F.L. Miller
E.J. Edmonds
A. Gunn

Foraging behaviour of Peary caribou in response to springtime snow and ice conditions

Occasional Paper
Number 48
Canadian Wildlife Service

Environment Canada / Environnement Canada

Canadian Wildlife Service / Service canadien de la faune

F.L. Miller*
E.J. Edmonds†
A. Gunn‡

Foraging behaviour of Peary caribou in response to springtime snow and ice conditions

Occasional Paper
Number 48
Canadian Wildlife Service

Disponible également en français

*CWS, Edmonton, Alta. T5K 2J5

† Alberta Fish and Wildlife Division, Dept. of Energy and Natural Resources, Edson, Alta. T0E 0P0

‡ Wildlife Service, Dept. of Renewable Resources, Government of the Northwest Territories, Yellowknife, NWT X1A 2L9

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

Catalogue No. CW69-1/48E
ISBN 0-662-12017-5
ISSN 0576-6370

Design: Rolf Harder & Associates

Contents

List of figures

List of appendices

Abstract

Acknowledgements

The Canadian Wildlife Service (CWS), Western and Northern Region, Environment Canada and the Polar Continental Shelf Project (PCSP), Energy, Mines and Resources Canada funded this research. We offer a special thanks to George D. Hobson, director, PCSP, and Frank Hunt, PCSP, for their continued support of our work and to Fred (A.) Alt and Bill (W.) Presley, PCSP, for logistical and technical support out of Resolute Bay, Cornwallis Island, NWT. We thank H.P.L. Kiliaan, CWS, for his technical assistance. W.E. Stevens, CWS, read and criticized the manuscript.

Studies of snow and ice conditions on Prince of Wales and Somerset islands; of inter-island movements of Peary caribou (*Rangifer tarandus pearyi*) between those two islands and the Boothia Peninsula; and of springtime foraging behaviour of Peary caribou were carried out during 1979 and 1980 in the Northwest Territories of Canada. Caribou in the Prince of Wales Island – Somerset Island – Boothia Peninsula complex function as an inter-island population with Prince of Wales serving as the major summering area for most of the caribou that winter on Somerset Island and the northern Boothia Peninsula. Comparison of spring snow and ice conditions suggests that there should be more snow-free caribou range available sooner on eastern Prince of Wales Island than on western Somerset Island. However, snow-covered ranges on either island would be iced over and unavailable to caribou at that time of the year. Peary caribou select poorly vegetated, windblown snow-free patches or cratering areas with shallow snow at the edge of snow-free sites or shallow fresh snow areas for springtime foraging sites because of the relative availability of forage. Inter-island movements, special springtime foraging behaviour, and late calving are some of the adaptive strategies that Peary caribou have evolved in response to restricted forage availability. The complex ecological relation of Peary caribou with their environment in the spring of the year warrants further study for a more detailed understanding of the key to caribou survival in the Canadian High Arctic.

Introduction

The Peary caribou (*Rangifer tarandus pearyi*) is found throughout the Canadian Archipelago and is a successful subspecific form of *Rangifer* which evolved under harsh climatic conditions.

Climatic extremes, especially of snow and ice, can cause periodic or sporadic oscillations in Peary caribou numbers. Unfavourable snow and ice conditions during a particularly severe winter probably caused the die-off and extensive intra- and inter-island movements of Peary caribou on the western Queen Elizabeth Islands in 1973–74 (Parker *et al.* 1975; Miller *et al.* 1977*a*, 1977*b*).

Many Peary caribou make traditional, annual movements between two or more islands, and those Peary caribou that remain on one island make extensive intra-island movements (Miller *et al.* 1977*a*, 1977*b*; Miller and Gunn 1978, 1980). Miller and Gunn (1980) suggested that the spring migrations of Peary caribou between Prince of Wales and Somerset islands were in response to the availability of shallow (< 10–15 cm) snow and snow-free ground on Prince of Wales. Their observations suggested that forage on most areas that have more than several centimetres of snow cover would become unavailable when snow began to melt in spring and ground-fast ice and ice lenses accumulate under and in the snow cover. In spring as the temperature of snow cover warms to > 0°C the melt water percolates down through the snow until it reaches the ground. The melt water then refreezes because the temperature of the ground stratum remains below freezing for some time after snow begins to melt. The ground-fast-ice layer accumulates to form an effective barrier to foraging by Peary caribou, its depth depending on the depth of snow cover, other climatic factors and site characteristics. Apparently, in years when the snow melts slowly, ground-fast ice can remain for a month or longer. In such years, Peary caribou can only forage on windblown beach ridges and snow-free slopes. This restriction of available forage occurs at the annual nadir of the Peary caribou's physical condition. Also, in some years, ground-fast ice persists into the late June calving period and in extremely harsh years (e.g., 1978 and 1979 on Prince of Wales Island) might remain for a week or more thereafter.

The study of the relation of springtime snow and ice conditions to movements of Peary caribou between Prince of Wales and Somerset islands began in spring and summer 1979. We expanded the study in 1980 to evaluate habitat used in spring by Peary caribou on the Savage Point area, Prince of Wales Island. This paper gives details of the following investigations: (1) aerial searches for evidence of inter-island movements of Peary caribou within the Prince of Wales Island – Somerset Island – Boothia Peninsula complex; (2) extensive snow and ice measurements on the coastal areas of eastern Prince of Wales Island and western Somerset Island before and during the period when snow melted in spring 1979; (3) intensive snow and ice measurements on the Savage Point area of Prince of Wales Island before and during the period when snow melted in spring 1980; (4) description and delineation of the plant communities used by Peary caribou on the Savage Point area of Prince of Wales Island in May and June 1980; (5) determination of possible relations between snow and ice conditions, plant community types, and caribou foraging areas on Savage Point, Prince of Wales Island, in May and June 1980; and (6) by inference, plant species eaten by caribou on Savage Point, Prince of Wales Island, in May and June 1980.

Study area

Prince of Wales and Somerset islands (Fig. 1) fall into the mid arctic zone of climate and vegetation (Woo and Zoltai 1977). There are no long-term weather records for either island, and the nearest weather station is about 160 km from those islands (Resolute Bay, Cornwallis Island). Weather conditions at Resolute Bay and at our camp on Savage Point were dissimilar. In 1980, temperatures were warmer in June at Savage Point than at Resolute Bay: the dates for the daily maximums exceeding 0°C were 7 and 13 June, respectively. The climate is severe, the growing season is short (June to August), and the islands are sparsely vegetated.

The climate of Prince of Wales Island is slightly cooler and drier than that of Somerset Island, and Maxwell (1981) separated the two islands in his classification of climatic regions of the Arctic. Maxwell (1981) based his subjective scheme on the percentage frequencies of the occurrence of low pressure centres, sea-ice conditions, topography, and annual net radiation. Prince of Wales Island and the western portion of Somerset Island lie in Region Ic (the Northwestern Region) together with Bathurst and Cornwallis islands. The eastern portion of Somerset Island lies within the Eastern Region in subregion IVb along with the Brodeur Peninsula of Baffin Island and Devon Island.

The Eastern Region ends and the Northwestern Region begins at the western edge of major cyclonic activity coming from Baffin Bay and Davis Strait. The influences of the greater cyclonic activity from the east causes the west-to-east gradient of heavier precipitation. The inland areas of Somerset Island and the Boothia Peninsula have a mean annual total snowfall in excess of 100 cm whereas Prince of Wales Island has less snow. The 75-cm isohyet runs north–south across Prince of Wales Island so that the western half of the island receives less than 75 cm of snow (Maxwell 1980). Although at the end of May, Somerset on the average has more than, and Prince of Wales less than 25 cm of snow, the latest date of snow-cover loss is similar for both islands, except on the extreme northwest corner of Prince of Wales Island. The difference in snowfall depth may be accentuated by topography. Western Somerset Island is rugged with valleys tending to run north–south almost perpendicular to the prevailing winds. Snow would tend to accumulate in the rugged rock outcrops and valleys, and be less wind-packed.

The isolines for the mean annual totals of growing days (temperatures exceeding 5°C) generally run along an east–west gradient in the Arctic. Both Prince of Wales and Somerset islands are cut centrally by the 50-day isoline and to the south the gradient is steep; the 100-day isoline cuts across the Boothia Peninsula. Although in summer, Prince of Wales and Somerset islands have similar temperatures, in winter Prince of Wales tends to be cooler (Maxwell 1980). The location of our study area halfway between the two nearest weather stations (Resolute Bay and Spence Bay) limits us to generalizations about differences within the study area.

We chose the study area (Figs. 2, 3, and 4) because it was where most of the inter-island movements of Peary caribou were detected in June 1977 (Miller and Gunn 1978) and in May–June 1978 (Miller and Gunn 1980). The observations in spring 1978 and additional observations in spring 1979 also indicated that the Savage Point area of Prince of Wales Island (72°34′N, 96°40′W) was one of the major landing areas for caribou migrating from Somerset Island (Figs. 2 and 3). Therefore, we established a base camp there in mid May 1980.

The north and east coasts of Savage Point are the only areas of Precambrian bedrock on Prince of Wales Island (Netterville *et al.* 1976). The Precambrian rock supported plant communities with some floristic differences from those found on the rest of Savage Point and Prince of Wales Island. Rock lichens, such as *Rhizocarpon geographicum*, *Umbilicaria* spp., and *Lecidea* spp.; the fruticose lichens, *Alectoria* and *Bryoria* spp.; and heath, *Cassiope tetragona*, were more common on this bedrock type. However, Savage Point included five plant communities representative of those found on the rest of Prince of Wales Island as well as two plant communities more typical of the Precambrian uplands on the west coast of Somerset Island (Russell *et al.* 1978).

The southern boundary of the study area was a ridge of sandstone and conglomerate bedrock rising to 150 m (Netterville *et al.* 1976). Much of the bedrock ridge had a surface veneer of silty sand and pebbles (Netterville *et al.* 1976) which supported a plant community of *Saxifraga oppositifolia* and a mixture of lichens and mosses. The bedrock outcrops were essentially barren, but a strip of well vegetated sedge – moss meadows several hundred metres wide ran along the base of the north-facing ridge. A barren limestone ridge (0–30 m high) that supported a sparse cover of *Saxifraga oppositifolia* ran in an east–west direction across the bridge of land connecting Savage Point to the rest of Prince of Wales Island.

