ABUNDANCE AND DISTRIBUTION OF PEARY CARIBOU AND MUSKOXEN ON BANKS ISLAND, NWT, JUNE 1991

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ABSTRACT

A strip transect aerial survey of Banks Island, NWT was flown between 27 June - 3 July 1991. The survey documented distribution and numbers of Peary caribou (Rangifer tarandus pearyi) and muskoxen (Ovibos moschatus). The total number of non-calf caribou observed on transect was 87, resulting in a population estimate of 888 ± 151 (SE of estimate). Densities varied from 0.01-0.02 (caribou/km^2). Mean group size, including calves, was 3.37 ± 1.65 (S.D.) overall. The proportion of calves to total classified was 5.4% (5/92). Caribou numbers have drastically declined from the 1970's.

A total of 4724 non-calf muskoxen were observed on transect resulting in a population estimate of 47,670 ± 3971 (SE of the estimate). This survey was not designed specifically for muskoxen and may overestimate numbers. Densities varied from 0.21-1.22 (muskoxen/km^2). Mean group size, excluding single animals but including calves, was 6.29 ± 5.06 (SD) overall. The proportion of calves to total number of animals classified was 14.5% (799/5523). Muskox numbers have increased since the 1970s.

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INTRODUCTION

Numbers of caribou (Rangifer tarandus pearyi) and muskoxen (Ovibos moschatus) have been monitored by aerial survey on Banks Island (70,028 km^2) since the 1970s. The caribou population was thought to be declining in the early 1980s although at a slow rate. The most dramatic decline in numbers occurred from 1987 to 1989 when only 2600 $\pm$ 340 were estimated (McLean and Fraser in prep.). Muskox numbers have increased from 3800 in 1973 (Urquhart 1973) to 34,225 $\pm$ 2360 in June 1989 (McLean and Fraser in prep.).

A strip transect survey was flown in June 1991 to monitor the status of the caribou and muskox populations.

METHODS

The aerial survey was conducted using methods similar to the 1989 Banks Island survey (McLean and Fraser in prep.). Methods differed slightly in that transect lines were spaced 10 km apart to provide 10% coverage (Figure 1) and strip width was 0.5 km on each side of the aircraft for a total transect width of 1.0 km.

A Cessna 185 and a Helio-Courier STOL (short takeoff and landing) equipped aircraft on tundra tires were used for the survey.

The population estimate was generated using a census data program based on Jolly (1969), method 2 for unequal sample sizes. Student's t-test was used to determine the probability of the 1991 population estimate differing in size from the 1989 estimate (Zar 1984, Gasaway et al. 1986). The statistical procedures to calculate the probability that a change occurred are provided in Appendix D.

