PEARY CARIBOU AND MUSKOXEN ON MELVILLE AND BYAM MARTIN ISLANDS, NORTHWEST TERRITORIES, JULY 1987

Frank L. Miller

Technical Report Series No. 37
Western & Northern Region 1988
Canadian Wildlife Service

This series may be cited as:

Miller, F.L. 1988. Peary caribou and muskoxen on Melville and Byam Martin islands, Northwest Territories, July 1987. Technical Report Series No. 37. Canadian Wildlife Service, Western & Northern Region, Alberta.

Issued under the Authority of the
Minister of Environment
Canadian Wildlife Service

Catalogue No. CW69-5/37E
ISBN 0-662-16023-1
ISSN 0831-6481

Copies may be obtained from:

Canadian Wildlife Service
Western & Northern Region
Room 210, Twin Atria #2
2nd Floor
4999 - 98 Avenue
Edmonton, Alberta
Canada
T6B 2X3

ABSTRACT. An aerial survey to determine numbers and distributions of Peary caribou (Rangifer tarandus pearyi) and muskoxen (Ovibos moschatus) was flown between 1 and 22 July 1987. The survey area included Melville and Byam Martin islands, Northwest Territories, in the Canadian Archipelago. A systematic unbounded line transect survey was flown at about 90 m above ground level along transects at 6.4-km intervals, for an overall coverage of about 27%. The survey aircraft was a Bell-206B turbo-helicopter on high-skid gear, equipped with an Omega/VLF Navigation System. A four-person survey crew was used. We observed 418 caribou and 2855 muskoxen on Melville Island and 90 caribou and 70 muskoxen on Byam Martin Island. Numbers of caribou and muskoxen were estimated at about 943 and 5652 on Melville and 98 and 100 on Byam Martin, respectively. Overall estimated mean density for all caribou was 2.2 caribou/100 km^{-2} on Melville and 8.4 caribou/100 km^{-2} on Byam Martin and for all muskoxen was 13.4 muskoxen/100 km^{-2} on Melville and 8.6 muskoxen/100 km^{-2} on Byam Martin. Caribou calves represented 19.4% of all caribou seen on Melville and 18.9% of all caribou seen on Byam Martin. Muskox calves represented 15.2% of all muskoxen seen on Melville and only 2.9% of all muskoxen seen on Byam Martin. Muskoxen have increased markedly within the 1987 two-island survey area by about 140% from 1974. Peary caribou have continued to decline markedly in number within the 1987 survey area by about a further 39% from 1974 and an overall 92% from 1961. The number of Peary caribou summering within the 1987 survey area would not safely support essentially any significant level of sustained annual harvest; especially, if it involved the removal of breeding age females.

RÉSUMÉ. Entre le 1er et le 22 juillet 1987 on a effectué un inventaire aérien afin de déterminer le nombre et la distribution des populations de caribous de Peary (Rangifer tarandus pearyi) et de boeufs musqués (Ovibos moschatus). Le territoire d'étude comprenait les îles Melville et Byam Martin, aux Territoires du Nord-Ouest, dans l'archipel canadien. A 90 m du sol, on a parcouru un transect linéaire non-interrompu a 6,4 km d'intervalle, pour une couverture totale d'environ 27 %. L'aéronef utilisé était le Bell 206B, un hélicoptere sur patins surélevés muni d'un équipment de radionavigation de type Omega/VLF. Une équipe de quatre personnes a effectué l'inventaire. Nous avons observé 418 caribous et 2 855 boeufs musqués sur l'ile Melville et 90 caribous et 70 boeufs musqués sur l'ile Byam Martin. On a estimé le nombre de caribous et de boeufs musqués a 943 et 5 652, respectivement, sur l'ile Melville et a 98 et 100 sur l'ile Byam Martin. La densité moyenne de la population totale de caribous a été évaluée a 2,2 animaux par 100 km^{-2} sur Melville et a 8,4 animaux par 100 km^{-2} sur Byam Martin. Dans le cas des boeufs musqués, la densité moyenne était de 13,4 animaux par 100 km^{-2} sur Melville et de 8,6 par 100 km^{-2} sur Byam Martin. Les nouveau-nés constituent 19,4 % de tous les caribous observés sur Melville et 18,9 % de tous les caribous sur Byam Martin. Ils représentent 15,2 % de tous les boeufs musqués observés sur Melville et seulement 2,9 % de tous ceux vus sur Byam Martin. Sur les deux îles du territoire de l'étude en 1987, on a constaté un accroissement marqué de la population de boeufs musqués (140 %) par rapport a 1974. Dans le territoire de l'étude en 1987, on a noté un fléchissement du nombre de caribous de Peary, qui est tombé de 39 % depuis 1974 et de 92 % au total depuis 1961. Le nombre de caribous de Peary estivant dans le territoire de l'inventaire en 1987 ne tolérerait pas de récolte importante soutenue sans que la population en soit affectée, surtout si les femelles en age de se reproduire étaient prises.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF TABLES (Continued)

LIST OF FIGURES

LIST OF APPENDICES

INTRODUCTION

Peary caribou (Rangifer tarandus pearyi) once ranged over the Canadian Arctic Archipelago and sections of Greenland (Banfield 1961). Currently, however, Peary caribou are restricted to Canada, having died out in Greenland (Meldgaard 1986). Thus, the Peary caribou is now a unique form of wildlife in the natural heritage of arctic Canada.

Numbers of Peary caribou on the islands of the Canadian Arctic Archipelago declined drastically from, at least, 1961 (Tener 1961, 1963) to 1974 (Miller et al. 1977a). In 1979 the Canadian Committee on the Status of Endangered Wildlife in Canada (COSEWIC) recognized the Peary caribou as a "Threatened" form of wildlife in Canada. The designation as "Threatened" was based on a Canadian Wildlife Service report to the committee (Gunn, Miller, and Thomas, COSEWIC, 1979; or see Gunn et al. 1981). Recognition of Peary caribou as a "Threatened" form of wildlife makes their conservation and preservation a responsibility of Environment Canada and more specifically the Canadian Wildlife Service under the Canada Wildlife Act.

The muskox (Ovibos moschatus) was designated as an "Endangered" form of wildlife in Canada by Order-in-Council in 1962, although numbers of muskoxen recently have increased markedly on the southern tier of islands in the Canadian Arctic Archipelago (essentially south of 74°N) and on mainland ranges. Also, numbers of muskoxen on the islands north of 74°N in the High Arctic declined drastically during the severe winter of 1973-74 (Miller et al. 1977a). Recovery was not documented prior to 1987; therefore, as muskoxen occur in association with Peary caribou in the High Arctic they were also monitored with Peary caribou, when possible, by the Canadian Wildlife Service.

Peary caribou and muskoxen essentially are the sole source of fresh red meat from terrestrial animals for Inuit in the Canadian High Arctic; and most Inuit prefer the meat of caribou to muskoxen. The annual replacement value of that fresh meat would represent an appreciable yearly cost to the federal government. Thus, both significant economic and intangible values are associated with conserving Peary caribou and muskoxen at usable population levels.

The Canadian Wildlife Service, especially because of its concern for Peary caribou, initiated a 3-yr aerial survey program to evaluate the current statuses of Peary caribou and muskoxen in the Canadian High Arctic. Due to limited resources, the planned aerial surveys are restricted to Melville, Bathurst, Prince Patrick, Eglinton, and Lougheed islands (and some of their small satellite islands). These Queen Elizabeth Islands are the ones which previously supported the greatest numbers of Peary caribou, when first surveyed by air in 1961 (Tener 1963). The following is a progress report of the third and final year's results obtained from aerial surveys of Melville and Byam Martin islands, Northwest Territories, July 1987.

SURVEY AREA

1. Islands

The Queen Elizabeth Islands surveyed in July 1987 lie between latitudes 74° and 77°N and longitudes 103° and 118°W (Fig. 1). Total landmass of the islands surveyed is about 43 380 km^2. Most (55.8%) of the landmass of Melville Island and all of Byam Martin Island lie below 150 m above mean sea level (amsl). However, the topography of the eastern half (55.7%, survey strata I-VI) of Melville differs greatly from that of the western half (44.3%, survey strata VII-XIII) of the island. Eastern Melville is mostly low-lying and mainly (72.6%) below 150 m amsl. The high ground on eastern Melville is essentially all (99.3%) below 300 m amsl. Western Melville is mostly high ground and mainly (65.4%) above 150 m amsl. Also, most (53.1%) of the high ground on western Melville is above 300 m amsl.

1.1. Melville Island

Melville is the largest (42 220 km^2) and most rugged of the western islands in the Queen Elizabeth group (Fig. 1). It is the most southerly of the western Queen Elizabeth Islands and is irregular in shape with deep inlets dividing the island into a series of peninsulas.

Eastern (strata III, 1940 km^2 and IV, 7260 km^2), central (Stratum V, 4560 km^2) and northwestern Melville (strata VIII, 5100 km^2 IX, 3330 km^2; XI, 1670 km^2; and XII, 1400 km^2) are a series of ridges and plateaus developed on folded Palaeozoic rocks (Thorsteinsson and Tozer 1960, Tozer and Thorsteinsson 1964). The area is varied but in general the eastern part is lower although more intensely folded than the western uplands (Dunbar and Greenway 1956). The Blue Mountains on the west coast (Stratum XIII, 4770 km^2) reach the maximum elevation on Melville of about 1000 m above sea level. The western uplands have four permanent snowfields totalling 335 km^2 in area (Bird 1967). The flat-topped ridges of the western uplands are most notably developed in the Canrobert Hills (Stratum XI) reaching an elevation of 594 m, and forming steep sea cliffs with a fiord-type coast (Bird 1967).

High sea cliffs also border part of southwestern Melville (strata XIII and VII, 1030 km^2), an area of high plateau country with many deep narrow ravines. To the south, across Liddon Gulf, is the Dundas Peninsula (Stratum VI, 5100 km^2), an area of dissected plateau (Tozer and Thorsteinsson 1964).

Northwestern (Stratum X, 1390 km^2) and northeastern (strata I, 2940 km^2 and II, 1730 km^2) Melville are areas of lowland. The lowlands are not featureless, however; strata dip forming several prominent steep faced hills in both areas, and the central part of the Sabine Peninsula (strata I and II) is an island plateau.

1.2. Byam Martin Island

Byam Martin, 1160 km^2, is a continuation of the anticlinal area of east-central Melville, eroded to an almost featureless peneplain, less than 150 m in elevation. The coast is low except for two hills on the east coast and one hill on the south coast that reach about 100 m above sea level.

2. Weather

The climate of the survey area is characterized by long cold winters, short cool summers and low precipitation. Air temperatures average below -17.7°C from December to March. Mean daily temperatures do not rise above 0°C until after 1 June on the extreme south of the survey area, and 15 June on the rest of the survey area (Meteorological Branch 1970). The snow cover usually starts to melt in early June, and rapidly dissipates to bare ground by mid June, except for snowbanks in sheltered sites (Potter 1965). However, extensive snow covered areas do persist into the first week of July in some years. Summer is the period when the ground is generally snow free, and lasts from the beginning of July to the end of August. Winter starts when the mean daily temperature falls below 0°C usually about 15 September. September and October are the stormiest months and much of the annual snowfall may occur in those months. From December to March anticyclones dominate the weather causing frequent calms, clear skies and light snowfall.

An east-west gradient of weather across the western and central Queen Elizabeth Islands appeared evident for the 1970s from weather records collected at Mould Bay, Prince Patrick Island, and Resolute Bay, Cornwallis Island, and empirical observations (Miller et al. 1977a). Unfortunately the absence of long-term weather records from Melville allows only an extrapolation of weather from Mould Bay and Resolute Bay to describe weather on Melville. Subjective observations suggest the weather of eastern Melville is most similar to that recorded at Resolute Bay. Thompson (1971) compared 1 year's weather data from the National Museum of Science research station in Polar Bear Pass on central Bathurst Island to data from Resolute Bay. Her results suggested that the differences in thes weather between the two locations were the result of the research station' inland site and local topographical effects. Mould Bay tends to have cooler, drier and less stormy weather than Resolute Bay (Maxwell 1981).

The amount and duration of snow cover, especially in spring, are critical to arctic ungulates, but also critical are the types of snow cover and incidences of freezing rain. Wind removes the snow from exposed slopes and redeposits it as shallow but hard compacted cover and drifts in more sheltered and relatively well-vegetated sites. Freezing rain in autumn which results in ground-fast ice before snow cover accumulates; ice layering in the snow, crusting of the snow; and especially the formation of ground-fast ice in spring (e.g., Miller et al. 1982) compounds the stress of forage unavailability on arctic ungulates. Unfortunately

neither the type of snow cover nor the incidence of ground-fast ice or ice layering is available for the Queen Elizabeth Islands.

METHODS

1. Aircraft

A Bell-206B (Jet Ranger) turbo-helicopter on high-skid gear was used as the survey aircraft. The helicopter was equipped with an Omega/VLF Navigation System.

2. Observers

I used a 4-person survey crew: pilot-navigator-spotter (right front seat); navigator-spotter (left front seat); and a left and a right rear seat observer. The survey crew communicated by use of a voice activated intercommunication system. The helicopter pilot navigated the line transects with the aid of the Omega/VLF Navigation System, making occasional visual reference checks with the 1:250 000 topographical maps. The navigator-spotter navigated visually with the 1:250 000 map sheets; recorded the location of each observation by consecutive numbering (within each stratum) directly onto the map sheet; and called out the number for each observation to the rear seat observers. Both the pilot and the navigator also served as spotters and alerted the rear seat observers to the sighting of animals. If one of the rear seat observers was first to see animals, he called out his sighting to alert the other crew members. The rear seat observer on the side of the helicopter where the animals were located recorded the details of the observation in a field notebook: (1) date; (2) stratum number; (3) transect number; (4) observation number; (5) degrees of angle of depression obtained with hand held clinometer; (6) species and composition of animals sighted, as bulls, calves, and/or others (cows, juveniles, yearlings); and (7) remarks, if any. The animal(s) sighted were circled, if necessary, to determine their number and/or sex and age composition (all 4 crew members participated in the determinations).