The point itself has three main geological and surficial land forms with associated plant communities. The southwest portion of Savage Point had extensive beach-ridge systems running from 0 to 30 m asl. *Dryas integrifolia* – mixed sedge – crustose lichen communities dominated the gravel and sedimentary substrate of those beach ridges. The north, east, and south coasts of Savage Point had high ridges and cliffs (up to 180 m) of Precambrian bedrock and were sparsely vegetated. The bedrock outcrops supported a rock lichen – fruticose lichen – moss community and the gravelly till deposited over much of the area was dominated by *Dryas integrifolia, Saxifraga oppositifolia*, and crustose lichens. The elevation decreased gradually from highlands on the east coast to beach-ridge systems on the west, and the extensive slopes were covered with sedge, *Salix*, and moss seepage meadows.

Figure 1
Area searched by helicopter in May–July 1979 and in June 1980 included the sea-ice and small islands of Peel Sound and northern Franklin Strait, and the adjacent land areas of Prince of Wales Island, Somerset Island, and the Boothia Peninsula, NWT

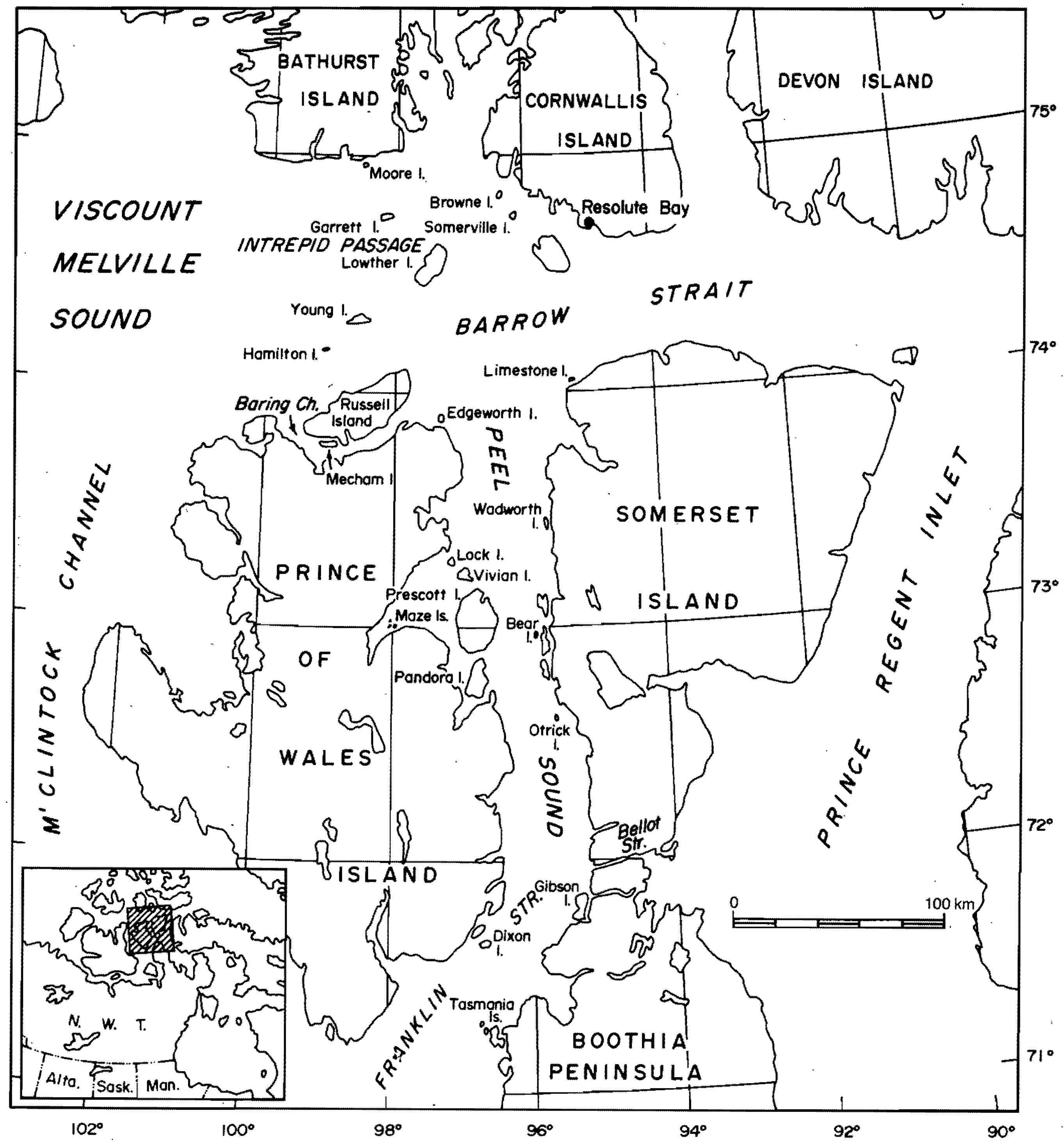


Figure 2
Locations of snow–ice sample sites on eastern Prince of Wales Island and its satellite islands of Prescott, Pandora, Vivian, and Lock; and western Somerset Island and its satellite islands of Wadworth, North, Central, and South, NWT, May–July 1979

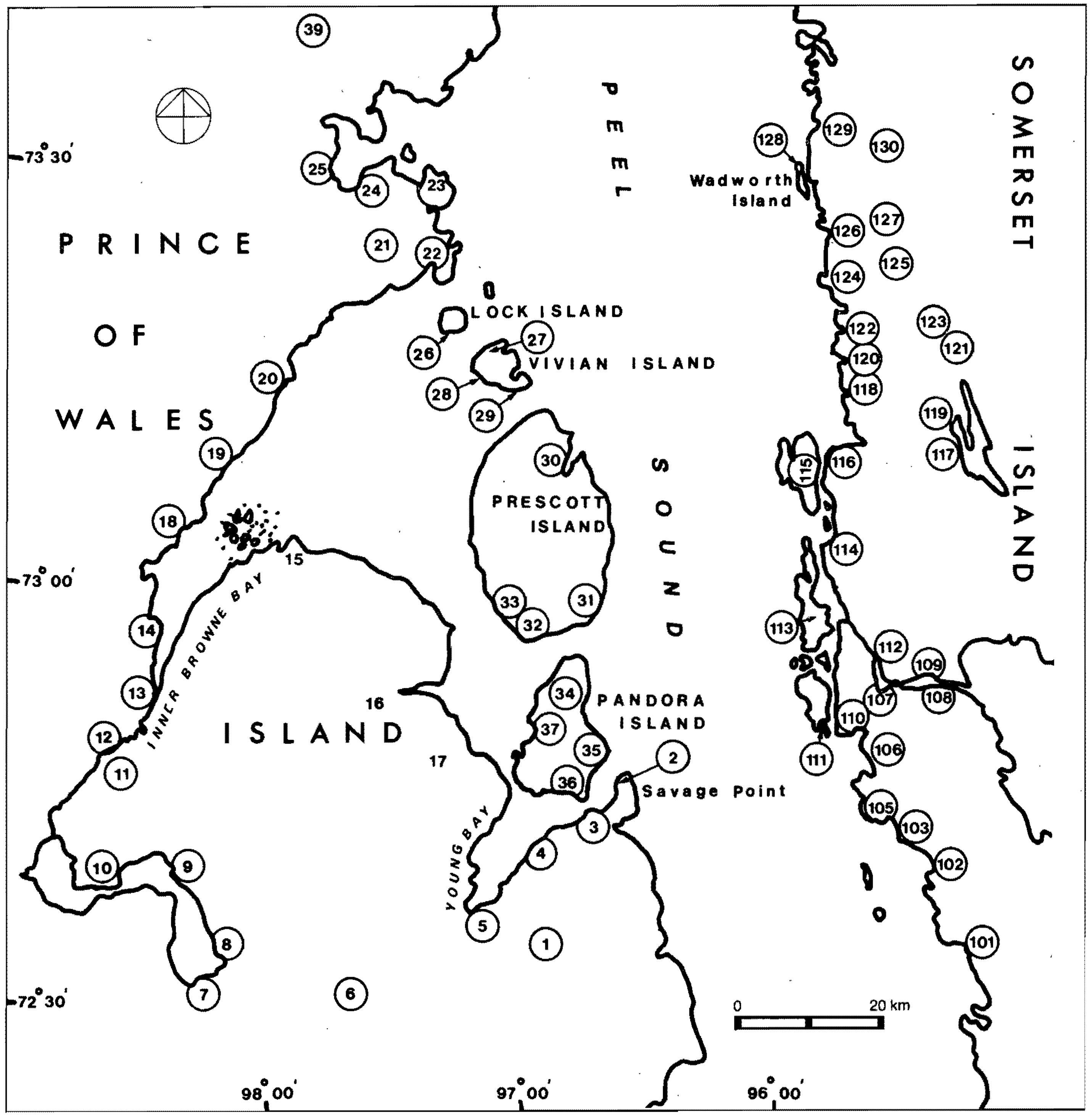


Figure 3
Zonation of western section (Prince of Wales Island area) of area searched by helicopter in May–July 1979 and in June 1980, NWT