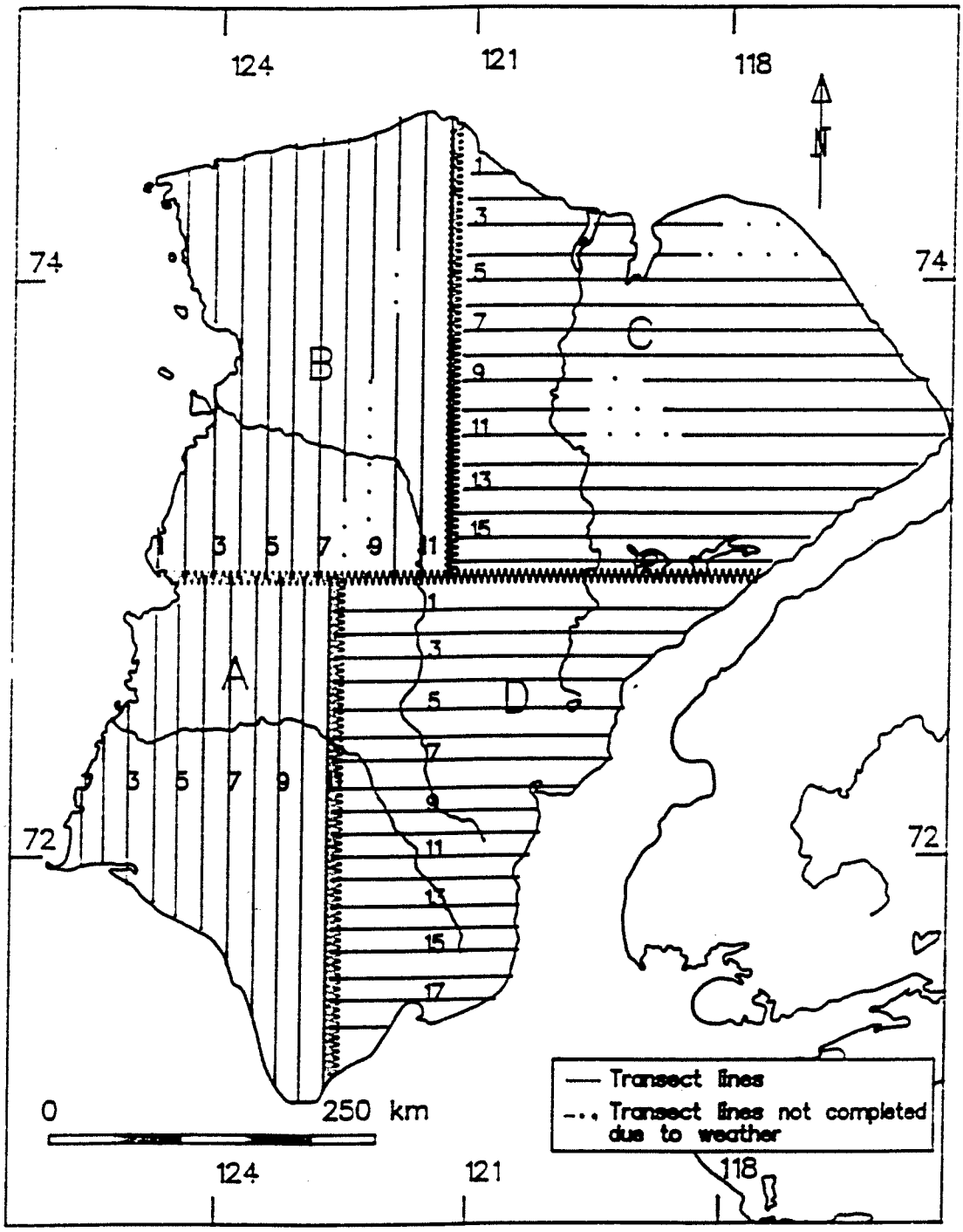

Figure 1. Transect lines and strata boundaries used during the caribou/muskox survey on Banks Island, NWT, June 1991.

RESULTS

The survey of the whole island was completed in approximately 75 h flying from 27 June - 3 July. The southern half of the island was 95% snow-free. The majority of the caribou were in light winter pelage and contrasted well with the bare ground. Snow was still present in the higher areas of the northwest and northeast portions of the island, percent coverage varying between 10-100%. Ground fog prevented some lines in the NW and NE strata from being surveyed completely (Figure 1). Surveying of the SE portion of the island (stratum D) was interrupted for 3 days because of bad weather while bad weather interrupted the surveying of the NE portion of the island (stratum C) for 1.5 days.

Caribou

A total of 87 non-calf caribou was observed on transect giving an estimate of 888 ± 150 (SE of the estimate, Table 1). Densities varied from 0.01-0.02 caribou/km^2 and mean group size was 3.37 ± 1.65 (n=16 groups). Including individual caribou and all groups for which calf and total counts were determined, the proportion of calves to total was 5.4% (5/93).

Six caribou carcasses were observed on transect during the survey. Extrapolating for the island produces an estimate of approximately 60 caribou carcasses (based on 10% coverage).

Table 1. Summary of survey information for Banks Island caribou, June 1991.

Stratum	Area (km2)	Population Estimate (S.E.)	CV	Density (/km2)	Mean group size (S.E.)	Calf/total %(n)
SW (A)	13317	169+47	0.28	0.01	3.60+0.80	0.05
NW (B)	15474	215+77	0.36	0.01	3.17+1.86	0.00
NE (C)	22301	101+44	0.44	0.00	3.00+1.00	0.00
SE (D)	18936	402+112	0.28	0.02	3.67+2.36	0.10
	70028	888+151	0.17		3.37+1.65	0.05

Muskoxen

A total of 5791 non-calf muskoxen were counted on transect resulting in a population estimate for the island of 47,670 ± 3971 (SE of the estimate, Table 2). Densities varied from 0.23-1.22 muskox/km^2 and mean group size (excluding single animals) was 6.29 ± 5.06 (n=766). Including individual muskoxen and all groups for which calf and total counts were determined, the proportion of calves to total was 14.5% (799/5523).