3. Omega/VLF Navigation System

The Omega/VLF Navigation System (ONS) is an automatic, computerized, earth-orientated navigational system (Canadian Marconi Company). The ONS uses signals from the network of Omega navigation transmitters and from selected United States Navy very low frequency (VLF) communications stations, when applicable, to provide continuous position and navigation information. I used the ONS to fly standard line transects (north-south) by the "cross track" method; and "deadheading" courses between predetermined points by the "waypoint coordinates" method (details available in Canadian Marconi Company. 1983. Operators guide (Part I System description). Publication No. 734/740/771-GEN-0319. 26 pp. and Canadian Marconi Company. 1983. Operators guide (Omega Navigation System CMA-734/740/771 Part II Operational program). Publication No. 734/740/

771-GEN-0101. 56 pp. Canadian Marconi Company, Avionics Division, 2442 Trenton Avenue, Montreal, Quebec, Canada H3P 1Y9).

4. Altitude

Altitude above ground level was maintained, as best possible, at about 90 m above ground level (agl) during the survey. Altitude was measured with a standard aviation altimeter (pressure type) in units of 6.1 m (20 ft).

5. Helicopter Speed

The air speed of the helicopter was held at about 160 $km \cdot h^{-1}$. Air speed was read from the aircraft air speed indicator.

6. Angle Of Animal(s) Sighting

Each angle from the animal(s) to the helicopter was indirectly measured in degrees with a hand held clinometer (Suunto Co., Helsinki, Finland). The actual angle obtained was the angle of depression from the horizontal plane of the inflight helicopter to the animal(s) (Fig. 2). Thus, when the height of the helicopter is supposedly known; distance along a horizontal plane (supposedly at ground level) to the animal(s) from the point where the vertical projection of the centre of the helicopter theoretically touches the ground can be obtained from the simple trigonometric function involving the tangent of an acute angle.

Given

(1) A right-angled triangle (ACB) is formed by joining (A) the helicopter, (B) the location of the animal(s) on the ground, and (C) the intercept of a horizontal plane from (A) with a vertical leg from (B) (Fig. 2).

(2) Side (CB) (Fig. 2) = (a) = vertical distance from animal(s).

(3) Side (AC) (Fig. 2) = (b) = horizontal distance from helicopter.

(4) Hypotenuse (AB) (Fig. 2) = (c) = diagonal leg from helicopter.

(5) Alpha (α) angle (BAC) is the acute angle of depression measured with a hand held clinometer by an observer (Fig. 2).

Assumptions

(1) Length (a) (Fig. 2) is equal to the height of the helicopter above ground level.

(2) Length (b) (Fig. 2) is equal to the horizontal distance from the helicopter to the animal(s).

Since $\text{Tangent } \alpha = \frac{a}{b}$

Therefore $b = \frac{a}{\text{Tan } \alpha}$

7. Survey Design

I used a systematic, unbounded line transect type, aerial survey to obtain numbers and distributions of Peary caribou and muskoxen. Evenly spaced north-south line transects were drawn directly onto 1:250 000 topographical map sheets at about 6.4-km or 3.2-km intervals over each of the 14 strata, originating from baselines at 111°00'W and 105°00'W, (App. 1 and 2). Selection of a baseline was done mainly as a technical consideration to allow connection of each cross (+) indicator at each 15 minutes of one degree of latitudinal change along that meridian to maximize the subsequent accuracy of ruling off transect lines. These indicators appear as crosses (+) for each 15 minutes of latitude and each full degree of longitude in a grid pattern over each entire 1:250 000 Geological Survey of Canada topographical map sheet.

Melville Island was divided into 13 survey land strata after Miller et al. (1977a) on Geological Survey of Canada 1:250 000 topographical map sheets (Fig. 1). The area of each stratum was determined with a planimeter. The whole of Byam Marin Island was treated as only one survey stratum.

Hereinafter "eastern Melville" and "western Melville" will always refer collectively to survey strata I-VI and survey strata VII-XIII, respectively.

8. Measurements And Units

An array of measurement units was employed and had to be converted to the metric system. (1) The Omega/VLF Navigation System gives distance readouts in "international nautical miles": one international nautical mile (hereafter referred to simply as a 'nautical mile') equals 1851.999 m (6,076.115 ft) or 1852 m. (2) The air speed indicator in the Bell 206B helicopter gives readings in "U.S. statute miles: one U.S. statute mile (hereafter referred to simply as a 'mile') equals 1609.344 m (5,280 ft) or 1609 m. (3) The Geological Survey of Canada topographical maps used in this work are scaled in imperial inches (hereafter referred to simply as 'inches'). The maps are at a scale of 1:250 000; therefore, each 2.54 cm (1 inch) equals 6350 m.

The smallest increment of transect length was measured from 1:250 000 topographical map sheets in units of 0.0625 inches (0.159 cm).

Then the total length of each transect in inches was multiplied times 6350 m (value of 1-inch in metres at 1:250 000 scale) and divided by 1000 to obtain distance in kilometres. Each resultant value of transect length (distance in km) was then rounded off to three places beyond the decimal point and multiplied by the appropriate transect width in kilometres (all values taken to three places beyond the decimal point) to obtain transect area (km^2).

Intervals between transects were first measured on 1:250 000 topographical maps in inches (smallest unit, 0.0625 inches); then resultant values were converted to kilometres by multiplying by 6350 m, dividing by 1000, and rounding to three places beyond the decimal point.

9. Statistical Methods

Density and population estimates as well as their variance estimates and 95% confidence intervals were made for both caribou and muskox populations in all survey strata. The probability $P < 0.05$ was the level of acceptance for significant relationships reported in this study.

The following symbols are used in the estimation procedures that follows:

N = the number of possible transects in the survey area.
n = the number of these N transects that are sampled.
f = n/N, the sampling fraction.

y_i = the number of animals counted on the ith sampled transect.

x_i = the area of the i'th sampled transect.

Y = the true population of animals in the survey area.

$\overline{Y}$ = the mean number of animals per transect on all N transects.

$\overline{X}$ = the mean area of all transects.

A = total area.

R = the true mean density of animals in the survey area, $R = \overline{Y}/\overline{X}$.

$d_i = y_i - \hat{R}x_i$ where $\hat{R}$ is an estimator of R.

The standard estimator for the true mean density R is the ratio estimate:

$$\hat{R} = \frac{\sum_{i=1}^{n} y_i/n}{\sum_{i=1}^{n} x_i/n} = \frac{\sum_{i=1}^{n} y_i}{\sum_{i=1}^{n} x_i} = \frac{\bar{y}}{\bar{x}}$$

where $\bar{y}$ = the mean count of animals on the sampled transects,
$\bar{x}$ = the mean area of the sampled transects.

Following the methods described by Kingsley and Smith (1981) an estimate of the variance of R is found by:

$$\hat{V}(R) = (1 - f) \frac{\sum_{i=1}^{n-1} (d_i - d_{i+1})^2}{2n\,(n-1)\bar{x}^2}$$

The estimate of the true population Y is found by multiplying the density estimate by the total area under consideration, that is: $\hat{Y} = \hat{R} \cdot A$ and the estimate of the variance of Y is obtained by multiplying the variance estimator of R by the square of the survey area.

$$\hat{V}(Y) = [A^2 \cdot \hat{V}(R)].$$

Confidence intervals (95%) for the true density and the true population total are given by:

$$R: \quad \hat{R} \pm t_{\frac{\alpha}{2},\, n-1} \sqrt{\hat{V}(R)}$$

$$Y: \quad \hat{Y} \pm t_{\frac{\alpha}{2},\, n-1} \sqrt{\hat{V}(Y)}$$

Observations of caribou or muskoxen with measured angles (to the nearest whole degree) below the horizon of 6° or more were considered to be "on transect" and were used to calculate the estimates. Observations with measured angles of 5° or less were considered "off transect" and were not included in the above analysis.

10. Definitions Of Terms Or Style

10.1. On transect

In this report all animals seen "on transect" are those animals that were seen within a strip width of 857 m on either side of the helicopter. The location of animals within that strip width was determined by the observer by reading an angle of depression of 6° or more

with the hand held clinometer. The 857-m-wide strip from each side of the helicopter was combined for a maximum feasible strip width of 1.714 km.

10.2. Off transect

In this report all animals seen "off transect" are those animals that were further than 857 m from either side of the helicopter and those animals seen while the helicopter was making the turn between transect lines. The position of the "off transect" animals was determined by the observer reading an angle of depression of 5° or less with the hand held clinometer or the helicopter being in the off transect portion of the turn between two transect lines.

10.3. On survey

In this report animals seen "on survey" are all of the animals seen by the observers while the helicopter was flying along the line transects or in the turn between any two transects. This condition excludes all animals seen while the helicopter was otherwise flying to or from the line transects (that is, flying to or from fuel caches or the base camp).

10.4. Off survey

In this report all animals seen "off survey" are those animals seen while the helicopter was otherwise flying to or from fuel caches or the base camp (excludes all animals seen on survey lines and turns).

10.5. Sex/age classification

Recognition of muskoxen was restricted to bulls, calves, and others. No special effort was made to separate cows from juveniles and no attempt was made to continually identify yearlings.

Peary caribou were recognized and classified by sex/age class as follows.

10.5.1. "Bulls" (mature males, assumed 4+ yr-old) are recognized by the relatively large size and advanced development of their new antler growth, which is exaggerated by the presence of velvet on the antlers. Diagnostic characteristics of the antler growth include the large diameter of the main beams: the long, posteriorly curved main beams; and the presence of well-developed, anteriorly directed brow or bez tines. Secondary characteristics include large body size, relatively large head size; and presence of new pelage, especially on the lateral parts of the body and on the face. When the caribou under consideration exhibits male-like antler growth, the following exercise is used to distinguish bulls from juvenile males. The observer makes a mental evaluation of the length of the new antler growth present in relation to the length of the animal's head (from crown of skull to tip of nose). If the impression received is that the

antler growth is longer than the head - the animal is classified as a bull; and if shorter than the head - a juvenile male.

10.5.2. "Cows" (mature females, assumed 3+ yr-old) are recognized by the retention of hard antlers from the previous year or the absence of antlers and any new growth of antlers. In some few cases, minor new growth on the simple main beams has begun (such new growth most likely occurs among individuals just coming of age or possibly some few older cows that maintained better physical condition because they did not have the added burden of carrying a fetus and nursing a calf in the current year). Cows, especially those that produced a calf in the current year, still retain much of their previous winter's pelage and have a faded, lifeless, often patchy appearance about them (relative to other sex/age classes in July). The general drab appearance of a successful maternal cow often remains clearly recognizable into August of the year.

10.5.3. "Juvenile males" (males, assumed 1-3 yr-old) are recognized by their new pelage and their advance, well-developed, but relatively small (when compared to bulls) new antler growth. Also, their relatively small body size (especially that of yearlings), when compared to adults, aids in their separation from bulls and cows.

10.5.4. "Juvenile females" (females, assumed 1-3 yr-old) are recognized by their new pelage, new antler growth, and relatively small body size (particularly yearlings). They are separated from juvenile males by the new antler growth appearing shorter than the ears and being restricted to small spike-like main beams or at the most, small main beams with minute branching. Antler growth characteristics together with the relatively small body size and new pelage separates them from cows or bulls.

10.6. Caribou group or muskox herd

A "caribou group" or "muskox herd" is composed of two or more individuals of the same species that were seen in close association (no fixed minimum or maximum distance of separation but usually much closer than 100 m) and apparently spatially isolated from other individuals of the same species at the time of observation. Two or more individuals (of the same species) are considered as one group even if they were more than 100 m apart but moved together when disturbed by the survey aircraft.

10.7. Bull-only caribou group or bull-only muskox herd

A "bull-only caribou group" is composed of mature males only (bulls, assumed 4+ yr old, relatively large antler size). In July of the year both bulls and immature males (at least 2 yr old and possibly 1-yr olds) are readily recognizable by their relatively advanced antler development from other sex/age classes of Peary caribou. A "bull-only muskox herd" is composed of only bulls (assumed 4+ yr old) that can be readily recognized by their large body size, and their relatively large horn size and well developed boss area of the horns.

10.8. Mixed sex/age caribou group or mixed sex/age muskox herd

A "mixed sex/age caribou group" or a "mixed sex/age muskox herd" may be mixed by sex or age or both and contains any possible combination of bulls, cows, juveniles, yearlings, or calves (when bulls could not be recognized, the presence of both sexes was not determined).

10.9. Values in parentheses

When values are given in parentheses (x+y) they always equal 1+ yr-old animals plus calves in this report: e.g., caribou (36+11) equals 36, 1+ yr-old caribou plus 11 caribou calves.

10.10. Estimates

The reader may note that slight inconsistencies sometimes occur between the summations of estimates by each survey stratum when compared with their counterparts that are obtained from a single estimate of several or all survey strata. The magnitude of these discrepancies is insignificant and they are pointed out only to assure the reader that the errors are the results of the method of machine calculation and not errors or transcription.

10.11. Sites

In this report a solitary animal is not considered as a group. Therefore, the term "site" is used to designate any observation regardless of whether it involved a solitary animal or a group of two or more animals. Site is essentially synonymous with observation.

10.12. Melville Island

Throughout this report Melville Island will be considered at three levels: (1) the entire island; (2) the two major geographic areas of the island, eastern Melville (survey strata I-VI) and western Melville (survey strata VII-XIII); and (3) each of the 13 survey strata on the island.

RESULTS

Aerial surveys of Melville and Byam Martin islands were carried out under favourable viewing conditions between 1-22 July 1987. Bare ground prevailed throughout the survey area with numerous, small, isolated, late-lying snowbanks present to varying degrees on all survey strata. Successful survey flights were possible on only 10 of 22 days: survey flights were aborted on 10 of the 12 intervening days due to deteriorating weather causing inadequate visibility; and prevented on the other 2 days by mechanical problems with the helicopter.

All Peary caribou and muskoxen seen "off survey" were also either seen "on survey" or I could not judge with confidence that they

were not. Therefore, all animals reported herein were considered seen "on survey" and the only distinction made is between those seen "on transect" (within a maximum feasible strip transect width of 1.714 km) and those seen "off transect" (beyond 857 m of either side of the aircraft).

1. Melville Island

Melville Island received a mean aerial coverage of 27.2%: 27.4% on eastern Melville and 26.9% on western Melville (Table 1; App. 1, 2).