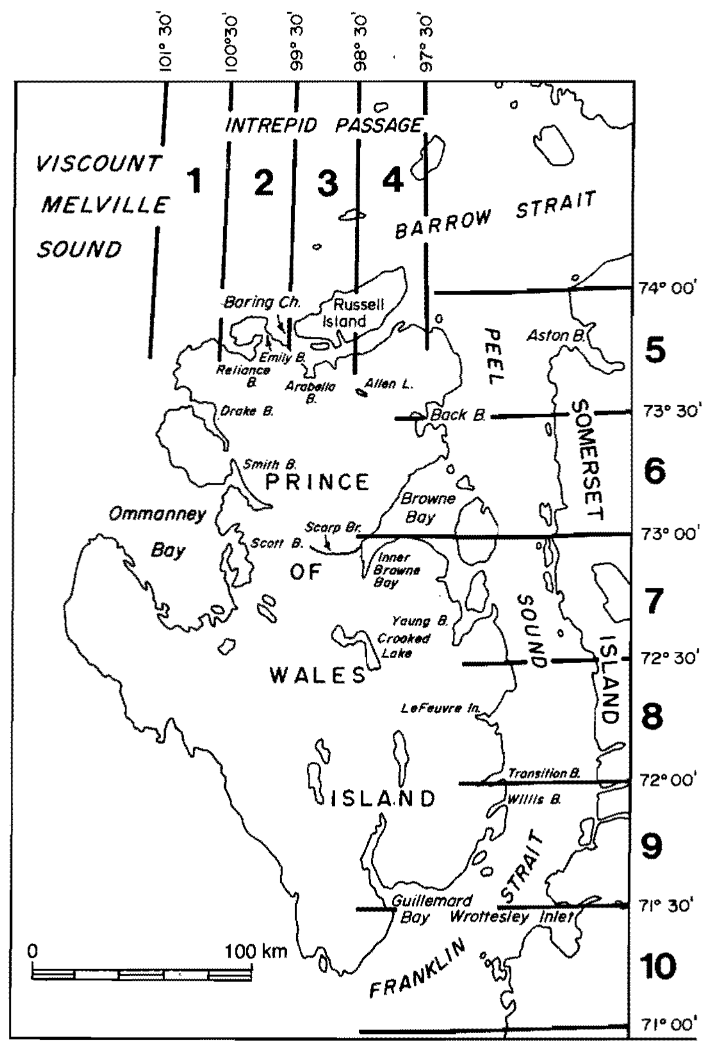
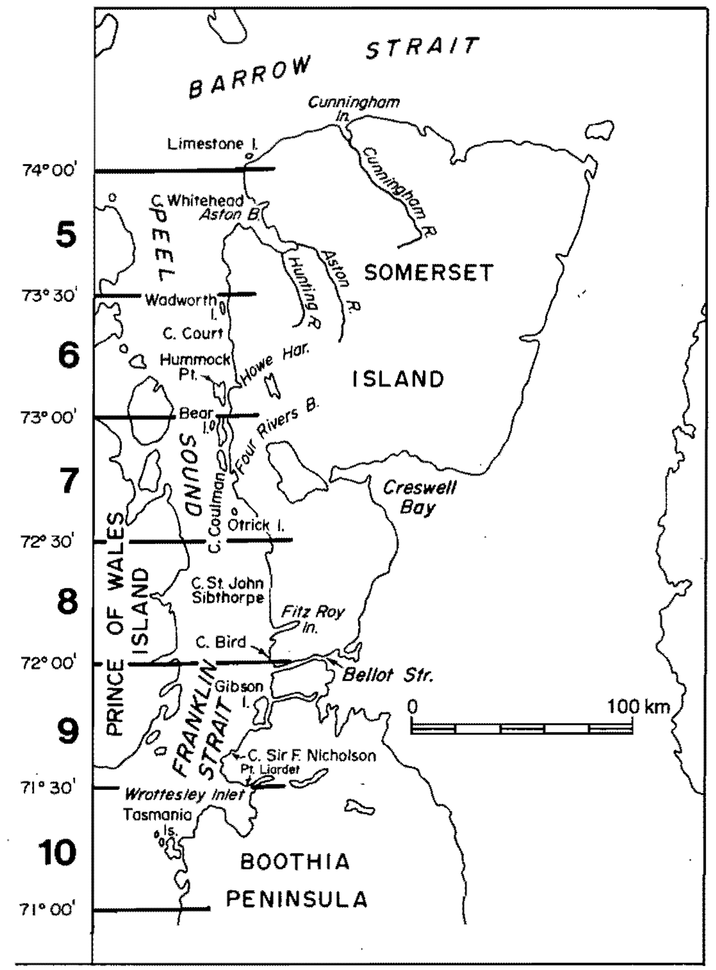


Figure 4
Zonation of eastern and southern sections (Somerset Island and Boothia Peninsula area) of area searched by helicopter in May–July 1979 and in June 1980, NWT



Methods

1 Snow–ice measurements

In 1979 a 2-man field crew chose snow–ice sample sites in areas of Prince of Wales Island and Somerset Island known to be used by Peary caribou in winter. Our crew used snowmobiles (Bombardier Scandic model) and a Bell 206B helicopter for transport.

Each snow–ice sample site consisted of six holes (digs) dug vertically to ground level and each dig was 20 m from the previous one. We numbered digs in an ascending direction from 0 to 100 m with the 0-m dig always at the lowest point. We dug holes with a straight, flat-edged shovel keeping the diameter of each dig as small as possible, depending on the snow depth.

We decided arbitrarily to take readings from the upslope side of each dig by cutting that side smooth with the shovel and sometimes brushing it with a mitten to reveal the snow-layer structure (profile) which we sketched.

We completed a standard form for each sample site. Measurements included temperature, taken with a bimetallic dial type thermometer (Weston model 2261) inserted in the snow–ground or snow–ice interface; thickness of each snow layer in millimetres measured with an aluminum metre stick; hardness in each layer, taken using two hardness gauges with capacities of 100–1000 g/cm^2 and 1000–10 000 g/cm^2. We took a minimum of three hardness measurements in each snow layer and recorded the range.

The thermometer was precooled in the snow while we dug each hole. It was the first instrument inserted and the last read: at all times the thermometer was left in the snow–ground or snow–ice interface a minimum of 3 min.

At each sample site we measured slope in degrees by means of a hand-held clinometer (Suunto Co., Finland). When possible, one of the workers went 20 m downslope from the 0-m dig and the other worker walked from the 0-m dig to the 100-m dig, pausing long enough at each dig to allow the slope reading to be taken. After recording (1) snow–ice sample site number, (2) dig number, (3) latitude, (4) longitude, (5) altitude, (6) aspect, (7) date, and (8) island, the worker marked the site for relocation by leaving a gravel-filled, green garbage bag beside the 100-m dig. We made subsequent readings 30–90 cm from previous digs to prevent measurements of conditions possibly caused by previous digs.

In 1980 we carried out an intensive study of spring snow and ice conditions because we lacked the resources to do the work effectively on an island-wide basis.

In 1980 snow–ice monitoring stations were established in 38 pairs along a 3.7-km transect on Savage Point that ran from N 120°W to N 60°E. We marked 38 intervals of 100 metres; then we positioned the other station of each pair 20 m away from the 100-m mark: upslope on even-numbered stations, starting with the 0-m station; and downslope on odd-number stations, starting with the 100-m station.

We followed the same general procedures as we used for making snow–ice measurements in 1979. At each station we recorded snow depth, range of snow-hardness values horizontally in each snow layer, temperature of the snow–ground or snow–ice interface, thickness of ground-fast ice (if any), aspect, slope, number of snow layers, number of ice lenses in the snow cover (if any), total ice-lens thickness (if any), and relative wetness of snow (5 categories). We also recorded when each station was first snow free.

We mapped the drainage patterns at each of the 76 snow–ice stations along the 3.7-km transect. We read slopes in degrees with a hand-held clinometer from each station to 20 m out on all eight major points of the compass: N, NE, E, SE, S, SW, W and NW. We determined snow-free aspects at the snow–ice stations based on these readings. Then we visually estimated the pattern of flow of water within a 20-m radius of the station and described any landform irregularities that would influence the flow of water to the station.

We determined the profile of the transect (m asl) by reading the slopes between stations and calculating the rise by: $\sin A = a/c$; where c and $\sin A$ were known (c = distance in metres between stations; $\sin A$ = slope in degrees from one station to the next station; and a = calculated rise in metres between stations). Altitudes (m asl) at 36 stations along the transect were initially determined by readings from a helicopter altimeter, pre-set at sea level on Young Bay, only several hundred metres north of the transect. We subsequently calculated the rise as a check on the helicopter altimeter readings using the lowest point on the transect (5.0 m asl) as our starting point.

2. Aerial searches

In 1979 we used either snowmobiles or a Bell 206B turbo-helicopter out of Resolute Bay, Cornwallis Island, to search for Peary caribou and their trails on the sea-ice within the study area. The helicopter flew at 20–40 m asl and about 130 km/h. The flights were non-systematic as weather most often dictated where and when we could fly. Thus, coverage was not equal throughout the search area. There were two observers and the front-seat observer plotted the observations on 1:250 000 topographic maps. Whenever caribou trails were encountered while searching with the helicopter, we circled and hovered or landed or both, to determine how many caribou had made the trails and which way (or ways) they had been going.

In 1980 we used a Bell 206B turbo-helicopter either out of Resolute Bay, Cornwallis Island, or our field camp on Savage Point, Prince of Wales Island, to search for caribou and their trails on the sea-ice within the study area, following the same procedures as in 1979.

In this report, as before, a "trail" is a series of tracks produced by one or more caribou; a "track" is a series of footprints put down by one caribou only. When trails separated into individual tracks, we counted the minimum number of individual caribou that travelled along them. In some instances, however, because of the caribou's habit of walking one behind the other and stepping in each other's footprints, we could not readily discern how many caribou actually had made a trail, and we only attempted to do so when it did not take too long. We assume in this report, lacking contrary evidence, that they were Peary caribou that crossed the sea-ice from northwestern Boothia Peninsula to southeastern Prince of Wales Island, but they could have been barren-ground caribou (*R. t. groenlandicus*) or crosses of the two subspecies.

3. Vegetation sampling

3.1. Field techniques

We sampled vegetation on the study area during July and August 1980. Sampling sites were located where caribou had cratered in May and June 1980. We recorded the positions of 24 sites on aerial photographs and carefully marked the 95 craters themselves in May and June 1980 with painted rocks to show their perimeters after snow melt.

Two-stage sampling could only be done when the vegetation was sufficiently grown for identification. First, we sampled vegetation in the marked craters, which varied in size both within a site and between sites. To determine percentage cover, we marked a 0.25-m × 0.50-m quadrat on each crater and in this area we made two counts using a pin frame of 10 pins. If a crater was larger than the quadrat, then more 0.25-m × 0.50-m quadrats were marked at 0.25-, 0.50-, or 1.0-m intervals, depending on the size of the crater. Thus the number of quadrats sampled for each crater site varied considerably (2–50). We identified plants to species, except for crustose lichens and mosses. We determined percentage frequency of occurrence of vegetation and bare ground for each quadrat. We noted slope, aspect, elevation, and animal use for each site. We subjectively estimated the moisture conditions of the substrate at each site: (1) xeric, when essentially no moisture could be detected; (2) mesic, when damp; and (3) hydric, when waterlogged, often with standing or running water.