Eight muskoxen carcasses were counted on transect during the survey. Extrapolating to the whole island would give a rough estimate of 80 carcasses (10% coverage).

Table 2. Summary of survey information for Banks Island muskox, June 1991.

Stratum	Area (km2)	Population Estimate (S.E.)	CV	Density (/km2)	Mean group size (S.E.)	Calf/total %(n)
SW (A)	13317	16258+2818	0.17	1.22		0.15
NW (B)	15474	7951+1583	0.20	0.51		0.14
NE (C)	22301	19081+2159	0.11	0.86		0.14
SE (D)	18936	4380+809	0.18	0.23		0.15
	70028	47670+3971	0.08		6.29+5.06	0.14

DISCUSSION

The estimate clearly indicates a dramatic decline in numbers of caribou. The 1991 estimate of 888 ± 151 is significantly lower than the 1989 estimate (2600 ± 340, McLean and Fraser in prep., $t'=4.673$; $t_{0.05[1]36}=1.688$). The reason for the decline remains unclear but hunting, wolf predation and winter weather are important factors (McLean and Fraser in prep.). The percent calves in 1991 was the lowest recorded during aerial surveys (Table 3). Low calf percentages may be indicative of low pregnancy rates and/or high calf mortality. The population would not increase with such a low calf increment.

The muskox estimate should be considered with caution. This survey was not intended to generate a muskox population estimate. Although high density muskox areas have been identified in strata A,B, and C from previous surveys, these areas were not flown at higher coverage during this survey. Without stratifying the high density areas, estimates within these strata are elevated which in turn inflates the population estimate for the island. The 1989 unstratified muskox population estimate (41,000 ± 5470, C.V. 0.13) was 19.6% higher than the stratified estimate (34,270 ± 2360, C.V. 0.069; McLean and Fraser in prep.).

Table 3. A comparison of caribou calf percentages during aerial surveys on Banks Island, NWT, 1970 - 1991.

Date	% Calves	Sample Size	Reference
06/1970	19.0	1078[1]	Kevan 1974
06/1971	27.9	-[2]	Urquhart 1973
06/1972	14.3	-[2,3]	Urquhart 1973
07/1982	25.0[4]	1491	Latour 1985
07/1985	15.4	980	McLean et al. 1986
07/1987	22.4	557	McLean in prep.
06/1989	25.5	462	McLean and Fraser in prep.
06/1991	5.4	93	This study

1 Northern Banks Island only.
2 Not given in the report.
3 Calving still in progress.
4 Estimated from report, not calculated by Latour.

RECOMMENDATIONS

1. Conduct a strip transect aerial survey in 1993 for caribou and muskox using the same methods as in 1991.

2. The subsistence harvest of caribou in Sachs Harbour should be reduced or curtailed completely to allow the caribou population to recover.

3. Conduct age and sex composition counts for caribou. Information on calf survival and adult sex ratios is lacking. Ground counts could be attempted in the late fall when caribou are close to Sachs Harbour.

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Appendix A. Survey schedule and costs, Banks Island, NWT June 1991.

Date	Location	Hours flown	Weather
26 June	Sachs Harbour (2 planes)	11.1 (ferry)	overcast
27 June	stratum A,B	17.5	overcast,4oC
28 June	stratum A,B,C	13.4	overcast,4oC
29 June	stratum A,C	8.5	CAVU, 10oC
1 July	stratum B,C	7.9	ground fog
2 July	stratum C	4.0	ground fog
3 July	stratum C,D	17.9	hi scattered,4oC
4 July	Inuvik	4.0 (ferry)	overcast
COSTS (x$1000)	Air charters	25.7	
	Fuel (1990)	6.8	
	Barge (1990)	1.5	
	Fuel caching	15.0	
	Accommodation	4.0	
	Casual	2.4	
	TOTAL	55.4	

Appendix B. Number of caribou observed on transect on Banks Island, NWT. June 1991

Str	Trans. Line	Area (km^2)	Left Observer Non-calf	Left Observer Calf	Right Observer Non-calf	Right Observer calf	Total
A	1	33.75	0	0	0	0	0
	2	49	0	0	0	0	0
	3	70.75	0	0	0	0	0
	4	117.5	0	0	1	0	1
	5	126.25	0	0	3	0	3
	6	140.75	0	0	0	0	0
	7	155	5	0	0	0	5
	8	175	0	0	0	0	0
	9	205	3	0	0	0	3
	10	218.5	4	0	0	0	4
	11	207.5	3	1	0	0	3+1
Subtotal		1499	15	1	4	0	19+1