1.1. Peary caribou

I observed 418 Peary caribou on 88 sites on Melville in July 1987: 57.9% of them were on eastern Melville and 42.1% were on western Melville (Table 2). Caribou occurred at a greater rate than expected by chance alone on eastern Melville (X^2 = 6.08, df = 1; P <0.05) when the rates of occurrences of the caribou are examined for only "on transect"d caribou relative to the landmasses that are available to them on eastern and western Melville. However, only cows and juveniles (X^2 = 5.33, df = 1; P <0.05) and calves (X^2 = 10.45, df = 1; P <0.05) were overrepresente on eastern Melville. Bulls occurred more frequently than expected by chance alone on western Melville (X^2 = 4.81, df = 1; P <0.05).

On an island-wide basis the distribution of caribou varied significantly (X^2 = 36.42, df = 4; P <0.05) among the zones describing the distance from the seacoast (Table 3), based on the landmass within each of the zones. Caribou occurred at a greater rate than expected by chance alone on sites >15.0 km from the seacoast and on sites between 10.1-15.0 km from the seacoast. Rate of occurrence was about as expected on sites <2.5 km from the seacoast and less than expected on sites 2.5-5.0 km and 5.1-10.0 km from the seacoast. On eastern Melville caribou occurred at a greater rate than expected by chance alone only on sites >15.0 km from the seacoast (X^2 = 52.04, df = 4; P <0.05). While on western Melville the distribution of caribou relative to the seacoast was more varied with greater occurrences than expected at the extremes, >15.0 km and <2.5 km respectively (X^2 = 20.28, df = 4; P <0.05).

Although the greatest number of caribou was seen on east-central Melville (St. IV), densities averaged higher in descending order on northwestern Melville (St. X) and on northeastern Melville (St. III and St. II) (Tables 4, 5).

All of the caribou seen except 19 solitary individuals (10 cows or juveniles and 9 bulls) occurred in 69 groups of 2 or more individuals (Table 6: N = 399 individuals). Mean group size (excluding singles) averaged significantly larger for caribou groups on eastern Melville than for those on western Melville (Table 6: Kruskal-Wallis H = 350, df = 1; P <0.05) but there were no significant differences in mean group size for each stratum among the 11 survey strata where caribou occurred (Table 6: Kruskal-Wallis H = 13.54, df = 10; P >0.05). Mixed sex/age groups constituted 76.8% and bull-only groups 23.2% of those groups (Table 7).

Caribou pairs (N = 10) consisted of 4 cow-calf, 4 cow-juvenile, 1 bull-young male, and 1 pair of bulls.

The two most common group sizes (excluding singles) for caribou on Melville were 2 and 4 individuals per group (Fig. 3). This pattern also pertained for caribou group sizes on eastern Melville (Fig. 4) but not those on western Melville (Fig. 5). The two most frequent group sizes for caribou on western Melville were larger than those for eastern Melville at 9 and 6 individuals per group (Fig. 5).

Proportional representation of calves among all caribou seen on Melville was 19.4%: 22.7% on eastern Melville and 14.8% on western Melville. Calves occurred in only about half of the mixed sex/age groups seen and ranged from 1 to 5 in each of those groups (Tables 8, 9). Most (80.2%) of the calves occurred in groups totalling <10 individuals (Tables 8, 9).

The 256 caribou seen "on transect" gave estimates of 942.7 $\pm$ 125.78 (SE) caribou at a mean density of 2.2 $\pm$ 0.30 (SE) caribou per 100 km^{-2} (Table 10). When only the 198 1+ yr-old caribou seen on transect are considered, I obtained estimates of 729.1 $\pm$ 104.31 (SE) 1+ yr-old caribou at a mean density of 1.7 $\pm$ 0.25 (SE) caribou per 100 km^{-2} (Table 11).

1.2. Muskoxen

I observed 2895 muskoxen on 537 sites on Melville in July 1987: 50.8% of them were on eastern Melville and 49.2% were on western Melville (Table 12).

Proportionately more muskoxen than expected by chance alone occurred on western Melville (X^2 = 21.83, df = 1; $P < 0.05$) when the rates of occurrences of those muskoxen are examined for only "on transect" muskoxen relative to the landmasses that are available to them on eastern and western Melville. However, when the 1396 muskoxen seen on transect among the 2259 muskoxen segregated are examined on the above basis we find that only the calves occurred at greater rates than the expected by chance alone on western Melville (X^2 = 42.22, df = 1; $P < 0.05$), while bulls and cows or juveniles occurred as expected ($P > 0.05$) on both eastern and western Melville.

On an island-wide basis the distribution of muskoxen varied significantly (X^2 = 2434.86, df = 4; $P < 0.05$) among distance from the seacoast zones (Table 13), based on the landmass within each of the zones. Muskoxen occurred at greater rates than expected by chance alone on sites within the <2.5 km and 2.5-5.0 km zones, and at less than expected rates on all other zones. This pattern also pertained for eastern Melville (X^2 = 689.90, df = 4; $P < 0.05$) and western Melville (X^2 = 1405.44, df = 4; $P < 0.05$). However, the strongest affinity appeared to be for sites within the 2.5-5.0 km zone on eastern Melville while on western Melville it was for sites within <2.5 km of the seacoast.

Although, most muskoxen were seen on strata XIII, VI, and IV (in that order) the highest mean densities were obtained for strata VII, VI, and XIII, respectively (Tables 14, 15).

All of the muskoxen seen except 117 solitary individuals (115 bulls and 2 unsegregated animals) occurred in 420 herds of 2 or more individuals (Table 16: N = 2778 individuals). Mean herd size (excluding singles) averaged significantly larger for muskox herds on western Melville than for those on eastern Melville (Table 16: Kruskal-Wallis H = 16.510, df = 1; $P<0.05$). Also the mean herd sizes for muskoxen on the three survey strata where the most muskox herds were seen per stratum (Table 16) were significantly different, Stratum XIII being greater than that for Stratum VI or Stratum IV (Kruskal-Wallis H = 37.65, df = 12; $P<0.05$). Mixed sex/age herds constituted 76.7% and bull-only herds 23.3% of those herds (Table 17). Muskox pairs (N = 71) consisted of 80.3% bulls-only, 8.4% 1 bull with 1 cow or juvenile, and 11.3% were not segregated.

The two most common herd sizes (excluding singles) for muskoxen on Melville were 2 and 3 individuals per herd (Fig. 6). This pattern also pertained for muskox herd sizes on eastern Melville (Fig. 7) but only for pairs on western Melville (Fig. 8). The second most frequent muskox herd size on western Melville was higher at 7 individuals per herd (Fig. 8).

Proportional representation of calves among all muskoxen seen on Melville was 15.2%: 9.2% on eastern Melville and 21.4% on western Melville. Calves occurred in slightly more than half of all mixed sex/age herds seen and ranged from 1 to 10 in each of those herds (Tables 18, 19). Most (50.5%) of the calves occurred in herds totalling 10-19 individuals (Tables 18, 19).

The 1535 muskoxen seen on transect gave estimates of 5652.4 $\pm$ 463.75 (SE) muskoxen at a mean density of 13.4 $\pm$ 1.10 (SE) muskoxen per 100 km^{-2} (Table 20). When only the 1293 1+ yr-old muskoxen seen on transect are considered, I obtained estimates of 4761.3 $\pm$ 372.76 (SE) 1+ yr-old muskoxen at a mean density of 11.3 $\pm$ 0.88 (SE) muskoxen per 100 km^{-2} (Table 21).

2. Byam Martin Island

Byam Martin received 54.1% aerial coverage on 8 July 1987 (Table 1; App. 1, 2). The total possible number of survey transects was 22 and 12 of them were surveyed for a total length of 366.314 km and a survey area of 627.862 km^2.

2.1. Peary caribou

I observed 90 caribou on 15 sites: 2 bulls, 17 calves, and 71 others. Less than half of the 71 caribou classified as "others" appeared to be cows; most appeared to be juveniles, many of them young males. All caribou except 2 solitary juveniles occurred in 13 groups of 2 or more

individuals (Table 22). The 2 caribou pairs seen consisted of 1 cow-calf pair and 1 pair of bulls. Caribou distribution was clumped in several locations: 32.2%, <2.5 km from the seacoast; 25.6%, 2.5-5.0 km; and 42.2%, 5.1-10.0 km ($X^2 = 0.54$, df = 2; $P > 0.05$).

Proportional representation of calves among all caribou seen was 18.9%. Calves occurred in only half of the 12 mixed sex/age groups seen, with a mean of 2.83 ± 2.40 (SD) and a range of 1-7 calves per group. The number of 1+ yr-old individuals in groups with calves present relative to the number of calves present varied from a low of 7 with 7 calves to a high of 10 with only 1 calf.

The 53 caribou seen "on transect" gave estimates of 97.9 ± 36.64 (SE) caribou at a mean density of 8.4 ± 3.16 (SE) caribou per 100 km^{-2}. When only the 38 1+ yr-old caribou seen on transect are considered, I obtained estimates of 70.2 ± 26.10 (SE) 1+ yr-old caribou at a mean density of 6.1 ± 2.25 caribou per 100 km^{-2}.

2.2. Muskoxen

I observed 70 muskoxen on 12 sites: 36 bulls, 2 calves, and 32 others. Only 56 of them were segregated for the presence of bulls (36 bulls, 2 calves, and 18 others). Most of the muskoxen classified as "others" appeared to be cows without calves at heel. All muskoxen except 1 solitary bull occurred in 11 herds of 2 or more individuals (Table 23). Only 2 pairs were seen, both were composed of 2 bulls each. Muskox distribution was clumped and coastal: 60.0%, <2.5 km from the seacoast; 37.1%, 2.5-5.0 km; and only 2.9%, 5.1-10.0 km ($X^2 = 40.86$, df = 2; $P < 0.05$).

Proportional representation of calves among all muskoxen seen was low at 2.9%. The 2 calves occurred in 2 of the 7 mixed sex/age herds, each in a herd of 8 other individuals.

The 54 muskoxen seen "on transect" gave estimates of 99.8 ± 61.07 (SE) muskoxen at a mean density of 8.6 ± 5.26 (SE) muskoxen per 100 km^{-2}. Estimates of 1+ yr-old muskoxen seen on transect were similar at 96.1 ± 59.30 (SE) 1+ yr-old muskoxen at a mean density of 8.3 ± 5.11 (SE) muskoxen per 100 km^{-2}.

DISCUSSION

1. Melville Island

1.1. Peary caribou

Three previous summertime estimates of the number of Peary caribou on all of Melville Island have been obtained from aerial survey: 12 799 in 1961 (Tener 1963), and 3422 in 1973 and 1679 in 1974 (Miller *et al.* 1977a). Thus, it now appears that the summertime population of Peary caribou on Melville has been in an overall continual state of decline

from, at least, 1961 to 1987 and has declined by nearly 93% of its former size in that period. The average rate of reduction in the population size has been about 7% annually over the past 26 years. However, we know that in at least one winter (1973-74) the annual loss was about 51% of the previous year's estimate and nearly 14% of the 1961 estimated size.

Fortunately, the dire forecast of extinction of Peary caribou on Melville by 1983 made by Thomas and Joly (1981) has not come to pass. Also, male Peary caribou appear to be well represented in the population at about 32% of the 337 1+ yr-old caribou seen in July 1987. However, it now appears that at least a decade would be required to permit the population of Peary caribou on Melville to significantly increase, when and if, a turnabout in the long-term downward trend occurs. With the current summertime estimate of only 943 Peary caribou on Melville in 1987, it is now most likely that there is no longer a single island in the entire Canadian High Arctic (N 74°) that supports 1000 or more Peary caribou seasonally or annually, even with inter-island movements (Miller et al. 1977b).

That most caribou occurred on eastern Melville rather than on western Melville in July 1987 is consistent with all previous findings for summer 1961 (Tener 1963) and summers 1973 and 1974 (Miller et al. 1977a). Relatively high occurrence of caribou on small areas of northwestern Melville (St. X) also pertained in summers 1961 and 1974, but went undetected in summer 1973 (Tener 1963, Miller et al. 1977a). Other strata with relatively high levels of occurrences of caribou in July 1987 have also been recorded in varying orders of importance in summers 1961, 1973, and 1974 (Tener 1963, Miller et al. 1977a).

The progression of phenological development of forage plants, from low coastal sites to higher inland sites and the associated timing of the aerial survey appear to be the major factors governing which eastern strata (I-VI) will hold the most caribou in any 1 year. Peary caribou move to coastal areas early in summer apparently to take advantage of the first new plant growth. Then, the caribou move inland throughout the summer as the season progresses and the greening of vegetation occurs on higher inland areas. Finally, with the killing frosts the caribou begin a retreat to coastal areas (most likely, remaining there throughout the rut).

Mean group size (excluding singles) of caribou groupings in July 1987 was larger than that reported by Tener (1963) in summer 1961 (mean 4.1) but maximal group size was the same (range 2-20). Both mean and maximal group sizes of caribou groupings in July 1987 were, however, smaller than those reported by Miller et al. (1977a) for summers 1972 (mean 10.1, range 2-77), 1973 (mean 8.6, range 2-60), and 1974 (mean 7.2, range 2-33). For unknown reasons, the formation of postcalving aggregations was strong in summers 1972-74, even after the severe winter of 1973-74 (Miller et al. 1977a) but weak in 1961 (Tener 1963) when a much higher number of caribou was present.

However, the temporal aspect of summertime caribou group size, as with the distribution of caribou in summer, most likely is also influenced by the phenological progression of forage plants on various parts of the range. Thus, much of the among-year variation in mean group sizes likely resulted from the timing of the aerial survey relative to the timing of postcalving aggregation and phenological development of forage plants on different areas in each of those years.

The higher frequency of larger group sizes for caribou on western Melville than on eastern Melville in July 1987 resulted from what appeared to be typical postcalving mixed sex/age aggregations and from bull-only aggregations. However, maximal group size tended to run higher on eastern Melville than on western Melville (Tables 6, 7; Figs. 4, 5).