Second, we sampled the plant communities in which the feeding areas were located. At each site we laid out two 100-m lines at right angles to each other. The lines were marked at 1-m intervals and a series of random numbers provided pairs of coordinates to position the quadrat (Kershaw 1964). The shape or size of some sites did not lend themselves to this grid system, so we laid out one or more 30–100-m transects (depending on the extent of the community) and located quadrats (0.25-m × 0.50-m) within a 20-m band on either side. Pairs of coordinates were taken from a random numbers table: even-numbered quadrats were located to the right of the transect and odd-numbered to the left. Percentage cover and frequency of occurrence were determined as described for stage one.

We found 24 feeding areas during late May – early June, but when we examined them during the snow-free period we subdivided three of them. Therefore, our analysis includes 27 feeding areas.

We also subjectively decided that some sites, though up to 1.6 km apart, were in the same plant community. We randomly sampled some quadrats at those feeding areas judged to be in the same plant community and combined the data to comprise one sample of a plant community. This occurred for 11 feeding areas and explains why sampling data are given for only 16 plant communities.

We observed foraging caribou with the aid of 10 × 40 field glasses and 60X zoom spotting scopes. We made the observations unsystematically, as our primary purpose was to locate and mark as many foraging areas and feeding craters as possible. We especially wanted not to disturb the caribou, so as not to influence their movements.

We measured the rate of travel by foraging caribou by timing the movements of caribou between identifiable landmarks. Then we attached a 60-m length of rope to the rear of a skidoo and pulled it along the caribou trails, recording the number of lengths between landmarks. The rate of travel was calculated by dividing the distance travelled by the caribou by the time they spent foraging and walking between those known landmarks.

3.2. Analysis of data

The two sets of field data, that for the feeding sites and that for the plant communities in which the feeding areas were located, were paired. For each feeding area and plant community we calculated means of percentage cover and percentage frequency of occurrence of plant species or plant groups: means were based on the sampled quadrats. Standard deviations and prominence values were calculated for the dominant plant species. Prominence values, calculated by multiplying cover by the square root of the frequency for each species (Douglas 1974), were an index to compare the relative importance of species in the feeding area and the plant community.

We grouped the 16 plant communities that were sampled and their corresponding 27 feeding areas into six "range types" or recognizable land forms characterized by certain dominant plant species and a distinct substrate and moisture regime. The plant communities had been based on percentage frequency of occurrence of plants and percentage cover, rather than simple dominance, in addition to moisture and substrate. Dominant plant species in a range type were those plants or plant groups that had both a relatively high percentage cover and a relatively high frequency of occurrence. A plant species is referred to as common if it has a high frequency of occurrence ($\geq$50%) in a range type. For each range type, the means of percentage cover and frequency of occurrence of plant species found in the feeding area or areas were compared to the same data for the plant community or communities, but the data were too variable to test for significant differences.

We used a 1:60 000, black-and-white aerial photograph of Savage Point to map land units that were recognizable at that scale: range types or range subtypes when possible, otherwise ecosites (a relatively large-scale ecological mapping unit that employs both plant associations and physiographic features). We calculated the area of each map unit by planimetry with a Keuffel and Esser planimeter.

4. Statistics

Throughout the text the accepted level of significance is $P \leq 0.05$. Observed/expected (O/E) indices were calculated in two-way contingency tables for standard Pearson chi-square tests.

Results

1. Snow–ice measurements 1979

Between 5 May and 2 July 1979 we made 1278 digs at 67 different sample sites (Fig. 2): 41 sites (we dug 228 holes during premelt, 414 during melt, and 198 during run-off for a total of 840 digs) along the east coast of Prince of Wales Island and 26 sites (we dug 156 holes during premelt, 156 during melt, and 126 during run-off for a total of 438 digs) along the west coast of Somerset Island (Fig. 2, App. 1 and 2).

We defined "premelt" as that period before the snow showed any signs of wetness; "melt" was the period from the first visible signs of wetness in the snow cover to when some streams contained visible free-flowing water; and "run-off" was the period from the beginning of visible free-flowing water in the streams until the snow cover was gone. In 1979 we terminated our sampling after the first few days of the run-off due to lack of funds.

We established all snow–ice sample sites on snow covered areas during premelt (5 May – 2 June). At that time, snow was 17.4% (4.4 cm) deeper at the digs on Somerset Island than at the digs on Prince of Wales Island, but the difference was not significant (Table 1).

Snow had disappeared at 35.9% (56) of the digs on Somerset Island and 24.2% (100) of the digs on Prince of Wales Island dug during melt (6–27 June). Average snow depth increased by 5.6% on Prince of Wales Island and decreased by 1.0% on Somerset Island. The average snow depth was, however, 10.1% (2.7 cm) greater on Somerset Island than on Prince of Wales Island, but the difference was not significant.

The pattern of snow loss on sample areas was reversed during run-off: 65.2% (129) of the digs were snow free on Prince of Wales Island and only 38.1% (48) on Somerset Island. Average snow depth remained, however, deeper (45.2% = 9.6 cm) on Somerset Island than on Prince of Wales Island (Table 1) and the difference had become significant. During run-off (1–2 July), proportionately more snow-free digs occurred on Prince of Wales Island than on Somerset Island.

We compared the percentage of snow-free digs during melt with the percentage of snow-free digs during run-off for each island. On Prince of Wales Island relatively more digs were snow free during run-off than during melt, and the difference was significant. However, that pattern was not obtained for Somerset Island where non-significant values for the snow-covered and snow-free digs occurred at about the expected rates during the two periods.

Maximum hardness of snow layers during the premelt varied from 7000 to 10 000 g/cm^2 and minimum hardness from 100 to 4000 g/cm^2. Snow hardness was measured only during the premelt, when the work could be done by snowmobile. Such measurements were discontinued during melt and run-off, because of the need for rapid sampling over extensive areas and the high cost of helicopter rental.

Snow layering in the snow-cover profile appeared minimal during the study periods. Ranges and means ± standard deviations for numbers of distinguishable snow layers in the snow cover were as follows:

	Snow layers		
	No.	Range	SD
Prince of Wales Is.			
Premelt	1–5	2.5	± 0.9
Melt	1–5	2.2	± 0.9
Run-off	1–3	1.9	± 0.8
Somerset Is.			
Premelt	1–4	2.2	± 0.9
Melt	1–3	2.0	± 0.4
Run-off	1–3	2.0	± 0.6

Ranges and means ± standard deviations for centigrade temperatures at the snow-cover – ground-surface interface were obtained as follows:

	Temperature, °C		
Island	Range	Mean	SD
Prince of Wales	−22 to − 7	−15.3	± 3.3
Somerset	−18 to − 5	−11.5	± 2.6
Prescott	−21 to − 8	−14.1	± 3.5
Pandora	−20 to − 7	−14.0	± 3.4
Vivian	−17 to − 7	−13.2	± 3.2
Lock	−15 to −10	−12.5	± 1.6
Wadworth	−15 to −11	−13.2	± 1.3
North	−14 to − 7	−11.3	± 2.4
Central	−15 to − 8	−12.2	± 3.0
South	−14 to −13	−13.8	± 0.4

Temperatures were recorded only during the premelt sampling period because of time and cost constraints.

Ground-fast ice, formed during autumn before snow fell, was found on only 6 (2.6%) digs on Prince of Wales Island and none on Somerset Island during premelt (Table 1). Whether or not standing water had existed on those six digs on Prince of Wales Island was not determined.

Springtime development of ground-fast ice occurred at 132 (31.9%) digs on Prince of Wales Island and 42 (26.9%) digs on Somerset Island during melt. Average thickness of ground-fast ice was not significantly greater (20.7%, 11.5 mm) on Prince of Wales Island than on Somerset Island.

We compared the relative frequency of occurrence of ground-fast ice on Prince of Wales and Somerset islands to

Table 1
Measurements of snow depth (cm), ground-fast-ice thickness (mm), and combined thicknesses of superimposed ice lenses (mm) in the snow cover of snow–ice sample sites, Prince of Wales Island and Somerset Island, NWT, 5 May – 2 July 1979

	Premelt*				Melt†				Run-off‡			
Island	No. samples	*x*	± SD	Range	No. samples	*x*	± SD	Range	No. samples	*x*	± SD	Range
Snow depth, cm												
Prince of Wales	228	25.3	18.8	1.5–107.0	314	26.7	19.7	2.0–113.5	69	21.3	14.2	3.0–67.0
Somerset	156	29.7	21.4	2.0–130.0	100	29.4	20.5	3.0–109.0	78	31.0	19.6	2.0–107.0
Ground-fast-ice thickness, mm												
Prince of Wales	6	13.2	14.7	1–34	132	66.5	48.1	5–270	72	68.5	45.5	5–280
Somerset					42	55.0	40.9	2–180	46	60.7	42.1	4–220
Superimposed ice lenses combined thicknesses, mm												
Prince of Wales	2	1.0		1–1	65	37.4	39.1	2–220	13	39.6	36.4	15–155
Somerset					31	27.3	26.7	3–110	24	29.4	27.8	4–110

*Prince of Wales = 228 digs; Somerset = 156 digs.
†Prince of Wales = 414 digs; Somerset = 156 digs.
‡Prince of Wales = 198 digs; Somerset = 126 digs.

evaluate the development of ground-fast ice on the two islands during melt. Sites with ground-fast ice increased slightly more than expected on Prince of Wales Island and less than expected on Somerset Island, but the differences were not significant.

Ground-fast ice occurred at 46 (36.5%) digs on Somerset Island and 72 (36.4%) digs on Prince of Wales Island during run-off (Table 1). The average thickness of ground-fast ice was still not significantly greater on Prince of Wales Island (12.9%, 7.8 mm) than on Somerset Island (Table 1).

We compared the relative frequency of occurrence of ground-fast ice on Prince of Wales and Somerset islands to evaluate the spread of ground-fast ice on both islands during run-off. The results were not significant; the spread of ground-fast ice was proportionally as expected.

We compared the percentage of digs with ground-fast ice during melt with the percentage of such digs during run-off for each island to evaluate temporal development of ground-fast ice on both islands. The two comparisons were not significant: on both islands, the rates suggested relatively more sites with ice during run-off.

We regressed maximum thickness of ice on maximum snow depth, treating each of the snow–ice sample sites on Prince of Wales Island in 1979 as a sample unit, and obtained a statistically significant relationship: max. ice (mm) = 67.5 mm + 0.083294 × snow depth (mm) (Fig. 5). The value of the prediction is weakened, however, by a 54.067 mm standard deviation of the residuals for the above relationship. We made the same regression for the snow–ice sample sites on Somerset Island in 1979 but obtained a statistically non-significant relationship (Fig. 6).

