on the northeastern mainland of the NWT, May 1995.

Stratum Number	Stratum Name	Density caribou/ km^2	Population estimate ± S.E.[a] (1983 results)	Coefficient of Variation	Sampling Intensity (%)
1	N Melville	0.0011	27 ± 18 (2500 ± 970)	0.68	3.8
2	S Melville	0.0553	2071 ± 790 (38 000 ±11 100)	0.38	4.0
3	Wager	0.1409	6776 ± 2166 (15 200 ± 2330)	0.32	4.2
4	Lorillard	0.3975	15 411 ± 4584 (20 000 ± 6000)	0.30	4.5
5	Chesterfield Inlet	0.0964	2570 ± 1125 (3300 ± 450)	0.44	5.6
6	Baker Lake	0.0602	1481 ± 495 (3000 ± 930)	0.33	5.4
7	Queen Maud	0.4549	31 556 ± 4879 (33 000 ± 5100)	0.15	4.3
8	Hayes River	0.0	-- (1900 ± 550)	--	2.1
9	Taloyoak	0.2723	12 503 ± 3175 (2900 ± 1000)	0.25	4.6
Total		0.23	72 395 ± 7857 (119 800±13 900)	0.11	4.3

[a] Standard error

Population size has changed significantly. $t' = 2.97$, $df = 110$, $\alpha = 0.1$

Table 2. Mean group size in each stratum on the northeastern mainland of the NWT, May 1995.

STRATUM	MEAN GROUP SIZE +/- SE	RANGE
1	1	1
2	3.3 +/- 0.4	1 - 8
3	5.2 +/- 0.8	1 - 25
4	4.9 +/- 0.4	1 - 36
5	3.8 +/- 0.5	1 - 14
6	5.3 +/- 1.6	1 - 25
7	13.4 +/- 1.3	1 - 90
8	0	0
9	5.2 +/- 0.4	1 - 29

Five pairs of observers were tested for significant differences between right and left observer counts. A significant difference was found in 2 cases, no significant difference was found in 2 cases, and in two cases there was not enough data to analyze. Viewing conditions were generally adequate during the survey (Appendix B) but long transects, low densities of caribou, and long days spent flying in an effort to capitalize on good weather probably accentuated observer fatigue.

Other Wildlife Observed

We observed a total of 258 adult muskox and 16 calves, 12 wolves and 1 wolverine (Stratum 7 - 66°02', 99°01') within the study area during the survey (Figure 2). All were observed on the western study area (strata 5, 6, 7 and 9). Nine of 12 wolves observed were found in stratum 7. Muskox group sizes ranged from 1 to 36. Although no muskoxen were seen outside of stratum 7 during this survey, they have been observed as recently as July/August 1992 in the Wager Bay area (E. Seale, pers. comm.).