The high percentage of calves among all caribou seen in July 1987 indicates both successful reproduction and a high rate of early survival of calves. The proportional representation of caribou calves in July 1987 was slightly higher but similar to the 19% reported in summer 1961 (Tener 1963) and 18% in summer 1973 (Miller et al. 1977a). Survival or initial production of caribou calves was extremely poor (1%) in summer 1974 after the severe winter of 1973-74 (Miller et al. 1977a). Percentages of caribou calves seen on areas of eastern Melville in summers 1975 (Fischer and Duncan 1976: 25%) and 1976 (McLaren et al. 1977: 27%) were higher but comparable to the 22% seen there in July 1987. However, not a single calf was seen among 1414 and 733 caribou segregated on eastern Melville in summers 1972 and 1974, respectively (Miller et al. 1977a). Initial production of caribou calves has varied markedly among years on Melville (Parker et al. 1975, Thomas et al. 1976, Thomas, et al. 1977, and Thomas and Broughton 1978). It now appears that rates of early calf survival also have varied markedly among years, either as a result of low initial production or subsequently independent of it. These variations seem to be caused by winter and spring environmental stresses due to the then prevailing snow and ice conditions and the resultant degree of widespread forage unavailability (Miller et al. 1982).

1.2. Muskoxen

Tener (1963) provided only a "tentative conservative estimate" for Melville Island of 1000 muskoxen because of the contagious distributions of muskoxen seen there in summer 1961. I think, however, that Tener's (1963) data and his survey maps for 1961 (Tener 1961) do allow extrapolations with some confidence. Most (245) of the 273 muskoxen seen on transect in 1961 were distributed over western Melville and when extrapolated yield an estimate of 4374 animals, while only 420 are extrapolated for eastern Melville. Therefore, the preponderance of observed muskoxen on western Melville seemingly does not detract as much from the extrapolated estimates (when only western Melville is used as the land base) as suggested. Also, Tener (1963) actually saw 525 muskoxen in total at only 6% aerial coverage. Thus, it is possible that muskoxen on Melville in summer 1961 actually approached 5000 in number; at any rate, the actual number present likely far exceeded Tener's (1963) consevative

estimate of 1000. In summers 1973 and 1974 Miller et al. (1977a) estimated 3171 and 2390 muskoxen, respectively, on Melville. Thus, the estimate of 5652 muskoxen in July 1987 indicates that the number of muskoxen on Melville is increasing and probably has already surpassed the number that occurred there in summer 1961. Perhaps, the best evidence for the marked increase in the number of muskoxen on Melville is in the relatively high number estimated for eastern Melville in 1987 (Table 20) compared to the estimates from previous aerial surveys in the mid 1970s (Fischer and Duncan 1976, Miller et al. 1977a). July 1987 is the first time that the absolute number of muskoxen seen on eastern Melville even closely approached let alone exceeded the number seen on westen Melville during a systematic aerial survey (however, western Melville still has more muskoxen on a proportional basis). The Dundas Peninsula (St. VI) now rivals southwestern Melville (St. XIII and St. VII) in importance for muskoxen both on a density basis and in sheer numbers present. The pattern of expansion appears to be one of relative stability on the "muskox heartland" of southwestern Melville (Thomas et al. 1981) with marked increases in numbers on southeastern (Dundas Pen.), central, and eastern Melville.

Although muskoxen in general showed a strong preference for coastal sites, many were also found considerable distances inland, mostly along stream courses. Also, although some muskoxen and caribou occurred in the same areas, muskoxen most always were associated with better vegetated sites than those occupied by caribou. It appears that muskoxen, like caribou, follow the phenological development of forage plants inland; thus, the timing of the survey will greatly influence the observed distribution of muskoxen relative to the seacoasts. Surveys conducted in August would likely give markedly different distributional results than those surveys carried out in early July of the year.

The mean herd size (6.6) for muskoxen in July 1987 was appreciably lower than mean herd sizes reported in previous summers but the range of herd size in July 1987 (2-26) was comparable: mean 11.9 (no range given) 1961 (Tener 1963); mean 9.2, range 2-24, 1972; mean 10.0, range 2-38, 1973; mean 7.2, range 2-25, 1974 (Miller et al. 1977a) mean 9.8 (no range given) 1977 (McLaren et al. 1977); mean 10.3 (no range given) 1982 (McLaren and Green 1982); and mean 10.5, range 2-25, 1983 (McLaren 1983). No factual reason(s) can be given for the relatively small average herd size in July 1987. Perhaps, however, the significantly smaller mean herd size on eastern Melville than on western Melville is a reflection of the dynamics of the recent expansion in numbers of muskoxen on eastern Melville. Once the expansion phase is over, individual herd sizes might average larger over time, especially if only certain sections of the range on eastern Melville will sustain the increased numbers of muskoxen there. Also, the mean herd size of muskoxen could shift downward considerably if the proportion of bull-only herds (which are most always smaller) to mixed sex/age herds has increased markedly in the population. Unfortunately, this attempt at refining herd size information for muskoxen by makng the distinction between "bull-only" herds and "mixed sex/age" herds is only a recent singular consideration.

Early survival of muskox calves in July 1987 appeared moderately high at about 15%. Production and/or early survival of muskox calves onn Melville have varied greatly among years, e.g., proportional representatio of muskox calves determined from aerial survey was about 17% in 1961 (Tener 1963); 10% in 1972, 19% in 1973, 10% in 1974 (Miller et al. 1977a); 19% in 1977 (McLaren et al. 1977); 9% in 1982 (McLaren and Green 1982); and 10% in 1983 (McLaren 1983). Reports for eastern Melville of no muskox calves in summer 1974 and 7% in 1975 (Fischer and Duncan 1976), seemingly, suffer from small sample sizes and the techniques used.

The reason(s) for the proportionately significant lower rate of muskox calf representation on eastern Melville compared to western Melville is unknown. Tener (1963) noted a similar variation in summer 1961 (18% vs. 12%) but dismissed it because too few muskoxen were seen on eastern Melville. In summer 1973 following a relatively mild winter the difference in muskox calf representation did not exist between eastern (19%) and western (18%) Melville (Miller et al. 1977a). However, in summer 1974 after the severe winter of 1973-74 there was a marked difference in muskox calf representation between eastern (ca. 4%) and western (ca. 13%) Melville (Miller et al. 1977a). It is possible that lower calf production or early survival of muskox calves on eastern Melville compared to western Melville reflect the relative capabilities of the respective ranges to support muskoxen at levels that allow successful reproduction and high rates of early survival of calves during periods of range-wide environmental stress (most likely initially brought on by extensive forage unavailability due to the then prevailing snow and ice conditions and subsequently due to the malnurished state of cows and/or calves (Miller et al. (1982)). However, the different rates of muskox calves present might simply reflect a relatively low level of environmental stresses on western Melville while those on eastern Melville were high.

2. Byam Martin Island

Byam Martin was not surveyed in 1961 but was subsequently aerially surveyed by CWS six times at 25 to 50% coverage from 1972 to 1974 (Miller et al. 1977a).

2.1. Peary caribou

Numbers of caribou seen and estimated on Byam Martin varied greatly by season and year in the early 1970s (Miller et al. 1977a). However, the occurrence of isolated clusters of caribou as seen in July 1987 also prevailed in summertime in the 1970s.

No calves were seen on Byam Martin in August 1972 or July 1974 but calves totalled 11.4% of the caribou seen in August 1973 (Miller et al. 1977a).

Miller et al. (1977a) concluded that (1) caribou numbers were low; (2) caribou distributions by distance from the seacoast were inconsistent among years; (3) variations in numbers of caribou seen in late winter vs. summer 1972 and 1973 suggested that most of the caribou were only summer migrants; and (4) the low numbers of caribou seen in 1974 reflected more the loss of caribou from other islands than on Byam Martin.

The observed and estimated numbers of caribou on Byam Martin in July 1987 either support Miller et al.'s (1977a) contention that most of the caribou are summer residents or it argues against their conclusion that the low number of caribou left in 1974 reflected more the loss of caribou on other islands than on Byam Martin. Whether or not those caribou seen on Byam Martin in July 1987 were mostly or all summer migrants or the product of 13 years of recovery among year-round residents will remain unanswered.

The numbers of caribou seen and estimated on Byam Martin in July 1987 exceed those reported in July 1974 at similar (50%) aerial coverage (3 seen, 6 estimated). The July 1987 estimate is comparable to that for August 1973 although the number seen in July 1987 is not as great as the number seen in August 1973 on a relative survey coverage basis (90 at 54% in 1987 vs. 79 at 25% in 1973). Thus, it now appears that caribou on Byam Martin have at least recovered to about the 1973 summertime level. The question remains are caribou on Byam Martin seasonal or year-round residents; and if seasonal, from what island(s) do they come (Melville, Bathurst, or even Eglinton or Prince Patrick (Miller et al. 1977b).

2.2. Muskoxen

Muskoxen seen and estimated on Byam Martin in 1972-74 varied markedly among surveys (Miller et al. 1977a). Those estimates were not precise (large variances) and at least one was imperfect due to a relatively low number of muskoxen being seen by chance "on transect" compared to those seen "off transect".

Proportional representation of calves among all muskoxen seen ranged from 7.1% (2) in August 1972 to 23.6% in July 1973 and none in August 1974 (Miller et al. 1977a).

The July 1987 estimates of muskoxen on Byam Martin also suffer from large variances. However, the number of muskoxen seen in July 1987 (N = 70) argues for a marked increase in muskoxen, at least summering, on Byam Martin over the number present in August 1974 (8 seen, none estimated). The July 1987 estimate appears comparable to the number estimated there in July 1973, 117 $\pm$ 84 (SE), (Miller et al. 1977a) although the number seen in July 1987 is not as great as the number seen in July 1973 on a relative survey coverage basis (70 at 54% in 1987 vs. 55 at 25% in 1973). Thus, it now appears that muskoxen on Byam Martin have recovered to about the 1973 summertime level.

ACKNOWLEDGEMENTS

The study was supported by the Canadian Wildlife Service (CWS), Environment Canada, and Polar Continental Shelf Project (PCSP), Energy, Mines and Resources Canada. I am grateful to G.D. Hobson, Director, PCSP, for his continued support of my research. S.J. Barry, CWS, kindly provided statistical assistance and S.M. Popowich, CWS, drafted the figures. I thank Dr. A. Gunn, Department of Renewable Resources, Government of the Northwest Territories and Dr. G.L. Holroyd, CWS, for critically reading the manuscript.

LITERATURE CITED

Banfield, A.W.F. 1961. A revision of the reindeer and caribou genus Rangifer. Nat. Mus. Can. Bull. 177, Bio. Ser. No. 66. 137 pp.

Bird, J.B. 1967. The physiography of Arctic Canada, with special reference to the area south of Parry Channel. John Hopkins Press, Baltimore. 336 pp.

Dunbar, M.; and Greenaway, K.R. 1956. Arctic Canada from the air. Can. Defense Res. Board. 541 pp.

Fischer, C.A.; and Duncan, E.A. 1976. Ecological studies of caribou and muskoxen in the Arctic Archipelago and northern Keewatin. Renewable Resources Consulting Services Ltd., Edmonton, Alberta. 194 pp.

Gunn, A.; Miller, F.L.; and Thomas, D.C. 1979. Peary caribou, a status report. Report prepared for Committee on The Status of Endangered Wildlife In Canada (COSEWIC) by Canadian Wildlife Service. 32 pp.

_____. 1981. The current status and future of Peary caribou (Rangifer tarandus pearyi) on the Arctic Islands of Canada. Bio. Conserv. 19:283-296.

Kingsley, M.C.S.; and Smith, G.E.J. 1981. Analysis of data arising from systematic transect surveys. Pages 40-48 in: Miller, F.L. and Gunn, A., co-editors, and Hieb, S.R., Publications editor. Northwest Section The Wildlife Society: Proceedings Symposium on Census and Inventory Methods for Population and Habitats. Published by the Forest, Wildlife and Range Experiment Station, University of Idaho, Moscow, Idaho, Contribution No. 217. 220 p.

Maxwell, J.B. 1981. Climatic regions of the Canadian Arctic Islands. Arctic 34:225-240.

McLaren, M.A. 1983. Aerial surveys of muskoxen on southeastern Melville Island, spring 1983. Unpubl. Rep. by LGL Ltd., Toronto, to Arctic Pilot Project, Calgary. 18 pp.

_____; and Greene, J.E. 1982. Studies of muskoxen and caribou on eastern Melville Island, N.W.T., in spring 1982. Unpubl. Rep. by LGL Ltd., Toronto, to Arctic Pilot Project, Calgary.

_____; Renaud, W.E.; Davis, R.A.; and Truett, J.C. 1977. Studies of terrestrial mammals on eastern Melville Island, July-August 1977. Unpubl. Rep. by LGL Ltd., Toronto, for Petro-Canada, Calgary. 110 pp.

Meteorological Branch Department of Transport, Canada. 1970. Climate of the Canadian Arctic. The Canadian Hydrographic Serv., Marine Sciences Br., Dep. Energy, Mines and Resources, Ottawa. 71 pp.

Miller, F.L.; Edmonds, E.J.; and Gunn, A. 1982. Foraging behaviour of Peary caribou in response to springtime snow and ice conditions. Can. Wildl. Serv. Occas. Pap. No. 48. 41 pp.

_____; Russell, R.H.; and Gunn, A. 1977a. Distributions, movements and numbers of Peary caribou and muskoxen on western Queen Elizabeth Islands, Northwest Territories, 1972-74. Can. Wildl. Serv. Rep. Ser. No. 40. 55 pp.

_____. 1977b. Interisland movements of Peary caribou (Rangifer tarandus pearyi) on western Queen Elizabeth Islands, Arctic Canada. Can. J. Zool. 44(6):1029-1037.

Parker, G.R.; Thomas, D.C.; Broughton, E.; and Gray, D.R. 1975. Crashes of muskox and Peary caribou populations in 1973-74 on the Parry Islands, Arctic Canada, Can. Wildl. Serv. Prog. Note No. 56. 10 pp.

Potter, J.G. 1965. Snow cover. Dep. Transport, Meteorological Br., Ottawa. Climatological Studies No. 3. 69 pp.

Tener, J.S. 1961. Queen Elizabeth Islands game survey. Can. Wildl. Serv. Unpubl. Rep. CWSC 972. 94 pp.

_____. 1963. Queen Elizabeth Islands game survey, 1961. Can. Wildl. Serv. Occas. Pap. No. 4. 50 pp.

Thomas, D.C.; and Broughton, E. 1978. Status of three Canadian caribou populations north of 70° in winter, 1977. Can. Wildl. Serv. Prog. Note No. 85. 12 pp.

_____; and Joly, P. 1981. Status of Peary caribou on the western Queen Elizabeth Islands in April 1980. Musk-ox 28:58-64.