Str	Trans. Line	Area (km^2)	Left Observer Non-calf	Left Observer Calf	Right Observer Non-calf	Right Observer Calf	Total
B	1	13.5	0	0	0	0	0
	2	60	0	0	0	0	0
	3	116.5	0	0	0	0	0
	4	157	0	0	0	0	0
	5	157	0	0	5	0	5
	6	160.5	0	0	0	0	0
	7	160	0	0	4	0	4
	8	177.5	0	0	3	0	3
	9	89.5	0	0	0	0	0
	10	152	7	0	0	0	7
	11	172.5	0	0	0	0	0
	12	166.5	3	0	0	0	3
Subtotal		1582.5	10	0	12	0	22

Appendix B (cont'd)

Str	Trans. Line	Area (km^2)	Left Observer Non-calf	Left Observer Calf	Right Observer Non-calf	Right Observer Calf	Total
C	1	15.5	0	0	0	0	0
	2	30	0	0	0	0	0
	3	93	0	0	2	0	2
	4	75	0	0	0	0	0
	5	127.5	0	0	0	0	0
	6	144.75	4	0	1	0	5
	7	153.5	1	0	0	0	1
	8	162.5	0	0	0	0	0
	9	105.5	0	0	0	0	0
	10	147.5	0	0	0	0	0
	11	156.25	0	0	0	0	0
	12	174.25	0	0	0	0	0
	13	160	0	0	0	0	0
	14	143.25	0	0	0	0	0
	15	135	0	0	0	0	0
	16	118.25	1	0	0	0	1
Subtotal		1941.75	6	0	3	0	9

Str	Trans. Line	Area (km^2)	Left Observer Non-calf	Left Observer Calf	Right Observer Non-calf	Right Observer Calf	Total
D	1	156.25	0	0	1	0	1
	2	142	7	2	0	0	7+2
	3	136.5	0	0	2	0	2
	4	122	1	0	2	0	3
	5	115	0	0	7	0	7
	6	115.5	0	0	0	0	0
	7	112.5	2	0	4	1	6+1
	8	106	0	0	0	0	0
	9	84.5	2	0	5	1	7+1
	10	83.75	0	0	1	0	1
	11	81.75	0	0	0	0	0
	12	75	0	0	0	0	0
	13	77.5	0	0	0	0	0
	14	76.5	0	0	2	0	2
	15	77.5	0	0	0	0	0
	16	77.5	0	0	1	0	1
	17	71.25	0	0	0	0	0
	18	31.25	0	0	0	0	0
Subtotal		1742.25	12	2	25	2	37+4

Appendix C. Number of muskoxen observed on transect on Banks Island, NWT June 1991.

Str	Trans. Line	Area (km^2)	Left Observer Non-calf	Left Observer Calf	Right Observer Non-calf	Right Observer Calf	Total
A	1	33.75	0	0	0	0	0
	2	49	6	2	0	0	6+2
	3	70.75	3	0	1	0	4
	4	117.5	21	1	26	2	47+3
	5	126.25	21	2	22	7	43+9
	6	140.75	113	5	81	20	4+35
	7	155	92	11	67	8	159+19
	8	175	164	26	202	45	366+71
	9	205	186	33	164	29	350+62
	10	218.5	213	31	161	40	374+71
	11	207.5	168	26	119	23	287+49
Subtotal		1499	987	147	843	174	1830+321

Str	Trans. Line	Area (km^2)	Left Observer Non-calf	Left Observer Calf	Right Observer Non-calf	Right Observer Calf	Total
B	1	13.5	0	0	1	1	1
	2	60	7	0	4	1	11+1
	3	116.5	5	0	1	0	6
	4	157	40	8	27	4	67+12
	5	157	37	5	33	4	70+9
	6	160.5	54	9	32	3	86+12
	7	160	8	3	41	8	49+11
	8	177.5	13	0	48	6	61+6
	9	89.5	0	0	4	0	0
	10	152	75	16	79	10	154+26
	11	172.5	139	31	49	8	188+39
	12	166.5	57	10	45	4	102+14
Subtotal		1582.5	435	82	364	48	799+130

Appendix C (cont'd)