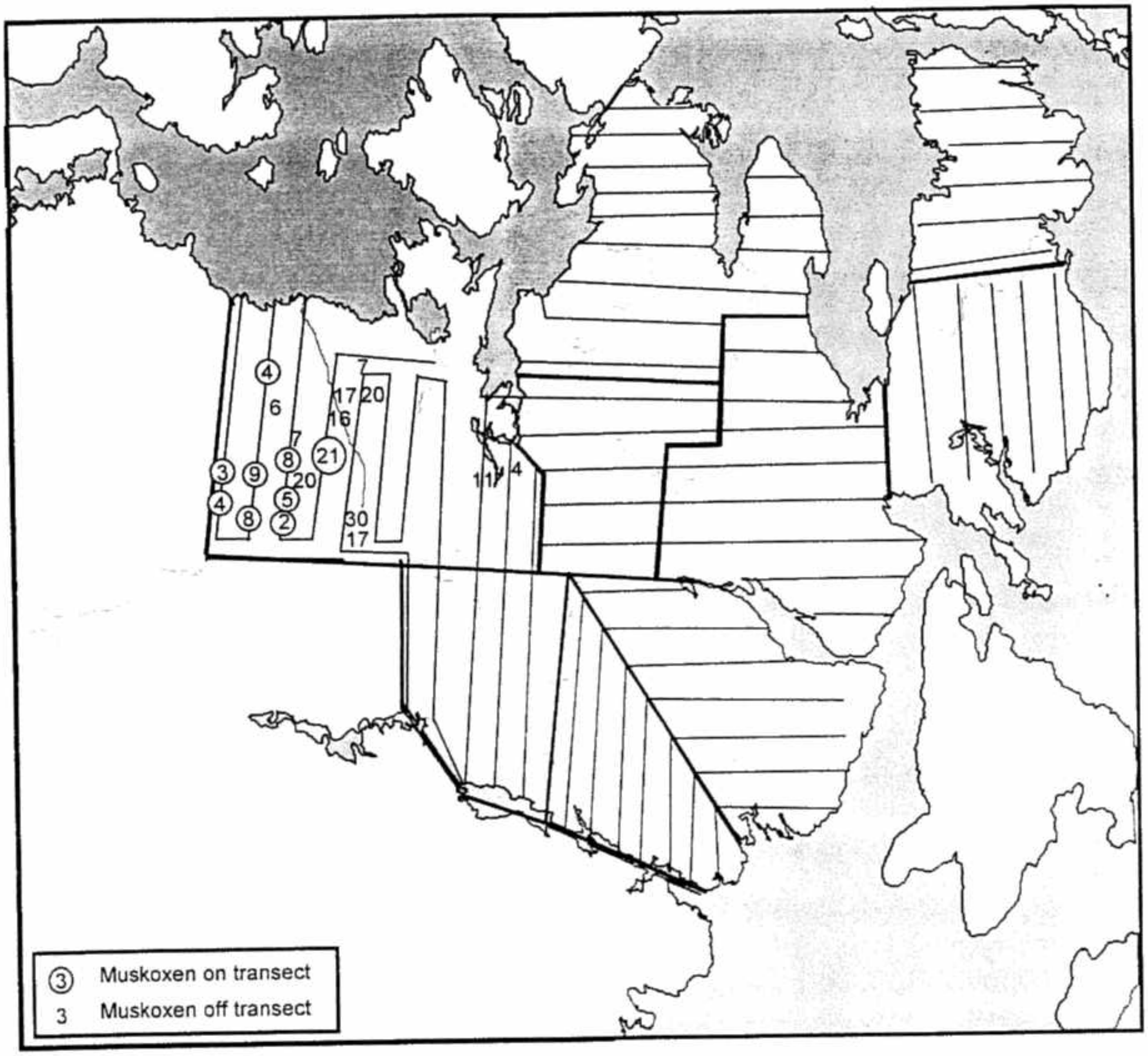

Figure 2. Northeastern mainland survey area showing number and location of muskoxen in May 1995.

DISCUSSION

The null hypothesis that the estimated numbers of caribou in May 1995 had not decreased since May 1983 was rejected ($t' = 2.97$; $t_{0.10, 110} = 1.66$). The decrease between 1983 and 1995 is 47 405 caribou, which exceeds the projected critical difference set at 25% of the 1983 estimate (29 950). We accept that both surveys would have reduced accuracy (observer bias) from failure to detect caribou resulting from fatigue, the difficulty in seeing caribou in late winter against a snow background when it is cloudy or conversely, in the sun's glare. Counting individuals in groups as a source of error would have been low as groups were small in 1983 and 1995. Heard *et al.* (1987) concluded that their observer bias was relatively low; as we had some inexperienced observers, we suspect that our detection may have been lower. Some hunters believe that we missed caribou during the survey and that areas were missed on the west coast of Melville Peninsula (M. Ferguson pers. comm. 1996). As both surveys used the same methods and covered similar areas with similar levels of precision, we suggest that survey error is unlikely a complete explanation for the differences in the 1983 and 1995 estimates. Hence, the estimate for 1995 suggests that some herds have declined in size and, or as well, undergone major shifts in distribution since 1983.

The reduction in the estimates between 1983 and 1995 was unevenly spread across the survey area. Significantly more caribou were estimated south of Taloyoak (stratum 9) in 1995 than in 1983 (Table 1) but this was the only stratum where there were more caribou in 1995. Numbers in the Lorillard, Chesterfield Inlet and Queen Maud Gulf areas (strata 4, 5 and 7) were similar in 1983 and 1995. Caribou have virtually disappeared from Melville Peninsula (strata 1 and 2) and decreased by half north of Wager Bay (stratum 3). Together those three strata show a drop of 84% from the number of caribou estimated there in 1983 (55 700).