_____; Miller, F.L.; Russell, R.H.; and Parker, G.R. 1981. The Bailey Point region and other muskox refugia in the Canadian Arctic: a short review. Arctic 34:34-36.

_____; Russell, R.H.; Broughton, E.; Edmonds, E.J.; and Gunn, A. 1977. Further studies of two populations of Peary caribou in the Canadian Arctic. Can. Wildl. Serv. Prog. Note No. 80. 7 pp.

_____; and Madore, P.L. 1976. Investigations of Peary caribou populations on some Canadian Arctic Islands, March 1975. Can. Wildl. Serv. Prog. Note No. 64. 13 pp.

Thompson, J. 1971. A comparison of meteorological observations from May 1970 through April 1971, National Museum Bathurst Island Station 75°43'N 98°25'W, Resolute Airport 74°43'N 94°59'W. Unpubl. Rep. Atmospheric Environment Serv. 15 pp.

Thorsteinsson, R.; and Tozer, E.T. 1960. Summary of account of structural history of the Canadian Arctic Archipelago since Precambrian times. Geol. Survey Can., Ottawa. Pap. 60-7. 25 pp.

Tozer, E.T.; and Thorsteinsson, R. 1964. Western Queen Elizabeth Islands, Arctic Archipelago. Geol. Survey Can., Mem. 332. 242 pp.

Table 1

Basic statistics for obtaining estimates of Peary caribou and muskoxen from a systematic aerial survey at about 27% overall coverage (1.714-km wide strip transects at 6.4-km intervals) of Melville Island, NWT, July 1987

Survey area (Stratum)	Stratum size (km^2)	Date(s) surveyed July 1987	Total transects possible	Number of transects surveyed	Total length of transects (km)
I	2940	1	37	10	470.298
II	1730	1	37	10	290.116
III	1940	4	25	7	313.532
IV	7260	9-10	51	14	1096.565
V	4560	9	51	14	779.066
VI	5100	5	66	18	806.055
VII	1030	11	25	7	163.514
VIII	5100	11	59	16	744.534
IX	3330	16	55	15	546.892
X	1390	16	29	8	225.822
XI	1670	22	33	9	275.828
XII	1400	21	40	11	223.839
XIII	4770	21-22	59	16	753.267

Table 2

Peary caribou seen during aerial survey of Melville Island, NWT, July 1987

Survey area (Stratum)	Caribou seen			Total 1+ yr-old caribou	Total all caribou
	Bulls	Calves	Others[a]		
I		2	6	6	8
II	6	7	30	36	43
III	6	13	20	26	39
IV	15	17	38	53	70
V		11	20	20	31
VI	20	5	26	46	51
VII					
VIII	2	8	44	46	54
IX	9	1	1	10	11
X	29	6	31	60	66
XI	11	3	3	14	17
XII					
XIII	9	8	11	20	28
I-VI	47	55	140	187	242
VII-XIII	60	26	90	150	176
I-XIII	107	81	230	337	418

[a]Includes all females 1+ years old and young males.

Table 3

Distributions from the seacoast of individual Peary caribou and groups of Peary caribou seen during an aerial survey of Melville Island, NWT, July 1987

Survey area (Stratum)[a]	Number caribou seen	Number groups seen	Distances from the seacost (km)				
			<2.5	2.5-5.0	5.1-10.0	10.1-15.0	>15.0
I	8	2	5(1)[b]			3(1)	
II	43	7			12(2)		31(5)
III	39	10	16(6)	6(1)	7(2)	10(1)	
IV	70	16	6(2)	7(3)		3(2)	54(9)
V	31	8	1(1)			18(3)	12(4)
VI	51	15	7(1)		11(5)	14(4)	19(5)
VII							
VIII	54	9	10(1)	8(1)	12(3)		24(4)
IX	11	3		6(1)		3(1)	2(1)
X	66	9	18(4)		5(1)	43(4)	
XI	17	3		11(2)		6(1)	
XII							
XIII	28	6	8(2)	4(1)	15(2)	1(1)	
I-VI	242	58	35(11)	13(4)	30(9)	48(11)	116(23)
VII-XIII	176	30	36(7)	29(5)	32(6)	53(7)	26(5)
I-XIII	418	88	71(18)	42(9)	62(15)	101(18)	142(28)

[a]Percentage of the land area of Melville Island is 16.3%, <2.5 km; 13.7%, 2.5-5.0 km; 24.6%, 5.1-10.0 km; 19.8%, 10.1-15.0 km and 25.6%, >15.0 km.

[b]Values equal number of individuals first with number of groups in parentheses; e.g., 5(1) equals 5 individuals in 1 group (in this table solitary animals are also included in the number of groups).

Table 4

Estimates of mean densities of all Peary caribou on Melville Island, NWT, July 1987, based on systematic aerial survey at about 27% overall coverage (1.714-km wide strip transects at 6.4-km intervals)

Survey area (Stratum)	Area surveyed (km^2)	Caribou seen on transect	Mean densities · 100 km^{-2}	
			Estimate	Variance
I	806.091	3	0.372	0.110
II	497.259	23	4.625	3.998
III	537.394	28	5.210	4.217
IV	1879.512	49	2.607	0.427
V	1335.319	26	1.947	0.525
VI	1381.578	33	2.389	0.591
VII	280.263			
VIII	1276.131	21	1.646	0.459
IX	937.373	11	1.173	0.327
X	387.059	44	11.368	28.316
XI	472.769	7	1.481	1.786
XII	383.660			
XIII	1291.100	11	0.852	0.345
I-VI	6437.153	162	2.517	0.139
VII-XIII	5028.355	94	1.869	0.237
I-XIII	11 465.508	256	2.233	0.089

Table 5

Estimates of mean densities of 1+ yr-old Peary caribou on Melville Island, NWT, July 1987, based on systematic aerial survey at about 27% overall coverage (1.714-km wide strip transects at 6.4-km intervals)

Survey area (Stratum)	Area surveyed (km^2)	Caribou seen on transect[a]	Mean densities · 100 km^{-2}	
			Estimate	Variance
I	806.091	2	0.248	0.049
II	497.259	21	4.223	3.639
III	537.394	17	3.163	1.547
IV	1879.512	35	1.862	0.239
V	1335.319	16	1.198	0.230
VI	1381.578	30	2.171	0.468
VII	280.263			
VIII	1276.131	16	1.254	0.152
IX	937.373	10	1.067	0.354
X	387.059	40	10.334	26.284
XI	472.769	4	0.846	0.583
XII	383.660			
XIII	1291.100	7	0.542	0.102
I-VI	6437.153	121	1.880	0.083
VII-XIII	5028.355	77	1.531	0.184
I-XIII	11 465.508	198	1.727	0.061

[a]Only 1+ yr-old caribou.

Table 6

Grouping statistics for Peary caribou on Melville Island NWT, July 1987, obtained from aerial survey

Survey area by (Stratum)	Number groups including singles	Number singles	Group size, excluding singles		
			Mean	+SD	Range
I	2		4.0	1.41	3- 5
II	7	2	8.2	6.91	2-20
III	10	2	4.6	1.71	2-10
IV	16	2	4.9	1.63	2-11
V	8	3	5.6	3.29	2-10
VI	15	5	4.6	2.22	2- 9
VII					
VIII	9	2	7.4	1.72	5-10
IX	3		3.7	2.08	2- 6
X	9		7.3	3.97	2-13
XI	3	1	8.0	2.83	6-10
XII					
XIII	6	2	6.5	2.08	4- 9
I-VI	58	14	5.2	3.34	2-20
VII-XIII	30	5	6.8	2.97	2-13
I-XIII	88	19	5.8	3.29	2-20

Table 7

Group statistics for various types of Peary caribou groups on Melville Island, NWT, July 1987, obtained from aerial survey

Group types by strata	Group statistics				
	N	Mean	±SD	Range	95% CI
Strata I-VI (eastern Melville)					
Bull-only groups	8	3.6	1.19	2- 6	2.6- 4.6
Mixed sex/age groups with calves					
calves included	24	6.2	3.88	2-20	4.5- 7.8
calves excluded	24	3.9	3.03	1-15	2.6- 5.2
Mixed sex/age groups without calves	12	4.3	2.53	2- 9	2.6- 5.9
Strata VII-XIII (wesstern Melville)					
Bull-only groups	8	5.9	2.64	3-10	3.7- 8.1
Mixed sex/age groups with calves					
calves included	11	6.7	2.90	2-13	4.8- 8.7
calves excluded	11	4.4	2.58	1-11	2.6- 6.1
Mixed sex/age groups without calves	6	8.3	3.39	2-12	4.8-11.9
Strata I-XIII Melville Island					
Bull-only groups	16	4.8	2.30	2-10	3.5- 6.0
Mixed sex/age groups with calves					
calves included	35	6.3	3.56	2-20	5.2- 7.5
calves excluded	35	4.0	2.86	1-15	3.1- 5.0
Mixed sex/age groups without calves	18	5.6	3.38	2-12	3.9- 7.3

Table 8

Statistics for Peary caribou calves obtained by aerial survey of Melville Island, NWT, July 1987

Survey area (Stratum)	Number of calves	Total number groups seen	% groups with calves present	Calves/group		
				Mean	±SD	Range
I	2	2	100.0	1.0		1-1
II	7	5	40.0	3.5	2.12	2-5
III	13	8	62.5	2.6	1.14	1-4
IV	17	14	50.0	2.4	0.98	1-4
V	11	5	100.0	2.2	1.30	1-4
VI	5	10	30.0	1.7	0.58	1-2
VII						
VIII	8	7	57.1	2.0	0.82	1-3
IX	1	3	33.3	1.0		1-1
X	6	9	22.2	3.0	1.41	2-4
XI	3	2	50.0	1.0		1-1
XII						
XIII	8	4	75.0	2.7	1.16	2-4
I-VI	55	44	54.5	2.3	1.16	1-5
VII-XIII	26	25	44.0	2.4	1.03	1-4
I-XIII	81	69	50.7	2.3	1.11	1-5

Table 9

Grouping statistics for Peary caribou groups with calves present on Melville Island, NWT, July 1987, based on only 1+ yr-old individuals and given by the number of calves present in each group

Survey area (strata)	Statistic	Number of calves/group				
		1	2	3	4	5
I-VI	N	7	8	5	3	1
	Mean	2.3	3.4	4.0	5.0	15.0
	SD	1.38	2.33	1.73	1.00	
	Range	1-4	2-9	3-7	4-6	15-15
	95% CI	1.0-3.6	1.5-5.3	1.9-6.1	2.5-7.5	
VII-XIII	N	2	5	2	2	
	Mean	3.0	5.0	3.5	5.0	
	SD	2.83	3.54	0.71		
	Range	1-5	2-11	3-4	5-5	
	95% CI	0.0[a]-28.4	0.6-9.4	0.0[a]-9.9		
I-XIII	N	9	13	7	5	1
	Mean	2.4	4.0	3.9	5.0	15.0
	SD	1.59	2.83	1.47	0.71	
	Range	1-5	2-11	3-7	4-6	15-15
	95% CI	1.2-3.6	2.3-5.7	2.5-5.3	4.1-5.9	

[a]Negative values are reported as 0.0.

Table 10

Estimates of numbers of all Peary caribou on Melville Island, NWT, July 1987, based on systematic aerial survey at about 27% overall coverage (1.714-km wide strip transects at 6.4-km intervals)

Survey area (Stratum)	Caribou seen on or off transect	Caribou seen on transect	Population estimates	
			Estimate	Variance
I	8	3	10.9	95.00
II	43	23	80.0	1196.60
III	39	28	101.1	1587.26
IV	70	49	189.3	2250.61
V	31	26	88.8	1091.22
VI	51	33	121.8	1528.11
VII				
VIII	54	21	83.9	1193.63
IX	11	11	39.1	363.05
X	66	44	158.0	5471.00
XI	17	7	24.7	498.22
XII				
XIII	28	11	40.6	785.41
I-VI	242	162	592.2	7698.83
VII-XIII	176	94	349.4	8276.30
I-XIII	418	256	942.7	15 821.32

Table 11

Estimates of 1+ yr-old Peary caribou on Melville Island, NWT, July 1987, based on systematic aerial survey at about 27% oveall coverage (1.714-km wide strip transects at 6.4-km intervals)

Survey area (Stratum)	Caribou seen on or off transect[a]	Caribou seen on transect[a]	Population estimates	
			Estimate	Variance
I	6	2	7.3	42.22
II	36	21	73.1	1089.16
III	26	17	61.4	582.03
IV	53	35	135.2	1261.49
V	20	16	54.6	477.49
VI	46	30	110.7	1218.00
VII				
VIII	46	16	63.9	395.92
IX	10	10	35.5	392.17
X	60	40	143.7	5078.31
XI	14	4	14.1	162.68
XII				
XIII	20	7	25.9	233.05
I-VI	187	121	442.3	4572.71
VII-XIII	150	77	286.2	6439.35
I-XIII	337	198	729.1	10 880.43

[a]Only 1+ yr-old caribou.

Table 12

Muskoxen seen during aerial survey of Melville Island, NWT, July 1987

Survey area by stratum	Muskoxen seen				Total 1+ yr-old muskoxen		Total all muskoxen	
	Bulls	Calves		Others[a]				
I	(3)					3		3
II	(24)		13	60		84		97
III	(12)		2	6		18		20
IV	(113)		22	(94)	203	(207)	316	(229) 338
V	(55)	(8)	15	(65)	101	(120)	156	(128) 171
VI	(207)	(75)	83	(352)	553	(559)	760	(634) 843
VII	(46)		30	(86)	94	(132)	140	(162) 170
VIII	(63)	(35)	47	(66)	131	(129)	194	(164) 241
IX	(13)		13		22		35	48
X	(6)		1		8		14	15
XI	(18)		14		27		45	59
XII	(21)		2		16		37	39
XIII	(203)	(159)	198	(299)	450	(502)	653	(661) 851
I-VI	(414)	(120)	135	(577)	923	(991)	1337	(1111) 1472
VII-XIII	(370)	(254)	305	(524)	748	(894)	1118	(1148) 1423
I-XIII	(784)	(374)	440	(1101)	1671	(1885)	2455	(2259) 2895

[a]Includes all females 1+ years old and young males (and some older bulls).

[b]Values in parentheses equal number of individuals that were segregated.