Superimposed single ice lenses occurred in the snow cover on only 2 (0.9%) digs on Prince of Wales Island and none on Somerset Island during premelt (Table 1). We later determined that those two digs on Prince of Wales Island were associated with stream courses and overflow (run-off) channels.

Superimposed ice lenses occurred in the snow cover on 31 (19.9%) digs on Somerset Island and on 65 (15.7%) digs on Prince of Wales Island during melt. Average thicknesses of total ice lenses found per dig was 37.0% (10.1 mm) greater on Prince of Wales Island than on Somerset Island, but the difference was not significant.

The occurrences of superimposed ice lenses decreased during run-off: ice lenses occurred at 24 (19.0%) digs on Somerset Island and only 13 (6.6%) digs on Prince of Wales Island. Average thicknesses of total ice lenses found per dig was still not significantly greater on Prince of Wales Island (34.7%, 10.2 mm) than on Somerset Island (Table 1).

Figure 5
Relationship between maximum accumulation of ice and maximum snow cover at each snow–ice sample site, Prince of Wales Island, NWT, 1979

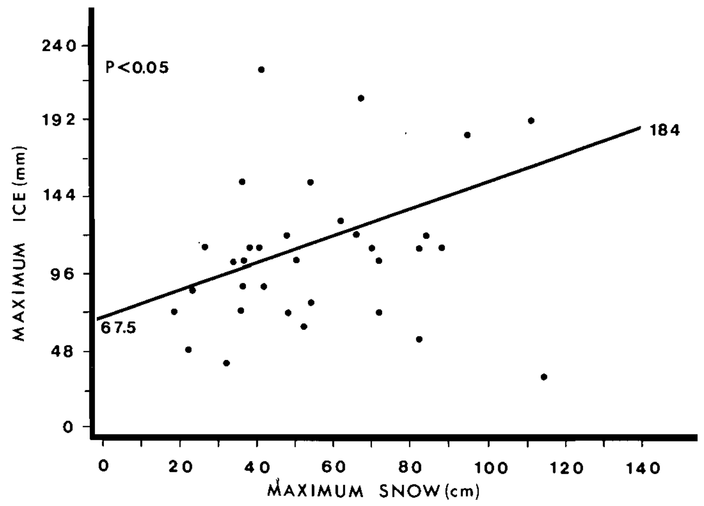
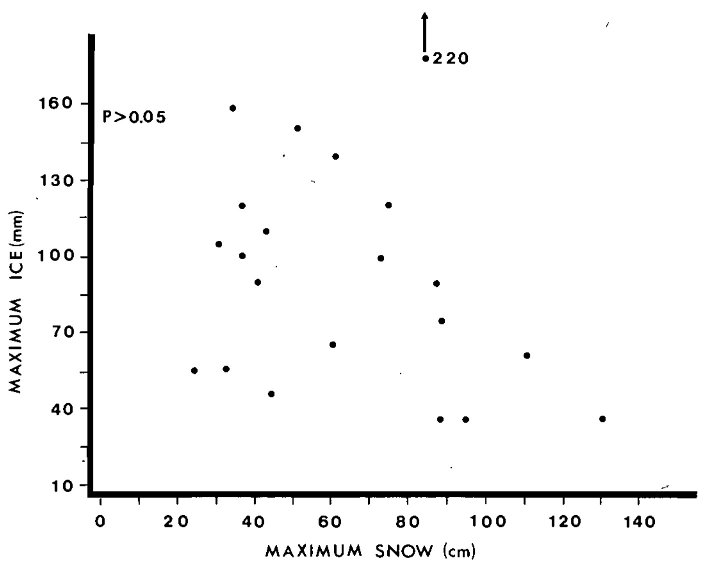


Figure 6
Relationship between maximum accumulation of ice and maximum snow cover at each snow–ice sample site, Somerset Island, NWT, 1979



We compared the percentage of digs where superimposed ice lenses occurred between islands and by island between melt and run-off. There was a proportionately greater than expected rate of occurrence of ice lenses at digs on Somerset Island and a lower than expected rate on Prince of Wales Island during melt. During run-off, ice lenses in the snow cover occurred at a relatively greater than expected rate on Somerset Island and at a less than expected rate on Prince of Wales Island. On Prince of Wales Island ice lenses occurred at a relatively greater than expected rate during melt and at a less than expected rate during run-off. On Somerset Island the results were not significant, as relative occurrences of ice lenses were as expected.

Percentage distributions and O/E indices were calculated for the slope classes, snow-cover-exposure classes, altitude classes, and distance-from-the-seacoast classes of snow–ice sample sites (Tables 2–5). Within island comparisons of those characteristics of snow–ice sample sites by sampling periods were all not significant (Tables 2–5). Their O/E indices can still be referred to, however, for some indication of proportional representation of the various classes of the site characteristics. All comparisons between sites on Prince of Wales Island and sites on Somerset Island were significantly different (Tables 2–5). The O/E indices for each island during all periods (Tables 2–5) can be used to indicate whether site characteristics are over or under represented.

Major differences in proportional over or under representation of site characteristics for the entire sample were as follows: (1) 1–3° slopes over represented on Prince of Wales Island and under represented on Somerset Island; (2) 7–11° slopes under represented on Prince of Wales Island and over represented on Somerset Island; (3) south-facing sites and flat sites over represented on Prince of Wales Island and under represented on Somerset Island; (4) east-facing and north-facing sites under represented on Prince of Wales Island and over represented on Somerset Island; (5) 1–30 m altitude over represented on Prince of Wales Island and under represented on Somerset Island; (6) 91–180 m and 181–420 m altitudes under represented on Prince of Wales Island and over represented on Somerset Island; (7) sites 15–38 km, 5–9 km, and 0.1–0.9 km from the sea coast over represented on Prince of Wales Island and under represented on Somerset Island; and (8) sites 1–4 km and 10–14 km from the sea coast under represented on Prince of Wales Island and over represented on Somerset Island.

Table 2
Percentage distributions, by slope classes, of digs sampled at snow–ice sample sites, Prince of Wales Island and Somerset Island, NWT, May–July 1979 and the corresponding observed/expected (O/E) indices*

Period	Digs sampled	% slope (O/E index)		
		1–3°	4–6°	7–11°
Prince of Wales Island				
Premelt	180†	52.8 (0.94)	41.1 (1.07)	6.1 (1.19)
Melt	330	59.1 (1.05)	37.0 (0.96)	3.9 (0.77)
Run-off	174	54.6 (0.97)	39.1 (1.01)	6.3 (1.24)
All periods	684	56.3 (1.47)	38.6 (0.95)	5.1 (0.24)
Somerset Island				
Premelt	126	4.8 (0.97)	42.8 (0.97)	52.4 (1.03)
Melt	126	4.8 (0.97)	42.8 (0.97)	52.4 (1.03)
Run-off	114	5.2 (1.15)	47.4 (1.07)	47.4 (0.93)
All periods	366	4.9 (0.13)	44.3 (1.09)	50.8 (2.42)

*O/E indices calculated in two-way contingency table for standard Pearson Chi square tests: by sample periods, Prince of Wales = $0.9>P>0.5$; Somerset = $0.975>P>0.9$; and by all sampling periods between islands = $P<0.005$.
†This consideration does not include 228 digs designated as being on flat (0° slopes): Prince of Wales Island (156 digs) premelt = 48, melt = 84, run-off = 24; and Somerset Island (72 digs) premelt = 30, melt = 30, run-off = 12.

Table 3
Percentage distributions, by snow-cover exposure, of digs sampled at snow–ice sample sites, Prince of Wales Island and Somerset Island, NWT, May–July 1979 and the corresponding observed/expected (O/E) indices*

Period	Digs sampled	% aspects (O/E index)				
		North	East	South	West	Flat
Prince of Wales Island						
Premelt	228	21.1 (1.05)	13.2 (0.88)	21.1 (0.92)	23.7 (1.00)	21.1 (1.13)
Melt	414	18.8 (0.94)	14.5 (0.97)	24.6 (1.08)	21.7 (0.92)	20.3 (1.09)
Run-off	198	21.2 (1.06)	18.2 (1.21)	21.2 (0.93)	27.3 (1.16)	12.1 (0.65)
All periods	840	20.0 (0.95)	15.0 (0.89)	22.8 (1.11)	23.6 (1.00)	18.6 (1.04)
Somerset Island						
Premelt	156	23.1 (0.99)	19.2 (0.94)	15.4 (0.94)	23.1 (0.99)	19.2 (1.17)
Melt	156	23.1 (0.99)	19.2 (0.94)	15.4 (0.94)	23.1 (0.99)	19.2 (1.17)
Run-off	126	23.8 (1.02)	23.8 (1.16)	19.0 (1.16)	23.8 (1.02)	9.5 (0.58)
All periods	438	23.3 (1.10)	20.6 (1.22)	16.4 (0.80)	23.3 (1.00)	16.4 (0.92)

*O/E indices calculated in two-way contingency table for standard Pearson Chi square tests: by sampling periods, Prince of Wales = $0.5> P>0.1$; Somerset = $0.9>P>0.5$; and by all sampling periods between islands = $P<0.05$.

2. Snow–ice measurements 1980

We measured snow and ice conditions at the 38 paired stations (n = 76) along the 3.7-km transect across the major valley on the base of Savage Point. The snow–ice stations were located and first read on 30–31 May and subsequently on 9, 15, 18, 23, 26, 28, 29 June, and 1, 3, 5, 7, 9 July 1980.

The high ground beyond the west end of the transect rises to about 150 m asl and beyond the east end to just under 150 m asl. Our transect course started at 132 m asl (0–20-m station) and descended eastwards 127 m to 5 m asl in the bottom of the major creek that drains north into Young Bay (between stations 900 + 20-m and 1000-m) (App. 3). Then the transect course rose 118 m to the east to 123 m asl at the 3700-m station (App. 3). The elevational distribution of the 76 stations was 36 in the 1–30-m-asl class, 14 in the 31–60-m-asl class, 10 in the 61–90-m-asl class, 12 in the 91–120-m-asl class, and 4 in the 121–150-m-asl class (App. 3). Maximal elevational difference within each pair of stations was 6 m and minimal less than 1-m; between pairs of stations it was 26 m maximum elevational difference and less than 1-m minimum (App. 4).