We have some reports of ingress elsewhere, which would explain the disappearance of caribou on Melville Peninsula and north of Wager Bay. Hunters from Igloolik and Hall Beach have observed fewer caribou wintering close to the communities in the last two winters, and they attribute the disappearance of the caribou to their moving to Baffin Island (B. Parker pers. comm. 1996). Hunters from Igloolik believe that caribou have always crossed between northern Melville Peninsula and north Baffin Island, but the movements and their timing are irregular and have not been documented (Ferguson and Vincent 1992). Although caribou increased in the northeast Kitikmeot, those reports had started in the early 1980s (Gunn and Fournier 2000, In Press). That timing would suggest that the increases preceded the decline of the caribou on Melville Peninsula and north of Wager Bay.

The survey was timed to map precalving distribution both in 1995 and 1983, and concentrations of caribou were found close to known calving areas (summarised in Gunn and Fournier 2000). The cows' fidelity to their traditional calving grounds means that calving distribution is the most predictable feature of annual movements (Gunn and Miller 1986). Based on our experience with other herds in Alaska and the NWT, we view it unlikely that caribou cows abandon their calving grounds. If spring migration is hampered by deep wet snow, caribou may be late reaching the calving grounds and they may even calve en route, but they persist in trying to reach it.

The fidelity of cows to their traditional calving grounds and lack of reports of an influx of caribou elsewhere points to a decrease in numbers through deaths exceeding births. Possible causes of increases in deaths are predation, hunting, malnutrition or disease. There have been no reports of unusually severe winters. Hunters from Igloolik reported that there have been no icing events on northern Melville Peninsula in the last 4 years (M. Ferguson, pers. comm. 1996). There have been recent reports of caribou in poor condition on Baffin Island, and Igloolik hunters have found animals dying in one of their preferred hunting areas on north Baffin. Some residents of Repulse Bay and Baker Lake have indicated in recent years that they have been encountering more caribou which are sick and in poor condition (R. Mulders, pers. comm.). Caribou in the survey area have brucellosis (Ferguson 1997) which could reduce productivity, but caribou south of Taloyoak also have brucellosis (Gunn *et al.* 1991) and despite that, their numbers increased.

Shifts in winter distribution can expose caribou to changing levels of hunting. In the 1980s, hunters at Pelly Bay commented on increases of caribou which, in winter, became common around the community. In 1991, one of those caribou, fitted with a satellite collar, migrated to and calved on the previously reported calving grounds of the Melville Peninsula herd (Gunn and Fournier 2000) That movement suggests that those wintering caribou around Pelly Bay were at least part of the South Melville Peninsula herd.

According to Ferguson and Vincent (1992), local hunters indicated that caribou leave the eastern portion of Melville Peninsula in late winter. This information and their observations of cows and calves along the west coast during a survey of northern Melville Peninsula in June 1982, suggest an east to west movement in late winter.

Caribou rotate their use of winter range so shifts in winter distribution are not unusual – for example, Ferguson and Messier (1997) compiled Inuit knowledge of caribou and their winter range shifts on Baffin Island. However, our results do not allow us to discriminate between a numerical decline or a distribution shift of caribou on Melville Peninsula and north of Wager Bay between 1983 and 1995.

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APPENDIX A. Analysis of data from the transect survey of caribou in the Northeast mainland, N.W.T., May 1995.