Table 13

Distributions from the seacoast of individual muskoxen and muskox herds seen during an aerial survey of Melville Island, NWT, July 1987

Survey area (Stratum)[a]	Number muskoxen seen	Number herds seen	Distances from the seacoast (km)				
			<2.5	2.5-5.0	5.1-10.0	10.1-15.0	>15.0
I	3	2	2(1)[b]		1(1)		
II	97	18	33(4)	20(3)	36(8)	8(3)	
III	20	5	6(2)	12(2)		2(1)	
IV	338	67	95(23)	118(20)	85(17)	25(5)	15(2)
V	171	27	112(16)	54(10)	5(1)		
VI	843	171	303(61)	181(45)	180(38)	23(7)	156(20)
VII	170	29	147(24)	23(5)			
VIII	241	56	68(19)	47(10)	99(10)	19(3)	8(4)
IX	48	7	7(1)			38(4)	3(2)
X	15	3	1(1)	3(1)	11(1		
XI	59	8	37(5)	22(3)			
XII	39	11	26(6)	13(5)			
XIII	851	133	454(69)	211(33)	166(26)	20(5)	
I-VI	1472	290	551(107)	385(80)	307(65)	58(16)	171(22)
VII-XIII	1423	247	740(125)	319(57)	276(47)	77(12)	11(6)
I-XIII	2895	537	1291(232)	704(137)	583(112)	135(28)	182(28)

[a]Percentage of the land area of Melville Island is 16.3%, <2.5 km; 13.7%, 2.5-5.0 km; 24.6%, 5.1-10.0 km; 19.8%, 10.1-15.0 km and 25.6%, >15.0 km.

[b]Values equal number of individuals first with number of herds in parentheses; e.g., 5(1) equals 5 individuals in 1 herd (in this table solitary animals are also included in the number of herds).

Table 14

Estimates of mean densities of all muskoxen on Melville Island, NWT, July 1987, based on systematic aerial survey at about 27% overall coverage (1.714-km wide strip transects at 6.4-km intervals)

Survey area (Stratum)	Area surveyed (km^2)	Muskoxen seen on transect	Mean densities · 100 km^{-2}	
			Estimate	Variance
I	806.091	1	0.124	0.112
II	497.259	64	12.871	18.780
III	537.394	8	1.489	0.156
IV	1879.512	153	8.140	4.335
V	1335.319	94	7.040	6.477
VI	1381.578	445	32.210	16.179
VII	280.263	109	38.892	139.075
VIII	1276.131	138	10.814	10.154
IX	937.373	29	3.094	2.628
X	387.059	15	3.875	6.559
XI	472.769	55	11.634	12.025
XII	383.660	36	9.383	4.948
XIII	1291.100	388	30.052	27.218
I-VI	6437.153	765	11.884	1.501
VII-XIII	5028.355	770	15.313	3.690
I-XIII	11 465.508	1535	13.388	1.207

Table 15

Estimates of mean densities of 1+ yr-old muskoxen on Melville Island, NWT, July 1987, based on systematic aerial survey at about 27% overall coverage (1.714-km wide strip transects at 6.4-km intervals)

Survey area (Stratum)	Area surveyed (km^2)	Muskoxen seen on transect[a]	Mean densities · 100 km^{-2}	
			Estimate	Variance
I	806.091	1	0.124	0.112
II	497.259	57	11.463	14.544
III	537.394	8	1.489	0.156
IV	1879.512	139	7.396	3.321
V	1335.319	87	6.515	5.619
VI	1381.578	398	28.808	10.651
VII	280.263	89	31.756	85.684
VIII	1276.131	107	8.385	5.712
IX	937.373	23	2.454	1.759
X	387.059	14	3.617	5.467
XI	472.769	41	8.672	6.306
XII	383.660	34	8.862	5.108
XIII	1291.100	295	22.849	15.496
I-VI	6437.153	690	10.720	1.102
VII-XIII	5028.355	603	11.992	2.152
I-XIII	11 465.508	1293	11.277	0.780

[a]Only 1+ yr-old muskoxen.

Table 16

Grouping statistics for muskoxen on Melville Island, NWT, July 1987, obtained from aerial survey

Survey area by (Stratum)	Number herds including singles	Number singles	Herd size excluding singles		
			Mean	+SD	Range
I	2	1	2.0		2- 2
II	18	7	8.2	4.79	2-17
III	5		4.0	3.46	2-10
IV	67	4	5.3	3.50	2-16
V	27	4	7.3	3.89	2-15
VI	171	29	5.7	3.47	2-20
VII	29	3	6.4	3.96	2-15
VIII	56	22	6.4	3.85	2-16
IX	7	1	7.8	6.05	2-17
X	3	1	7.0	5.66	3-11
XI	8		7.4	5.13	2-16
XII	11	4	5.0	2.24	3- 9
XIII	133	41	8.8	5.28	2-26
I-VI	290	45	5.8	3.64	2-20
VII-XIII	247	72	7.7	4.86	2-26
I-XIII	537	117	6.6	4.29	2-26

Table 17

Herd statistics for various types of muskox herds on Melville Island, NWT, July 1987, obtained from aerial survey

Herd types by strata	Herd statistics				
	N	Mean	±SD	Range	95% CI
Strata I-VI (eastern Melville)					
Bull-only herds	61	2.5	0.77	2- 5	2.3- 2.7
Mixed sex/age herds with calves					
calves included	70	9.4	3.48	4-20	8.6-10.2
calves excluded	70	7.5	3.18	2-17	6.7- 8.2
Mixed sex/age herds without calves	114	5.4	2.63	2-15	4.9- 5.9
Strata VII-XIII (wesstern Melville)					
Bull-only herds	37	2.6	0.86	2- 5	2.3- 2.9
Mixed sex/age herds with calves					
calves included	106	10.3	4.35	4-26	9.5-11.1
calves excluded	106	7.4	3.32	3-21	6.8- 8.1
Mixed sex/age herds without calves	32	5.0	2.41	2-12	4.2- 5.8
Strata I-XIII (Melville Island)					
Bull-only herds	98	2.6	0.80	2- 5	2.4- 2.7
Mixed sex/age herds with calves					
calves included	176	10.0	4.01	4-26	9.4-10.6
calves excluded	176	7.5	3.25	2-21	7.0- 7.9
Mixed sex/age herds without calves	146	5.3	2.58	2-15	4.9- 5.7

Table 18

Statistics for muskox calves obtained by aerial survey of Melville Island, NWT, July 1987

Survey area (Stratum)	Number of calves	Total number herds seen	% herds with calves present	Calves/herd		
				Mean	±SD	Range
I						
II	13	11	45.5	2.6	0.89	2- 4
III	2	5	20.0	2.0		2- 2
IV	22	63	19.0	1.8	1.03	1- 4
V	15	23	34.8	1.9	0.84	1- 3
VI	83	142	31.0	1.9	0.87	1- 4
VII	30	26	53.8	2.1	0.95	1- 4
VIII	47	34	55.9	2.5	1.12	1- 6
IX	13	6	66.7	3.3	2.50	2- 7
X	1	2	50.0	1.0		1- 1
XI	14	8	50.0	3.5	1.29	2- 5
XII	2	7	14.3	2.0		2- 2
XIII	198	92	68.5	3.1	1.60	1-10
I-VI	135	245	28.6	1.9	0.89	1- 4
VII-XIII	305	175	60.6	2.9	1.50	1-10
I-XIII	440	420	41.9	2.5	1.37	1-10

Table 19

Grouping statistics for muskox herds with calves present on Melville Island, NWT, July 1987, based on only 1+ yr-old individuals and given by the number of calves present in each herd

Survey area (strata)	Statistic	Number of calves/herd							
		1	2	3	4	5	6	7	10
I-VI	N	25	30	10	5				
	Mean	7.6	6.4	9.2	10.2				
	SD	2.97	2.36	4.42	3.35				
	Range	3-15	2-10	4-17	5-14				
	95% CI	6.4-8.8	5.5-7.3	6.0-12.4	6.0-14.4				
VII-XIII	N	11	42	28	12	6	4	2	1
	Mean	5.7	6.2	6.8	10.7	10.8	10.3	12.0	16.0
	SD	2.10	2.26	2.47	4.38	2.48	3.69	2.83	
	Range	3-10	3-11	4-14	6-21	8-15	6-15	10-14	16-16
	95% CI	4.3-7.1	5.5-6.9	5.8-7.8	7.9-13.5	8.3-13.5	4.4-16.2	0.0[a]-37.4	
I-XIII	N	36	72	38	17	6	4	2	1
	Mean	7.0	6.3	7.4	10.5	10.8	10.3	12.0	16.0
	SD	2.84	2.29	3.22	4.01	2.48	3.69	2.83	
	Range	3-15	2-11	4-17	5-21	8-15	6-15	10-14	16-16
	95% CI	6.0-8.0	5.8-6.8	6.3-8.5	8.4-12.6	8.2-13.4	4.4-16.2	0.0[a]-45.2	

[a]Negative values are reported as 0.0.

Table 20

Estimates of numbers of all muskoxen on Melville Island, NWT, July 1987, based on systematic aerial survey at about 27% overall coverage (1.714-km wide strip transects at 6.4-km intervals)

Survey area (Stratum)	Muskoxen seen on or off transect	Muskoxen seen on transect	Population estimates	
			Estimate	Variance
I	3	1	3.7	10.56
II	97	64	222.7	5620.65
III	20	8	28.9	58.76
IV	338	153	591.0	22 846.89
V	171	94	321.0	13 467.32
VI	843	445	1642.7	42 081.12
VII	170	109	400.6	14 754.49
VIII	241	138	551.5	26 409.46
IX	48	29	103.0	2914.48
X	15	15	53.9	1267.28
XI	59	55	194.3	3353.56
XII	39	36	131.4	969.82
XIII	851	388	1433.5	61 929.53
I-VI	1472	765	2796.3	83 121.59
VII-XIII	1423	770	2862.0	128 886.47
I-XIII	2895	1535	5652.4	215 060.55

Table 21

Estimates of numbers of 1+ yr-old muskoxen on Melville Island, NWT, July 1987, based on systematic aerial survey at about 27% overall coverage (1.714-km wide strip transects at 6.4-km intervals)

Survey area (Stratum)	Muskoxen seen on or off transect[a]	Muskoxen seen on transect[a]	Population estimates	
			Estimate	Variance
I	3	1	3.7	10.56
II	84	57	198.3	4352.94
III	18	8	28.9	58.76
IV	316	139	536.9	17 504.97
V	156	87	297.1	11 682.79
VI	760	398	1469.2	27 703.35
VII	140	89	327.1	9090.19
VIII	194	107	427.6	14 857.45
IX	35	23	81.7	1950.89
X	14	14	50.3	1056.31
XI	45	41	144.8	1758.56
XII	37	34	124.1	1001.15
XIII	653	295	1089.9	35 257.31
I-VI	1337	690	2552.2	60 986.21
VII-XIII	1118	603	2241.3	75 163.94
I-XIII	2455	1293	4761.3	138 952.67

[a]Only 1+ yr-old muskoxen.

Table 22

Group statistics for Peary caribou on Byam Martin Island, NWT, July 1987, obtained from aerial survey

Group types by strata	Group statistics				
	N	Mean	±SD	Range	95% CI
Bull-only groups	1	2.0			
Mixed sex/age groups with calves					
calves included	6	10.2	6.37	2-18	3.5-16.9
calves excluded	6	7.3	5.05	1-14	2.0-12.6
Mixed sex/age groups without calves	6	4.2	1.33	3- 6	2.8- 5.6

Table 23

Herd statistics for muskoxen on Byam Martin Island, NWT, July 1987, obtained from aerial survey

Herd types by strata	Herd statistics				
	N	Mean	±SD	Range	95% CI
Bull-only herds	4	3.8	1.50	2- 5	1.36- 6.14
Mixed sex/age herds with calves					
calves included	2	9.5	0.71	9-10	3.15-15.85
calves excluded	2	8.5	0.71	8- 9	2.15-14.85
Mixed sex/age herds without calves	5	7.0	2.55	4-10	3.84-10.17

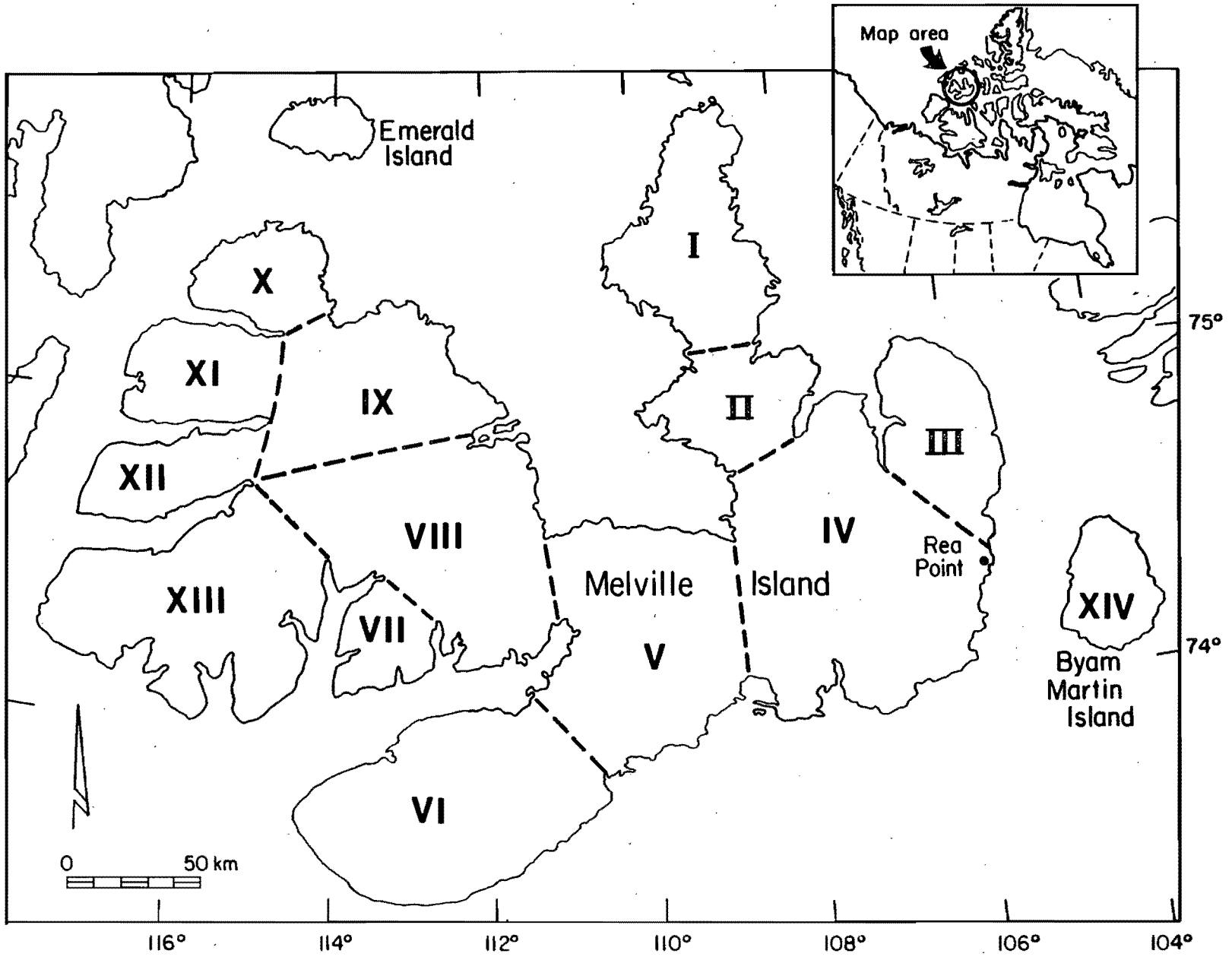

Figure 1. Locations of the 14 survey strata used in July 1987 survey of Melville and Byam Martin islands, NWT.