The primary drainage fields along the transect were northward, west of the 1000-m station, and to the south, on the section east of the 1000–20-m station. Immediate drainage fields within 20-m radii of the stations varied by station (App. 5).

All 76 stations were snow covered on 30–31 May (when established and first sampled). Three of the stations had ground-fast ice that had formed during the previous autumn (we subsequently determined during summer 1981 that those three sites were in small ponds). Snow cover persisted on all stations until after the second sample was taken on 9 June (Table 6). Ablation of the snow cover at the stations began (was detectable) about 12 June and by 15 June when the third sample was taken, 10 stations had lost their snow cover and were snow-free (Table 6). No ground-fast ice had formed on those 10 stations before the snow went off but ground-fast ice had formed at the snow–ground interface on 58 (87.9%) of the 66 stations still with snow cover (Table 7). On 18 June, 53 stations had snow cover; one station had ground-fast ice only; one station had free-standing water over ground-fast ice; and 21 stations were snow and ice free. All 53 snow-covered stations also had ground-fast ice (Tables 6 and 7). By 23 June, 26 stations still had snow cover and ground-fast ice; 2 stations had ground-fast ice only; one station had free-standing water over ground-fast ice; and 47 stations were bare-ground sites (Tables 6 and 7). On 26 June only 2 stations still had snow cover. Those two also had ground-fast ice and a third station had ground-fast ice only (Tables 6 and 7). The remaining 73 stations were without snow or ice. The melt was essentially over, except for persistent deep snow banks.

On 28 June three stations were recorded as having snow cover over ground-fast ice (the one station that had ice only on 26 June, had 1.5 cm of slush over ice on 28 June). On 29 June we recorded snow/ice data for only two stations: one had both snow cover and ground-fast ice; whereas the

Table 4
Percentage distributions, by altitude classes, of digs sampled at snow–ice sample sites, Prince of Wales Island and Somerset Island, NWT, May–July 1979 and the corresponding observed/expected (O/E) indices *

Period	Digs sampled	% altitude class, m asl (O/E index)			
		1–30	31–90	91–180	181–420
Prince of Wales Island					
Premelt	228	50.0 (1.04)	31.5 (0.87)	5.3 (0.92)	13.2 (1.32)
Melt	414	46.4 (0.97)	40.6 (1.11)	5.8 (1.01)	7.2 (0.72)
Run-off	198	48.4 (1.01)	33.4 (0.92)	6.1 (1.06)	12.1 (1.21)
All periods	840	47.9 (1.23)	36.4 (1.03)	5.7 (0.61)	10.0 (0.61)
Somerset Island					
Premelt	156	23.1 (1.05)	34.6 (1.05)	15.4 (0.94)	26.9 (0.94)
Melt	156	23.1 (1.05)	34.6 (1.05)	15.4 (0.94)	26.9 (0.94)
Run-off	126	19.1 (0.87)	28.5 (0.87)	19.1 (1.16)	33.3 (1.16)
All periods	438	21.9 (0.56)	32.9 (0.93)	16.4 (1.75)	28.8 (1.75)

*O/E indices calculated in two-way contingency table for standard Pearson Chi square tests: by sampling periods, Prince of Wales = $0.5>P>0.1$; Somerset = $0.9>P>0.5$; and by all sampling periods between islands = $P<0.05$.

Table 5
Percentage distributions, by distance-from-the-seacoast classes, of digs sampled at snow–ice sample sites, Prince of Wales Island and Somerset Island, NWT, May–July 1979 and the corresponding observed/expected (O/E) indices*

Period	Digs sampled	% distance from the seacoast, km (O/E index)				
		0.1–0.9	1–4	5–9	10–14	15–38
Prince of Wales Island						
Premelt	228	23.7 (0.87)	18.4 (0.89)	15.8 (1.30)	18.4 (1.23)	23.7 (0.95)
Melt	414	29.0 (1.07)	23.2 (1.12)	10.1 (0.84)	11.7 (0.77)	26.0 (1.04)
Run-off	198	27.3 (1.00)	18.2 (0.88)	12.1 (1.00)	18.2 (1.21)	21.0 (0.97)
All periods	840	27.1 (1.07)	20.7 (0.71)	12.1 (1.12)	15.0 (0.89)	25.0 (1.40)
Somerset Island						
Premelt	156	23.1 (1.05)	46.2 (1.02)	7.7 (0.94)	19.2 (0.94)	3.8 (0.94)
Melt	156	23.1 (1.05)	46.2 (1.02)	7.7 (0.94)	19.2 (0.94)	3.8 (0.94)
Run-off	126	19.0 (0.87)	42.9 (0.95)	9.5 (1.16)	23.8 (1.16)	4.8 (1.16)
All periods	438	21.9 (0.86)	45.2 (1.55)	8.2 (0.76)	20.6 (1.22)	4.1 (0.23)

*O/E indices calculated in two-way contingency table for standard Pearson Chi square tests: by sampling periods, Prince of Wales = $0.1>P>0.5$; Somerset = $0.975>P>0.9$; and by all sampling periods between islands = $P<0.005$.

Table 6
Snow-depth measurements at snow–ice stations on a 3.7-km transect, Savage Point, Prince of Wales Island, NWT, 1980

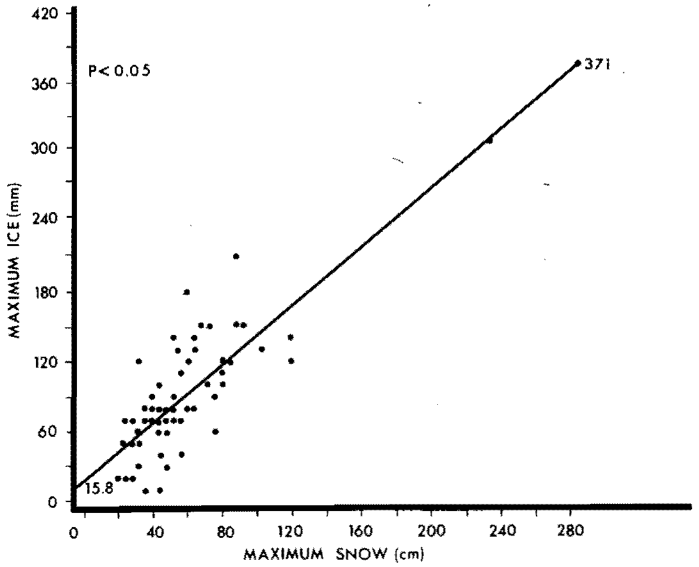
Date, day/mon.	Sample size	Snow-cover statistics, cm			
		Minimum	Maximum	Mean	SD
30-31/5	76	2.5	194.5	39.6	28.86
9/6	76	7.0	232.0	50.8	32.53
15/6	66	1.5	184.0	33.2	28.46
18/6	53	0.5	180.0	25.6	29.40
23/6	26	0.5	141.0	18.6	29.89
26/6	2*	3.5	85.0	44.2	57.63
28/6	3	1.0	72.5	25.0	41.14

*One station had solid ice cover on 26 June; then on 28 June it had 1.5 cm of slush which was classified as snow cover over the ice.

Table 7
Ground-fast-ice thickness at snow–ice stations on a 3.7-km transect, Savage Point, Prince of Wales Island, NWT, 1980

Date, day/mon.	Sample size	Ground-fast-ice thickness, mm			
		Minimum	Maximum	Mean	SD
15/6	58	5.0	115.0	40.1	24.50
18/6	54	4.0	146.0	64.6	31.71
23/6	29	18.0	210.0	104.3	41.77
26/6	3	109.0	235.0	154.0	70.29
28/6	3	35.0	255.0	111.7	124.23
29/6	2	57.0	305.0	181.0	175.36

Figure 7
Relationship between maximum accumulation of ice and maximum snow cover at each snow–ice station, Savage Point, Prince of Wales Island, NWT, 1980



other had ground-fast ice only. By 1 July only one station remained snow covered and still with ground-fast ice. The ground-fast ice at that station continued to accumulate from 220 mm on 1 July to 225 mm on 3 July and 265 mm on 5 July. The snow cover also persisted until after 5 July (11th sampling period). On 7 July the snow cover was gone but 190 mm of ground-fast ice remained. When last checked on 9 July the station was ice free.

We regressed maximum thickness of ice on maximum snow depth, treating each of the 76 snow–ice stations on Savage Point in 1980 as a sample unit, and obtained a statistically significant relationship: max. ice (mm) = 15.8 mm + 0.12688 × snow depth (mm) (Fig. 7). Residual values for maximum accumulation of ice in relation to maximum snow depth at each snow–ice station indicate, however, wide deviations from the prediction (30.783 mm standard deviation of the residuals). Extreme deviations were 11.1 and 225.2% of the expected values. Maximum accumulation of ice at 28 snow–ice stations was greater than predicted and less than predicted at 38 stations.

Mean snow depth was greatest at stations in the 61–90 m asl altitude class and least at stations in the 121–150-m-asl class (Table 8). Mean snow depth was also greatest at stations in the 12–16° slope class (Table 8). No apparent difference in mean snow depth was determined by exposure of snow cover (Table 8).

All stations with slopes of 0–1° were in the 1–30-m-asl altitude class; most stations with slopes of 2–4° were below 60 m asl; whereas most stations with slopes of 5–9° were within 31–90 m asl (Table 9). As snow depth was greatest at stations with slopes of 12–16° and all those stations were within 61–120 m asl (Table 9), thus, mean snow depth was greatest on steep slopes at intermediate altitudes, regardless of the exposure of the site. The exposures of snow covers at the 76 snow–ice stations varied markedly with their actual aspects when snow and ice were melted (Table 10, App. 5). Only 12 stations had snow-free aspects that were the same as the exposure of their snow cover. We found no relation between the exposure of snow cover and the subsequent accumulation of ground-fast ice at the snow–ice stations.

Loss of snow cover began after 9 June on the 76 snow–ice stations (Table 11). Reduction of snow cover increased markedly after 15 June and the melt was nearly over (except on persistent deep snow banks) by 23 June. The melt period was relatively early and brief on Savage Point, Prince of Wales Island, in June 1980.