	Strata									
	I	II	III	IV	V	VI	VII	VIII	IX	**TOTAL**
Maximum number of transects (N)	119	141	184	137	134	87	205	100	240	**1,347**
Number of transects surveyed (n)	6	6	9	7	7	5	13	3	11	**67**
Stratum area, km (Z)	24,840	37,487	48,104	38,765	26,670	24,612	69,373	26,111	45,914	**341,876**
Transect area, km (z)	934	1,484	2,030	1,761	1,505	1,330	3,010	536	2,097	**14,686**
Number of caribou counted (y)	1	82	286	700	145	80	1,492	0	571	**3,357**
Caribou density, (R) (caribou/km^2)	0.0011	0.0553	0.1409	0.3975	0.0964	0.0602	0.4549	0.0	0.2286	**0.2286**
Population estimate (Y)	27	2,071	6,776	15,411	2,570	1,481	31,556	--	12,503	**72,395**
Population variance (Var Y)	338	624,011	4,693,453	21,009,671	1,265,061	245,389	23,808,453	--	10,081,362	**61,727,738**
Standard error (SE,Y)	18	790	2,166	4,584	1,125	495	4,879	--	3,175	**7,857**
Coefficient of variation (CV)	0.68	0.38	0.32	0.30	0.44	0.33	0.15	--	0.25	**0.11**

APPENDIX B. Weather and light conditions during transect aerial survey of NE Mainland, NWT, May 1995.

Date	Transect (stratum)	Weather and light conditions
Repulse Bay:		
16 May	22, 16, 15, 14 (3)	sunny, <5% cloud, excellent visibility, -8°C
17 May	Part of 13 (3)	0°C, overcast, with patchy low cloud; survey after 20 min. due to low cloud and poor visibility
18 May	13 (3), 8 (2)	-2°C, scattered low cloud. Transect 13 discontinued after 5 min. due to poor visibility. Transect 8 discontinued after 33 min due to low cloud and near whiteout conditions
19 May		weather too poor to survey
20 May		0°C; encountered extensive low cloud en route to Igloolik. No surveying done.
21 May		weather too poor to survey
22 May	17, 21, 20, 19 (2), 7, 2, 3, 4, 5, 6 (1)	<5% cloud, -6°C, excellent visibility
23 May	13, 12, 11, 10, 9 (3), 8, 18 (2)	80-95% cloud cover, -4°C, visibility ranged from 5-15 miles
Baker Lake:		
16 May		weather too poor to survey
17 May		weather too poor to survey
18 May		weather too poor to survey
19 May		weather too poor to survey
20 May		weather too poor to survey
21 May		weather too poor to survey
22 May		weather too poor to survey
23 May	24, 25 (5), 1, 23 (4)	clear and sunny, -2 to 0°C; fair to good visibility; intermittent light haze or ground fog
	22, 19 (5), 21, 20 (4)	-2 to 0°C; fair visibility; light gray/flat
24 May	15, 18 (5), 17, 16 (4)	0-1°C; mainly overcast with a few clear breaks; intermittent snow; fair to good visibility; which was reduced intermittently due to snow
	9 (6&7), 12 (8), 14 (5)	-4°C, overcast, visibility nil to good. Transect 9 reflown at later date due to snow showers which interrupted survey
25 May	4 (6&7), i (6), ii, 1, 2, 3 (7)	-4°C, 100% thin cloud at 2,000 ft., 20-30 miles visibility; scattered sunny breaks as survey progressed
26 May	13 (4), 11 (8), 9, 5, 8 (6&7)	-1°C; broken low cloud, 5-10 miles visibility; poor visibility on transect 11 due to low cloud; transect 5 ended 10 miles short due to very low cloud
27 May 10	(8)	-4°C; overcast, 2500 ft. scattered cloud; visibility variable at 1-15 miles

APPENDIX B (cont'd).

Date	Transect (stratum)	Weather and light conditions
Gjoa Haven:		
19 May	6 (8&9)	500-2000 overcast; some ground fog; visibility range 1-5 miles, poor to good, -5°C; transect could not be completed and was reflown at a later date
20 May		weather too poor to survey
21 May	3, 4, 5 (7), 6, 7 (8&9)	transects 3 & 4 not completed due to low cloud and poor visibility (reflown later). For remaining transects, scattered and broken cloud at min. 1,000 ft; excellent visibility, generally >15 miles
22 May	9, 16, 8, 14 (9) 10, 11 (8 & 9)	broken cloud at min. 1500 ft, visibility fair to good at >15 miles; -4°C
23 May	12 (8 & 9), 13 (9)	3000 overcast; visibility good at >15 miles
24 May	4, 3 (7)	thin, scattered cloud at min. 1000 ft., visibility good, ranging from 5 to >15 miles
25 May	2, 1 (7)	thin and scattered cloud at min. 1000 ft.; visibility mainly excellent, at >15 miles

Appendix C. Caribou observed on transect by left and right observers during an aerial survey of Northeast mainland, NWT, May 1995.