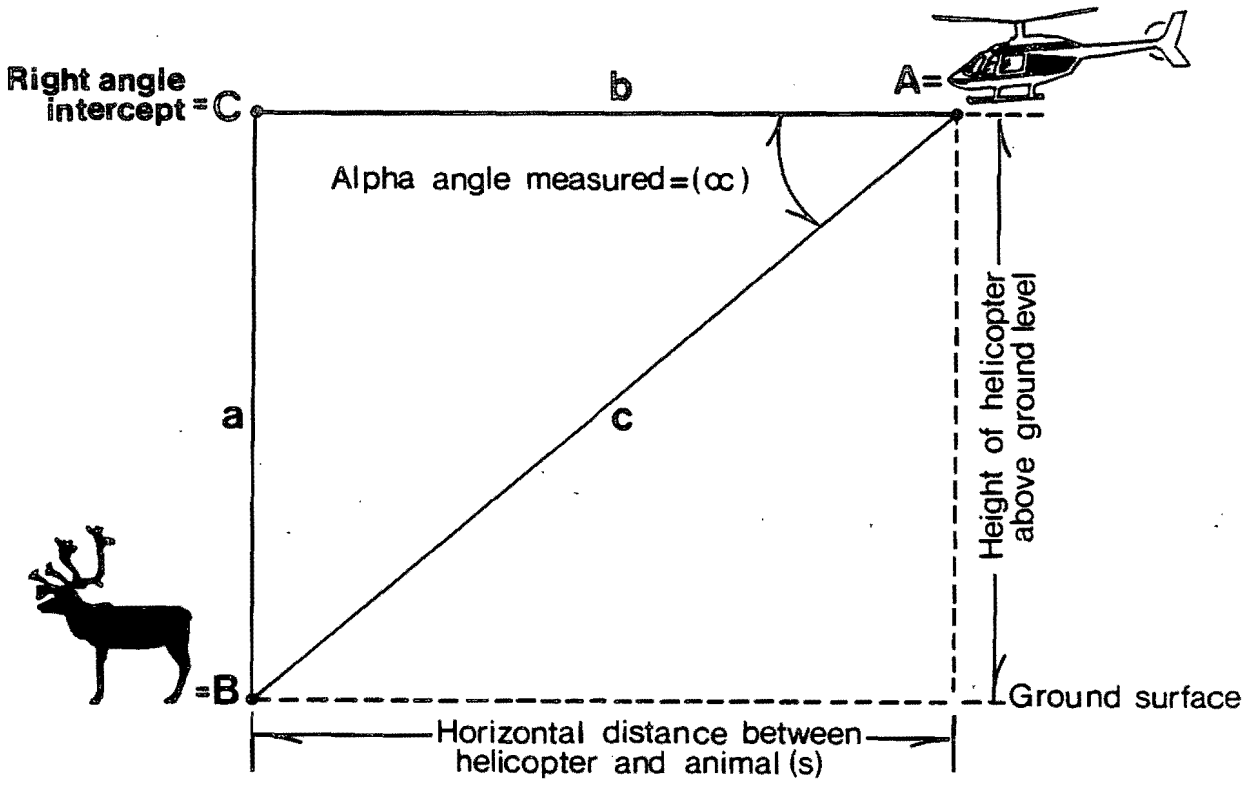

Figure 2. Schema of angle measured with hand held clinometer for calculation of horizontal right angle distance to animal(s) sighted along line transects.

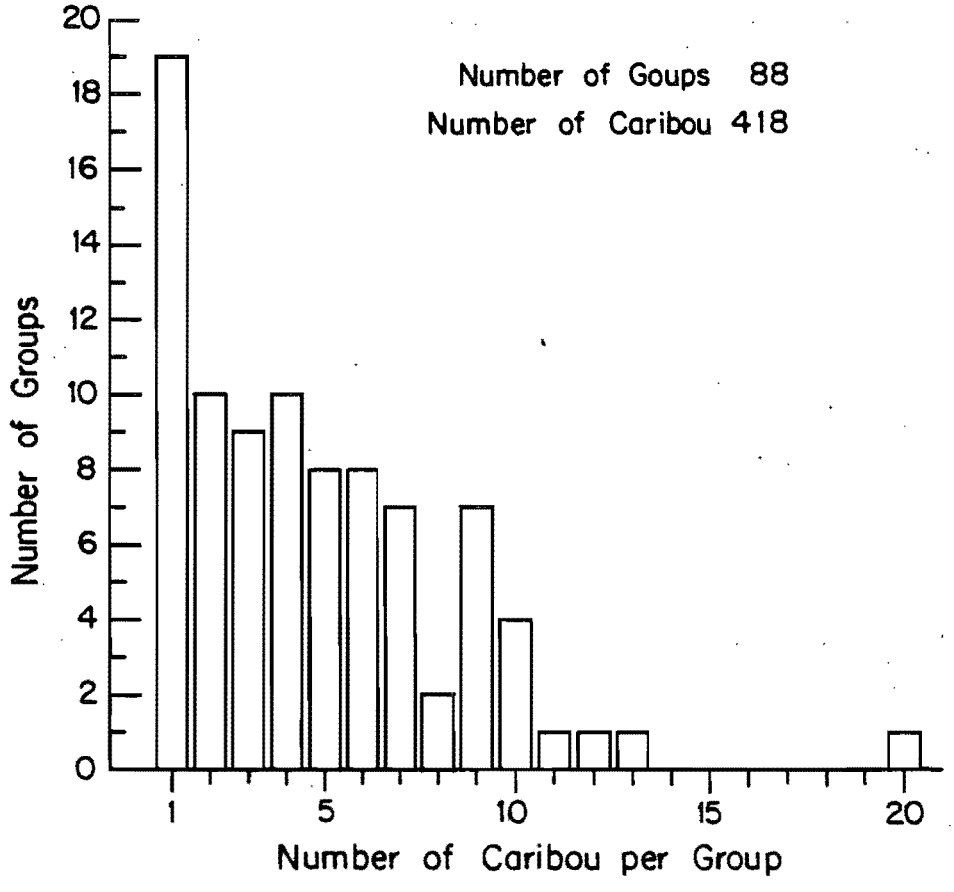

Figure 3. Distribution of Peary caribou by group size, obtained from aerial survey of Melville Island (st. I-XIII), NWT, July 1987.

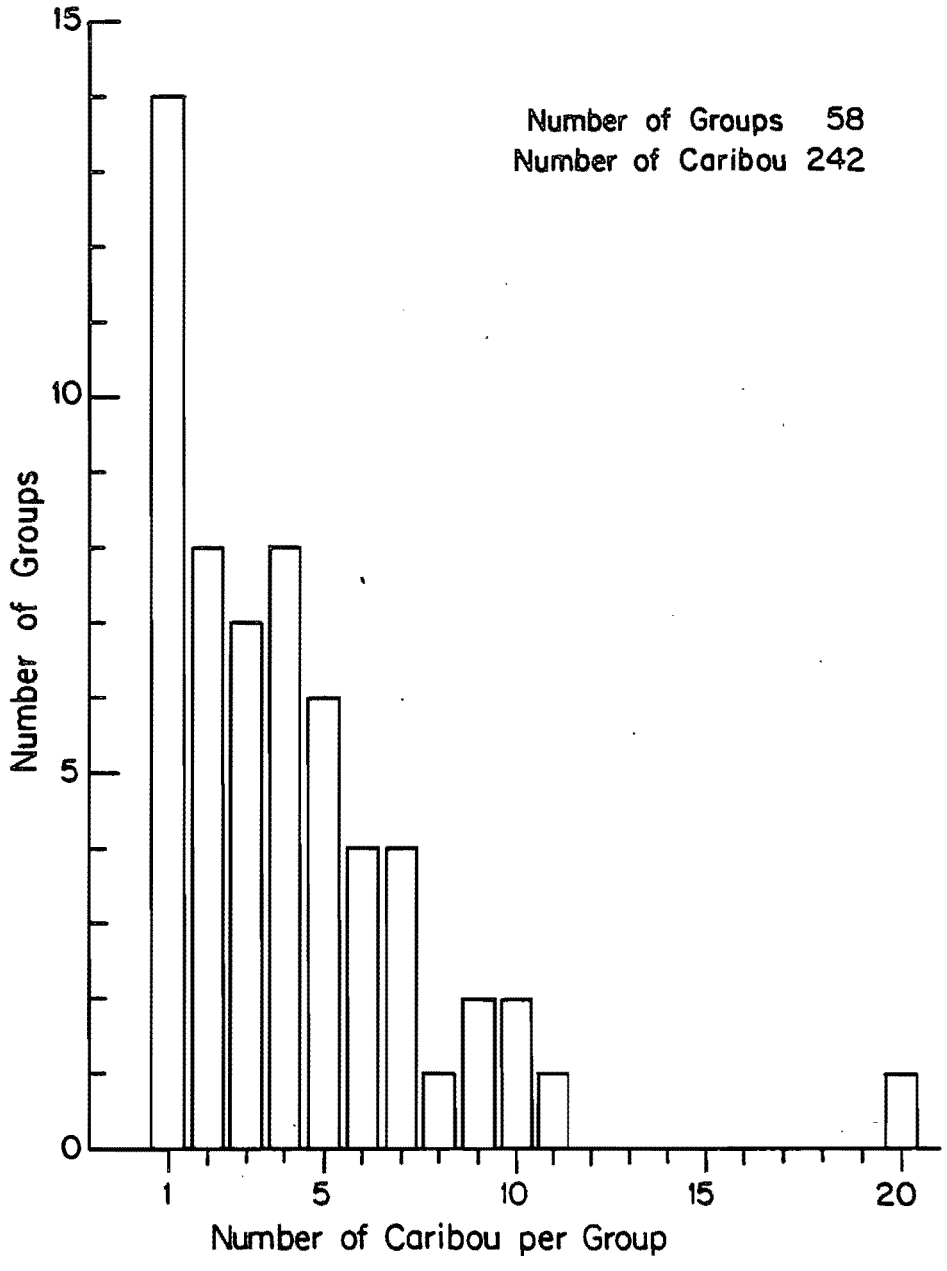

Figure 4. Distribution of Peary caribou by group size, obtained from aerial survey of eastern Melville (st. I-VI), NWT, July 1987.

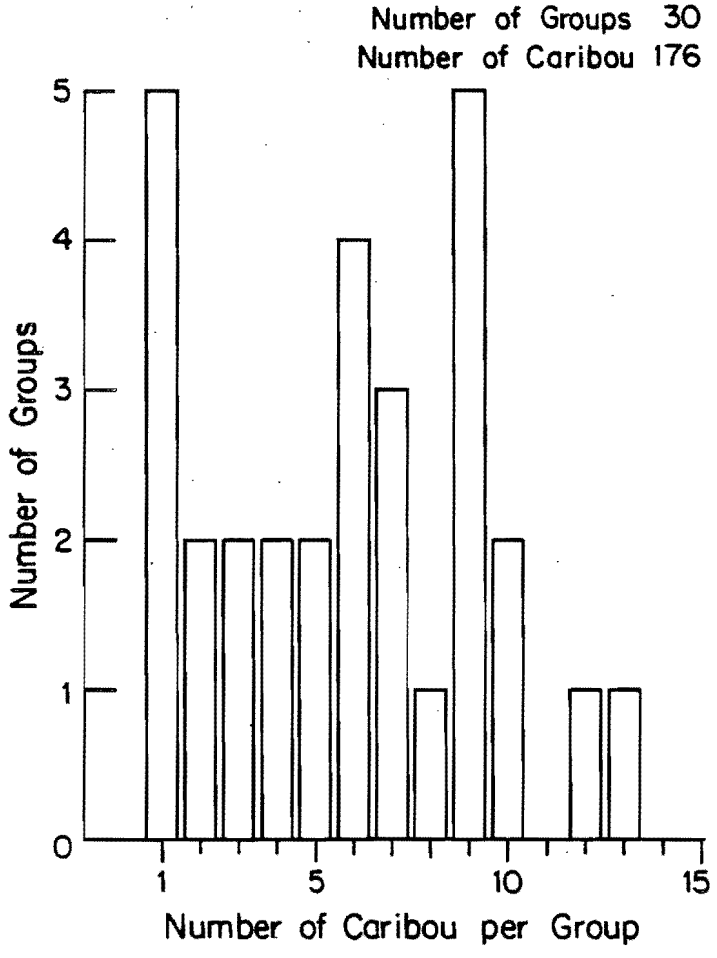

Figure 5. Distribution of Peary caribou by group size, obtained from aerial suvey of western Melville (st. VII-XIII), NWT, July 1987.