Maximum average daily loss of snow cover was 3.9 cm with a mean loss of 2.6 cm between 9 and 15 June. Maximum average daily loss of snow cover increased rapidly to 15.2 cm with a mean loss of 4.2 cm between 15 and 18 June. Maximum average daily loss of snow cover was retarded to 5.7 cm with a mean of 2.2 cm between 18 and 23 June. Maximum average daily loss of snow cover then increased to 13.2 cm with a mean of 3.4 cm between 23 and 26 June. Only three stations remained snow covered by 26 June. The lightest snow cover was 1.5 cm of slush and it was gone by 29 June. The intermediate snow cover was 3.5 cm, it was reduced to 1.0 cm on 28 June, and was gone on 29 June. The heaviest snow cover was 85.0 cm, it was reduced to 72.5 cm on 28 June, then to 61.0 cm on 29 June, 40.5 cm on 1 July, 26.0 cm on 3 July, 15.0 cm on 5 July, and was gone on 7 July.

No visual sign of wetness in the snow cover was apparent at any of the snow–ice stations on 30–31 May. The first visual sign of wetness in the snow cover occurred on 9 June, when 49 (64.5%) of the 76 stations had visible partial wetness in some layers of snow. On 15 June all 66 snow-covered stations had varying degrees of wetness in the snow cover: all layers were wet at 47 (71.2%), only some layers were wet at 15 (22.7%), and slush occurred in some layers at 4 (6.1%). On 18 June the snow cover at the stations was wetter: all layers were wet at 25 (46.3%), 11 (20.4%) had slush in all layers, and slush occurred in some layers at 11 (20.4%). We found free-standing water at 7 (13.0%) stations: 6 of them had snow cover over the water. Free-standing water averaged 111.4 mm ± 102.54 mm (SD) and ranged from 15 to 300 mm in depth. On 23 June, 15 (53.6%) stations had slush in all layers of the snow cover and 10 (35.7%) stations had slush in only some layers. We found free-standing water at three (10.7%) stations: two had snow cov-

Table 8
Analyses of variance for snow depth (cm) against altitude class, slope class, and aspect at snow–ice stations on a 3.7-km transect, Savage Point, Prince of Wales Island, NWT, 1980

Variable	Sample size	Mean snow depth	SD	F statistic
Altitude class, m asl				11.92*
1–30	137	30.6	20.15	
31–60	52	35.7	29.42	
61–90	56	59.9	49.09	
91–120	47	33.3	23.87	
121–150	14	17.2	13.47	
Slope class,°				12.08*
0–1	61	33.7	19.80	
2–4	151	31.2	21.78	
5–9	65	38.5	29.41	
12–16	29	67.2	65.29	
Snow exposure				0.54†
east	82	39.5	45.45	
west	193	35.9	25.24	
flat	31	33.7	19.10	

*Significant at 0.1%.
†Not significant.

Table 9
Percentage distribution of slope classes by altitude classes at snow–ice stations on a 3.7-km transect, Savage Point, Prince of Wales Island, NWT, 1980

Slope class,°	Sample size	% distribution by altitude class, m asl				
		1–30	31–60	61–90	91–120	121–150
0–1	80	100.0				
2–4	189	48.7	19.1	6.3	20.1	5.8
5–9	83	6.0	37.4	41.0	7.2	8.4
12–16	37			56.8	43.2	

Table 10
Apparent exposures of snow covers compared to snow-free aspects at 76 snow–ice stations along a 3.7-km transect, Savage Point, Prince of Wales Island, NWT, 1980

Exposure of snow cover (no. sta.)		Snow-free aspects							
		N	NE	E	SE	S	SW	W	NW
Westward	(46)			2	1	8	14	12	9
Eastward	(22)	8	12		2				
Flat	(8)				6	1	1		
Total	(76)	8	12	2	9	9	15	12	9

Table 11
Time periods for loss of snow cover and amounts of snow cover removed at snow–ice stations on a 3.7-km transect, Savage Point, Prince of Wales Island, NWT, 1980

Time int. for snow loss, day/mon.	Sample size	Amount of snow cover ablation, cm			
		Minimum	Maximum	Mean	SD
9–15/6	10	7.0	23.5	15.3	4.84
15–18/6	13	1.5	45.5	12.5	13.36
18–23/6	27	0.5	28.5	10.8	8.10
23–26/6	23	0.5	39.5	10.1	11.52

Table 12
Distribution of superimposed ice lenses in snow cover by number of ice lenses in each snow profile at snow–ice stations on a 3.7-km transect, Savage Point, Prince of Wales Island, NWT, 1980

Date, day/mon.	Sample size	No. of ice lenses in snow cover		
		(1)	(2)	(3)
30–31/5	25	23	2	
9/6	7	7		
15/6	39	30	5	4
18/6	22	13	7	2
23/6	8	8		
26/6	1		1	

er, one did not. Free-standing water averaged 56.7 mm ± 15.28 mm (SD) and ranged from 40 to 70 mm in depth. On 26 June one station had ice and two had wet snow — one with slush in all layers and one with slush in only some layers. On 28 June two stations had slush in all layers and the other had slush only in some layers. After 29 June slush occurred in some layers of the snow cover on the one remaining station until 7 July.

For unknown reasons the count of superimposed ice lenses in the snow cover was relatively high on 30–31 May, when first sampled, and relatively low on 9 June, when sampled the second time (Table 12). After the melt began, the number of ice lenses in the snow cover increased rapidly to a peak on 15 June; then decreased to nearly its 9 June level on 23 June (Table 12). From 26 June to 5 July only one station remained with ice lenses, 2 on 26 June and 1 thereafter.

The combined thicknesses of superimposed ice lenses in the snow cover increased markedly from 9 to 15 June (Table 13). Maximum and mean total ice-lens thicknesses continued to increase rapidly from 15 to 18 June. Then the maximum and to a lesser extent the mean total ice lens thickness decreased between 18 and 23 June as the melt advanced beyond its peak (Table 13). Total ice-lens thickness at the one station where lenses persisted after 26 June increased from 8 mm on 26 June to 20 mm on 29 June; then decreased to 8 mm on 1 July; then increased to 28 mm on 5 July; and finally was gone on 7 July.

The hardness of snow cover (measured horizontally) varied greatly both between snow–ice stations and between snow layers in the snow cover at each station. The range of variation in snow hardness between snow layers in the snow cover at most stations was so great as to make any tabular presentation of minimum, maximum, mean, and standard deviation values meaningless.

Therefore, maximal hardness values were put into classes of increasing hardness (Table 14). From 30–31 May through 9 June most of the stations had maximum hardnesses in the snow cover of 1000–10 000 g/cm² (Table 14). This condition persisted through 15 June and then weakened (Table 14). By 18 June, the snow was softening considerably and most stations had values of less than 400 g/cm² (Table 14). By 23 June the majority of stations with snow had maximum hardnesses in the snow cover of less than 100 g/cm² (Table 14).

On 26 June, snow at two remaining snow-covered stations had maximum hardnesses of 1000–5000 g/cm² (ice lumps) and less than 100 g/cm² (slush), respectively. On 28 June snow at one station had a maximum hardness of 1000–5000 g/cm² and at two others had maximum hardnesses of less than 100 g/cm² (slush). Then between 29 June and 3 July the one remaining snow-covered station had a maximum hardness of 500–900 g/cm² in its snow cover; then dropped to less than 100 g/cm² on 5 July (site was snow free on 7 July).

On 30–31 May the number of snow layers in the late winter snow cover ranged from 1 to 11 on the 76 stations (Table 15). The station with the deepest snow cover had the most layers.

As we had no check on the possible error associated with visually determining the number of snow layers at each station, some of the data in Tables 15 and 16 are suspect. Poor and often changing light conditions may have influenced the visual determinations of the number of snow layers at some stations (Table 16).

On 26 June one of the two remaining snow-covered stations had three layers of snow in its profile and the other station had only one layer. The three layers in the snow

Table 13
Combined thicknesses of superimposed ice lenses in each snow profile at snow–ice stations on a 3.7-km transect, Savage Point, Prince of Wales Island, NWT, 1980

Date, day/mon.	Sample size	Total ice-lens thickness, mm			
		Minimum	Maximum	Mean	SD
30–31/5	25	2.0	6.0	3.0	1.04
9/6	7	2.0	3.0	2.3	0.49
15/6	39	4.0	50.0	19.4	12.20
18/6	22	2.0	84.0	27.9	23.27
23/6	8	9.0	36.0	22.5	9.87

Table 14
Percentage distribution of horizontal-hardness measurements for snow layers in the snow cover at snow–ice stations on a 3.7-km transect, Savage Point, Prince of Wales Island, NWT, 1980

Date, day/mon.	Sample size	% snow-cover horizontal-hardness classes, g/cm²					
		100	100–400	500–900	1000–5000	6000 10 000	10 000
30–31/5	76	1.3	6.6	6.6	35.5	47.4	2.0
9/6	76		6.6	9.2	40.8	38.1	5.0
15/6	66	19.7	22.7	13.6	19.7	21.2	3.0
18/6	53	43.3	26.4	15.1	7.6	7.6	
23/6	26	65.4	15.3	11.5	3.9		3.0*

*Ice lumps caused high hardness measurement.

Table 15
Distribution of the number of snow layers in the snow cover at snow–ice stations on a 3.7-km transect, Savage Point, Prince of Wales Island, NWT, 1980

Date, day/mon.	Sample size	Number of snow layers										
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
30–31/5	76	1	10	13	16	17	10	6	2			1
9/6	76		8	13	19	18	11	4	1	2		
15/6	66	21	25	11	8			1				
18/6	53	25	13	12	2		1					
23/6	26	17	8	1								

Table 16
Changes in number of snow layers at snow–ice stations on a 3.7-km transect, Savage Point, Prince of Wales Island, NWT, 1980

Time interval. day/mon.	Sample size	Change in number of snow layers at station									
		(+4)	(+3)	(+2)	(+1)	(0)	(−1)	(−2)	(−3)	(−4)	(−6)
31/5 – 9/6	76		2	8	19	24	12	8	2	1	
9/6 – 15/6	66					2	8	23	20	11	2
15/6 – 18/6	53	1			5	19	21	5	1	1	
18/6 – 23/6	26					6	14	5	1		

Table 17
Measurements of snow–ground and snow–ice temperatures at snow–ice stations on a 3.7-km transect, Savage Point, Prince of Wales Island, NWT, 1980

Date, day/mon.	Sample size	Temperature, °C			
		Minimum	Maximum	Mean	SD
Snow–ground					
30–31/5	76	−15	−4	−11.2	2.58
9/6	76	−14	−4	−10.5	2.61
15/6	8	−9	−1	−6.4	2.67
Snow–ice					
15/6	58	−7	0	−2.0	1.68
18/6	53	−3	0	−0.4	0.72
23/6	26	−1	0	−0.4	0.20
26/6	2	0	0	0.0	0.00

cover at the one station persisted to 3 July; then were reduced to only one layer by 5 July. The station was snow free by 7 July. The single-layer station persisted to only 28 June.