Str	Trans. Line	Area (km^2)	Left Observer Non-calf	Left Observer Calf	Right Observer Non-calf	Right Observer Calf	Total
C	1	15.5	10	0	12	3	22+3
	2	30	29	8	29	5	58+13
	3	93	30	9	44	4	74+13
	4	75	45	11	69	10	114+21
	5	127.5	82	16	87	10	169+26
	6	144.75	153	37	94	12	247+49
	7	153.5	80	18	86	14	166+32
	8	162.5	65	8	36	4	101+12
	9	105.5	56	10	115	16	171+26
	10	147.5	79	10	126	16	205+26
	11	156.25	65	11	42	7	107+18
	12	174.25	29	5	64	10	93+15
	13	160	35	3	16	4	51+7
	14	143.25	60	3	17	3	77+6
	15	135	19	5	11	1	30+6
	16	118.25	1	0	6	2	7+2
Subtotal		1941.5	838	154	854	121	1692+275

Str	Trans. Line	Area (km^2)	Left Observer Non-calf	Left Observer Calf	Right Observer Non-calf	Right Observer Calf	Total
D	1	156.25	8	1	27	4	35+5
	2	142	2	0	15	2	17+2
	3	136.5	13	2	20	3	33+5
	4	122	9	0	11	2	20+2
	5	115	0	0	1	0	1
	6	115.5	0	0	9	3	9+3
	7	112.5	3	1	12	2	15+3
	8	106	19	2	18	6	37+8
	9	84.5	11	2	16	3	27+5
	10	83.75	13	1	15	2	28+3
	11	81.75	8	0	8	0	16
	12	75	4	1	10	2	14+3
	13	77.5	0	0	4	2	4+2
	14	76.5	5	0	2	0	7
	15	77.5	21	4	0	0	21+4
	16	77.5	23	5	13	5	36+10
	17	71.25	28	6	46	11	74+17
	18	31.25	0	0	9	1	9+1
Subtotal		1742.25	167	25	236	48	403+73

APPENDIX D. Statistical procedures used to calculate the Student's t-test (Gasaway et al. 1986).

The Student's t-test is used to make two types of tests, one-tailed and two-tailed tests, that detect if changes in population size are statistically significant. Two-tailed tests are used to detect a change, if it occurred, in either direction, i.e. increase or decrease. One-tailed tests detect change in a specific direction.

a) Hypotheses for a one-tailed test to test for a decrease in population size are:

H_o: The population size has not decreased, i.e. $T_1 \leq T_2$
H_a: The population size has decreased, i.e. $T_1 \geq T_2$
Reject H_o in favour of H_a if $t' \geq$ than t_{table}.

Calculated t-statistic is:

$$t' = \frac{T_1 - T_2}{\sqrt{V(T_1) + V(T_2)}}$$

where t' = calculated t-statistic
T_1 = population estimate at year 1
T_2 = population estimate at year 2
$V(T_1)$ = variance of T_1 population estimate
$V(T_2)$ = variance of T_2 population estimate

An estimate of the number of degrees of freedom (v_t) associated with the test statistic, t', is calculated as:

$$v_t = \frac{[V(T_2) + V(T_1)]^2}{\frac{V(T_2)^2}{v_{T2}} + \frac{V(T_1)^2}{v_{T1}}}$$

where v_t = degrees of freedom associated with the test statistic, t'
v_{T1} = degrees of freedom of T_1 population estimate
v_{T2} = degrees of freedom of T_2 population estimate

b) Hypotheses for a one-tailed test to test for an increase in population size are:

H_o: The population size has not increased, i.e. $T_1 \geq T_2$
H_a: The population size has increased, i.e. $T_1 < T_2$
Reject H_o in favour of H_a if $t' \geq$ than t_{table}.

Calculated t-statistic is:

$$t' = \frac{T_2 - T_1}{\sqrt{V(T_1 + V(T_2)}}$$

t-test for significance of Banks Island caribou/muskox population estimates

	caribou	muskox
T1 population estimate in year 1	2600	34226
T2 population estimate in year 2	888	47670
V1 (variance of T1)	111446	5566449
V2 (variance of T2)	22790	15766279
v1 (degrees of freedom)	26	28
v2 (degrees of freedom)	31	33
t' (test statistic)	4.672714	2.910752
vt (degrees of freedom of t')	36.44277	52.67671
t(.05,[2],vt)	2.028	2.007
t(.05,[1],vt)	1.688	1.675