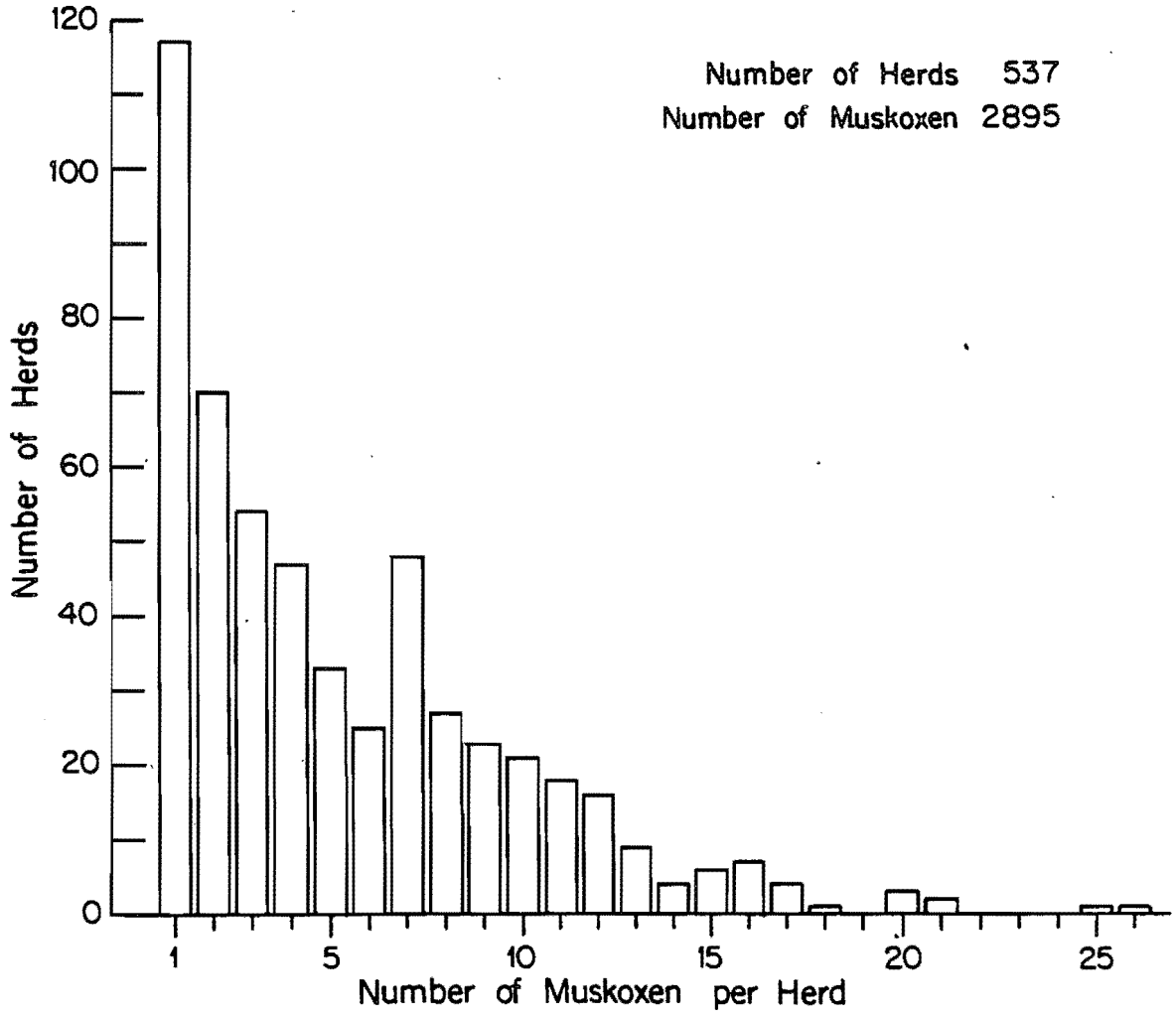

Figure 6. Distribution of muskoxen by herd size, obtained from aerial survey of Melville Island (st. I-XIII), NWT, July 1987.

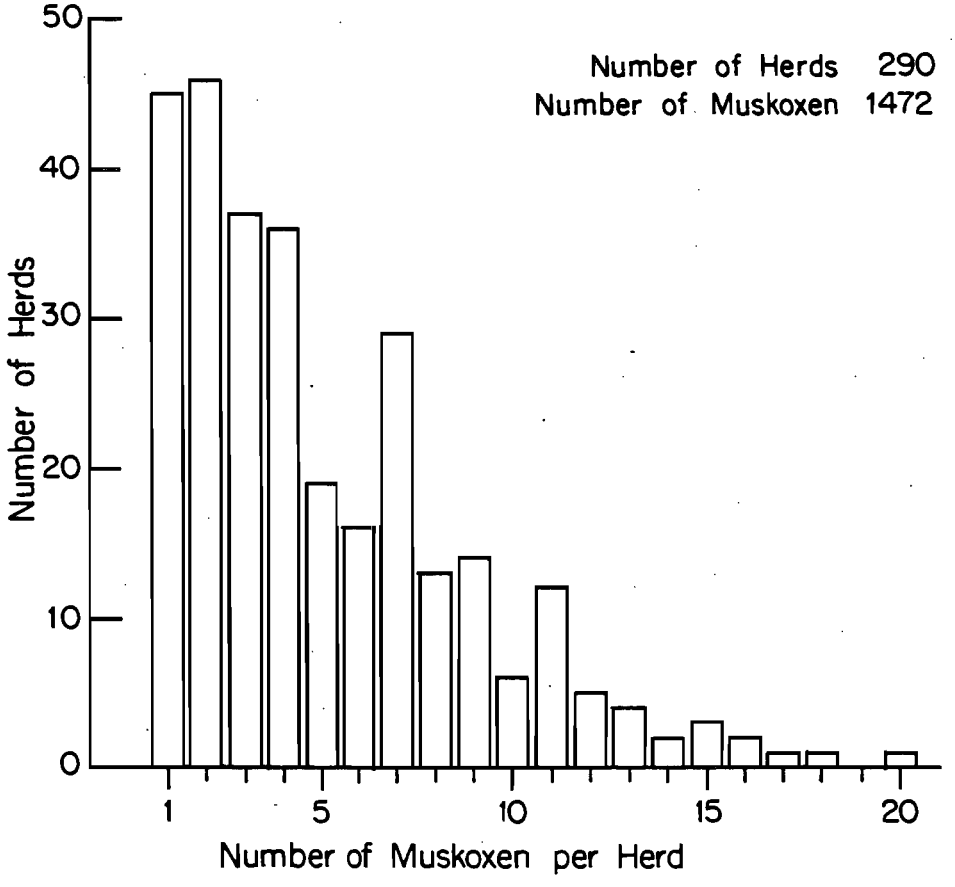

Figure 7. Distribution of muskoxen by herd size, obtained from aerial survey of eastern Melville (st. I-VI), NWT, July 1987.

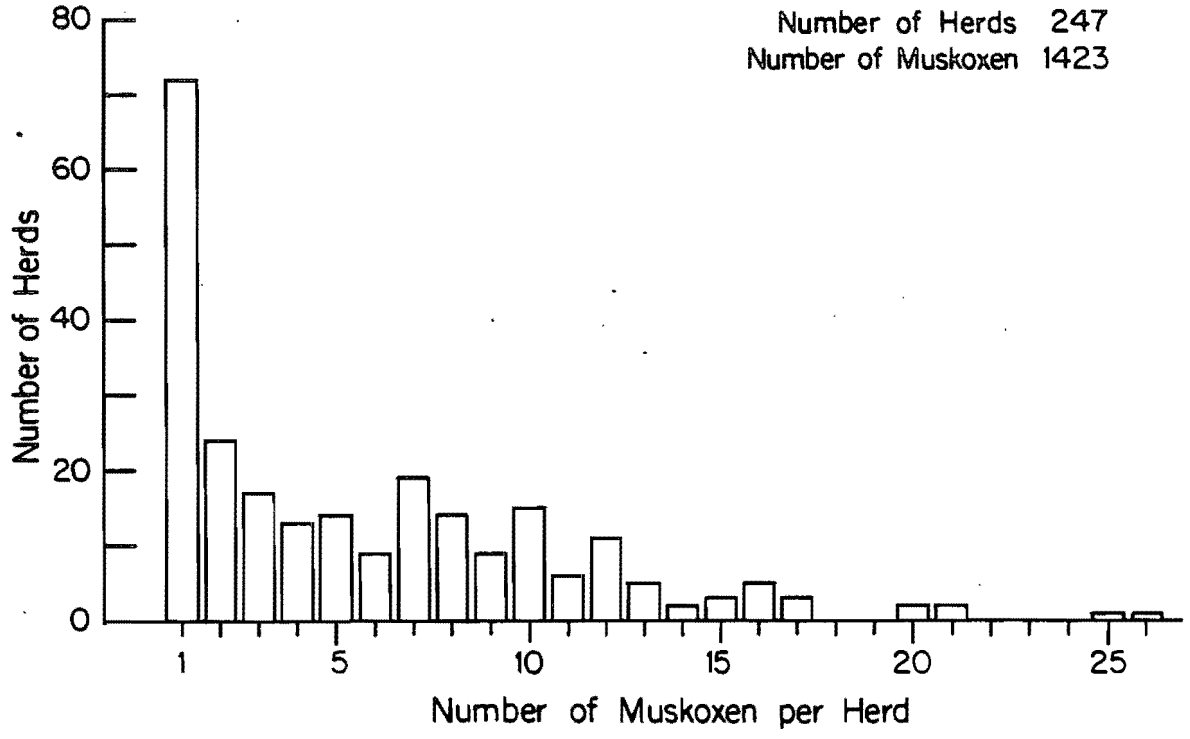

Figure 8. Distribution of muskoxen by herd size, obtained from aerial survey of western Melville (st. VII-XIII), NWT, July 1987.

Appendix I

Locations of survey line transects used during aerial survey of Melville (st. I-XIII) and Byam Martin (St. XIV) islands, NWT, July 1987, distances given by survey stratum as west (left) or east (right) of a baseline at 111°00'W for Melville and 105°00'W for Byam Martin

	Distance of transect from baseline by stratum (km)						
Transect number	I	II	III	IV	V	VI	VII
1	east 19.0	east 31.8	east 114.3	east 63.5	west 12.7	west 95.2	west 82.6
2	25.4	38.1	120.6	69.8	6.4	88.9	82.6
3	31.8	44.4	127.0	76.2	(baseline) 0.0	82.6	76.2
4	38.1	50.8	133.4	82.6	west 6.4	76.2	69.8
5	44.4	57.2	139.7	88.9	0.0	69.8	63.5
6	50.8	63.5	146.0	95.2	east 6.4	63.5	57.2
7	57.2	69.8	152.4	101.6	12.7	57.2	50.8
8	63.5	76.2		108.0	19.0	50.8	
9	69.8	82.6		114.3	25.4	44.4	
10	76.2	88.9		120.6	31.8	38.1	
11				127.0	38.1	31.8	
12				133.4	44.4	25.4	
13				139.7	50.8	19.0	
14				146.0	57.2	12.7	
15						6.4	
16						(baseline) 0.0	
17						east 6.4	
18						12.7	

Appendix I. cont.

Transect number	Distance of transect from baseline by stratum (km)						
	VIII	IX	X	XI	XII	XIII	XIV
1	west 108.0	west 108.0	west 127.0	west 152.4	west 171.4	west 184.2	east 3.2
2	101.6	101.6	120.6	146.0	165.1	177.8	6.4
3	95.2	95.2	114.3	139.7	158.8	171.	9.5
4	88.9	88.9	108.0	133.4	152.4	165.1	12.7
5	82.6	82.6	101.6	127.0	146.0	158.8	15.9
6	76.2	76.2	95.2	120.6	139.7	152.4	19.0
7	69.8	69.8	88.9	114.3	133.4	146.0	22.2
8	63.5	63.5	82.6	108.0	127.0	139.7	25.4
9	57.2	57.2		101.6	120.6	133.4	28.6
10	50.8	50.8			114.3	127.0	31.8
11	44.4	44.4			108.0	120.6	34.9
12	38.1	38.1				114.3	38.1
13	31.8	31.8				108.0	
14	25.4	25.4				101.6	
15	19.0	19.0				95.2	
16	12.7					88.9	

Appendix II

Lengths of line transects used during aerial survey of Melville (st. I-XIII) and Byam Martin (St. XIV) islands, NWT, July 1987

Transect number	Length of transect (km) given by stratum						
	I	II	III	IV	V	VI	VII
1	14.288	7.938	32.147	69.850	5.159	18.256	7.144
2	25.003	17.859	47.625	77.788	19.050	29.766	3.969
3	28.575	31.750	51.197	92.869	36.909	38.894	31.750
4	51.594	38.100	52.388	94.853	27.781	45.244	34.925
5	74.612	44.847	51.594	96.838	29.766	48.419	35.719
6	79.375	43.656	50.006	93.662	80.169	55.562	29.369
7	83.344	39.688	28.575	106.362	86.519	58.738	20.638
8	73.422	32.544		101.203	79.375	64.294	
9	32.544	25.400		80.962	78.978	64.691	
10	7.541	8.334		74.216	73.819	63.103	
11				65.484	73.819	61.912	
12				61.119	71.438	57.944	
13				53.975	61.912	55.166	
14				27.384	54.372	50.006	
15						39.688	
16						30.559	
17						19.447	
18						4.366	
Total for stratum	470.298	290.116	313.532	1096.565	779.066	806.055	1096.565

Appendix II. cont.

Transect number	Length of transect (km) given by stratum						
	VIII	IX	X	XI	XII	XIII	XIV
1	1.191	5.556	12.700	18.256	7.541	19.447	4.762
2	10.716	25.400	21.034	31.353	19.844	31.353	11.906
3	17.462	49.212	24.209	35.719	26.194	36.909	28.575
4	25.003	49.212	29.766	36.116	26.591	39.688	35.322
5	34.131	49.212	36.116	33.734	25.797	35.719	42.862
6	40.084	49.212	36.116	34.131	23.416	31.750	44.847
7	36.909	50.403	34.925	34.131	23.812	47.625	46.831
8	40.481	51.594	30.956	29.369	21.431	55.562	44.053
9	46.831	53.181		23.019	20.241	61.912	40.084
10	53.181	52.388			18.256	53.975	34.925
11	58.659	44.450			10.716	55.562	25.400
12	71.834	32.941				78.184	6.747
13	75.009	22.225				73.819	
14	74.612	9.922				63.103	
15	76.200	1.984				38.497	
16	72.231					30.162	
Total for stratum	744.534	546.892	225.822	275.828	223.839	753.267	366.314