Transect no.	Transect Area (km^2)	No. of Caribou Observed Left Observer	Right Observer	Total no. Caribou
Stratum 1	**Z = 24,840 km^2**	**N = 119**		
2	100.0	0	0	0
3	140.0	0	0	0
4	196.0	0	0	0
5	152.0	0	0	0
6	150.4	0	0	0
7	196.0	0	1	1
Subtotal	934.4	0	1	1
Stratum 2	**Z = 37,487 km^2**	**N = 141**		
8	284.0	10	1	11
17	285.6	8	0	8
18	243.2	11	5	16
19	272.0	0	0	0
20	269.6	5	9	14
21	129.6	13	20	33
Subtotal	1,484.0	47	35	82
Stratum 3	**Z = 48,104 km^2**	**N = 184**		
22	126.4	52	0	52
16	216.0	9	8	17
15	401.6	20	18	38
14	339.2	6	9	15
13	339.2	4	4	8
12	176.0	0	3	3
11	136.0	3	6	9
10	148.8	13	72	85
9	147.2	50	9	59
Subtotal	2,030.4	157	129	286

Transect no.	Transect Area (km^2)	No. of Caribou Observed Left Observer	Right Observer	Total no. Caribou
Stratum 4	**Z = 38,765 km² N = 137**			
1	228.0	80	39	119
13	192.0	0	0	0
16	289.6	22	9	31
17	284.0	25	9	34
20	328.0	111	109	220
21	261.6	168	81	249
23	177.6	15	32	47
Subtotal	1,760.8	421	279	700
Stratum 5	**Z = 26,670 km² N = 134**			
14	316.0	0	5	5
15	283.2	19	7	26
18	245.6	15	18	33
19	220.0	13	0	13
22	181.6	5	58	63
25	155.2	0	0	0
24	103.2	1	4	5
Subtotal	1,504.8	53	92	145
Stratum 6	**Z = 24,612 km² N = 87**			
i	208.0	0	28	28
4south	181.6	9	0	9
5south	300.0	5	24	29
8south	312.0	0	10	10
9south	328.0	0	4	4
Subtotal	1,329.6	14	66	80

Transect no.	Transect Area (km²)	No. of Caribou Observed Left Observer	Right Observer	Total no. Caribou
Stratum 7	**Z = 69,373 km² N = 205**			
1	326.4	12	50	62
4	284.0	119	88	207
5	184.0	126	95	221
ii	137.6	0	80	80
1	233.6	72	67	139
2	224.0	186	87	273
3	220.0	221	47	145
2	324.0	8	88	96
3	344.0	39	12	51
4north	236.0	0	16	16
5north	216.0	28	17	45
8north	166.4	2	28	30
9north	113.6	0	4	4
Subtotal	3,009.6	813	679	1,492
Stratum 8	**Z = 26,111 km² N = 100**			
6	388.8	--	--	--
7	334.4	--	--	--
10	174.4	0	0	0
11	171.2	0	0	0
12	190.4	0	0	0
Subtotal	536.0 (transects 6 & 7 not flown)	0	0	0
Stratum 9	**Z = 45,914 km² N = 240**			
6	298.4	11	24	35
7	240.8	30	39	69
8	403.2	39	111	150
9	113.6	0	0	0
10	104.8	5	0	5
11	84.8	0	0	0
12	140.0	8	22	30
13	144.0	8	23	31
14	153.6	0	33	33

Transect no.	Transect Area (km^2)	No. of Caribou Observed Left Observer	Right Observer	Total no. Caribou
15	201.6	12	30	42
16	212.0	52	124	176
Subtotal	2,096.8	165	406	571
	Σz = 14,686.4			**Σ y =3,357**

N = maximum no. of transects in the stratum
n = no. of transects surveyed
Z = stratum area
ΣZ = 341,876 km^2
ΣN = 1,347
Σn = 67