Snow–ground interface temperatures varied considerably at the different snow–ice stations (Table 17). Temperatures averaged markedly lower during the premelt period 30 May to 9 June, than temperatures did after the initiation of the melt (15 June). Temperatures at the snow–ground-fast-ice interface were higher than those for the snow–ground interface (Table 17). Mean snow–ice temperatures rose rapidly between 15 and 18 June, continued to rise to 0°C by 26 June, and stayed at that level on the remaining snow-covered stations until at least 5 July.

3. Aerial searches 1979

We travelled 1087 km over sea-ice by snowmobile during the May–July 1979 study period. Only 309 km (58.5%) of the 528 km travelled over sea-ice in May by snowmobile and 537 km (96.1%) of the 559 km travelled in June were, however, during periods of good visibility. Snowmobile treks were made on 15 days in May (5–11, 13, 16–18, 24, and 28–30) and 13 days in June (2, 3, 5–7, 10, 11, 14–18, and 24) (App. 6).

We flew 5227 km by helicopter during the 1979 study period. However, we had good visibility for only 2049 km (75.6%) of the 2710 km over sea-ice in May and 1682 km (73.9%) of the 2277 km over sea-ice in June. Helicopter flights were made on 5 days in May (21–23, 25, and 26) and 5 days in June (8, 9, and 20–22). On 1 July 1979 we flew 240 km over sea-ice, but meltwater covered 50–80% of the surface ice and we saw no trails on the sea-ice (App. 6).

We found on sea-ice 107 caribou trails put down by at least 306 individuals, and we actually saw 25 caribou crossing sea-ice. Most of the sightings were on the sea-ice of Peel Sound between western Somerset Island and eastern Prince of Wales Island (80 trails put down by at least 225 individuals and 10 caribou seen) and on Franklin Strait (20 trails made by at least 65 individuals and 14 caribou seen) (Table 18). To the north, we sighted only three caribou trails put down by at least five individuals, and one caribou, on the sea-ice of Baring Channel between Mecham, Russell, and Prince of Wales islands. To the south, we located only four caribou trails made by at least 11 individuals on Bellot Strait between Somerset Island and the Boothia Peninsula.

We saw 49 trails and 140 tracks of individuals on the sea-ice of Peel Sound between eastern Prince of Wales Island (including satellite islands) and western Somerset Island (Table 18). Of those trails and tracks, 63.3 (31) and 72.9% (102) respectively were made by caribou travelling from east to west, and the remainder by those going eastwards. On the sea-ice of northern Franklin Strait 55.0% (11) of the trails and 56.9% (37) of the tracks of individuals were produced by caribou travelling westwards (from northwestern Boothia Peninsula to southeastern Prince of Wales Island) and 45.0% (9) of the trails and 43.1% (28) of the tracks of individuals were made by caribou travelling eastwards (from southeastern Prince of Wales Island to northwestern Boothia Peninsula). We saw 23 trails and 57 tracks of individuals on the sea-ice of Brown Bay between Prince of Wales and its eastern satellite islands (Table 18). Caribou travelling westwards to Prince of Wales Island, and eastwards to the satellite islands made 78.3 (18) and 77.2% (44) of those trails and tracks, respectively. Only eight trails and 28 tracks of individuals were found between the eastern satellite islands (Table 18); all except two trails and three tracks of individuals were generally travelling from east to west.

Table 18
Summary of evidence for inter-island movements of Peary caribou within the Prince of Wales Island–Somerset Island–Boothia Peninsula complex, NWT, May–July 1979

Zones*	Date	Trails seen on sea-ice	Tracks of individuals discerned
Peel Sound			
Between Prince of Wales and Somerset islands			
Westward crossings:			
5	25 May	2	5
6	25	1	5
	29	2	5
	3 June	1	2
7	21 May	1	7
	25	1	4
	29	1	1
	3 June	1	2
	9	3	14
8	21 May	3	10
	9 June	3	12
	21	2	4
Eastward crossings:			
5	3 June	1	1
6	25 May	3	6
	29	6	21
	2 June	2	2
	3	3	3
7	21 May	1	2
	28	1	1
	29	1	2
Between Prince of Wales and Prescott islands			
Westward crossings:			
6	16 May	1	4
	17 June	5	5
Between Prince of Wales and Pandora islands			
Westward crossings:			
7	5 May	1	4
	13	1	7
	5 June	1	1
	7	2	4
	10	3	12
	18	1	1
	24	2	5
Eastward crossings:			
7	5 June	1	5
	7	2	4
	10	1	2
	18	1	2
Between Prince of Wales and Lock islands			
Westward crossings:			
6	25 May	1	1
Between Somerset and Prescott islands			
Westward crossings:			
6	3 June	8	20
7	8	1	6
Between Somerset and Pandora islands			
Westward crossings:			
7	7 June	1	5
Between Prescott and Pandora islands			
Westward crossings:			
7	26 May	1	4
Eastward crossings:			
7	8 June	1	2
Between Prescott and Vivian islands			
Westward crossings:			
6	8 June	1	1
Eastward crossings:			
6	17 June	1	1
Between Vivian and Lock islands			
Westward crossings:			
6	25 May	4	20
Franklin Strait			
Between Prince of Wales Island and Boothia Peninsula			
Westward crossings:			
9	21 May	6	21
	21 June	3	10
10	21 May	2	6
Eastward crossings:			
9	21 May	9	28

*See Figures 3 and 4.

We discovered most trails in zones 6, 7, and 9, in that order (Table 18; Figs. 3, 4), but the effort required (measured in kilometres travelled per caribou trail located) varied as follows: 34 km/trail in zone 9, 38 km/trail in zone 6, and 66 km/trail in zone 7. The numbers of trails seen per unit of effort cannot be compared between zones because we searched zones with varying thoroughness and at different times (Table 18). We searched most thoroughly in zones 7, 6, and 9, in descending order, and found the most trails by zone in nearly that order (and in exactly that order if the trails on Inner Browne Bay and Young Bay are included in zone 7).

4. Aerial searches 1980

We flew a total of 2263 km over the sea-ice of Peel Sound and Franklin Strait, making aerial searches of 4.9 h on 14 June, 5.8 h on 16 June, 1.0 h on 19 June, and 7.5 h on 22 June. We also flew along caribou trails between their origins and termini on 19 June (575 km, 4.8 h).

We saw 588 caribou trails, 1799 tracks of individual caribou, and 15 caribou on the sea-ice of Peel Sound and northern Franklin Strait between 14 and 22 June (Tables 19 and 20). We located 408 and 1250 of those trails and tracks while searching the west sides of Peel Sound and northern Franklin Strait (Table 19), and 180 trails and 549 tracks on the east sides (Table 20). Because of possible double counting of some trails and tracks on opposing coastlines in the same latitudinal zones (Figs. 3 and 4) we can only say that a minimum of 414 trails and 1261 tracks of individuals were discrete. However, because of the caribou's habit of following in each other's tracks, the track count was probably well below the actual number of caribou. We suggest that the majority of caribou estimated by the NWT Wildlife Service on Prince of Wales Island in July 1980 (about 5000, A. Gunn, pers. comm.) had crossed the sea-ice from Somerset Island and/or Boothia Peninsula in the spring.

We saw 404 trails produced by at least 1263 individuals crossing on the sea-ice of Peel Sound between eastern Prince of Wales Island and western Somerset Island (Tables 19 and 20). All of those caribou except one individual were travelling from western Somerset Island to eastern Prince of Wales Island (or its satellite islands). Also, all sea-ice crossings by caribou on northern Franklin Strait were from east to west, northwestern Boothia Peninsula to southeastern Prince of Wales Island (Tables 19 and 20). We saw 89 trails and 254 tracks of individuals between Prince of Wales Island and its eastern satellite islands (Table 19). Of those trails and tracks, 92.1 (82) and 96.1% (244), respectively were produced by caribou travelling westwards, and the remainder by those going eastwards. We found only 33 trails and 115 tracks of individuals between the eastern satellite islands (Table 19): all except three trails and three tracks were generally travelling westwards.

As in 1979, we used the distance flown per caribou trail seen as a general measure of searching effort that seemingly reflected the relative frequency of sea-ice crossings by caribou within the searched area during that period. On 14 June we flew 479 km and saw 73 trails for an average effort of 6.6 km/trail; 16 June, 450 km, 298 trails, 1.5 km/trail; 19 June, only 91 km applicable to this evaluation, 44 trails, 2.1 km/trail; and 22 June, 668 km, 147 trails, 4.5 km/trail. According to these data, sea-ice crossings by caribou were relatively most frequent on or about 16 June.

Table 19
Summary of evidence for inter-island movements of Peary caribou within the Prince of Wales Island–Somerset Island–Boothia Peninsula complex, NWT, June 1980, along west sides of Peel Sound and Franklin Strait

Zones*	Date	Trails seen on sea-ice	Tracks of individuals discerned
Peel Sound			
Between Somerset and Prince of Wales islands			
Westward crossings:			
5	16	6	25
5	22	9	33
6	16	15	36
6	22	2	4
7	14	2	4
7	16	15	54
7	19	18	40
7	22	8	18
8	14	39	134
8	19	26	70
8	22	18	37
Between Somerset and Lock islands			
Westward crossings:			
6	16	3	8
6	22	3	8
Between Somerset and Vivian islands			
Westward crossings:			
6	16	5	11
6	22	2	3
Between Somerset and Prescott Islands			
Westward crossings:			
6	16	21	98
6	22	19	55
7	16	12	44
7	22	10	27
Between Somerset and Pandora islands			
Westward crossings:			
7	16	11	55
7	22	11	31
Between Prince of Wales and Lock islands			
Westward crossings:			
6	16	22	57
Between Prince of Wales and Vivian islands			
Westward crossings:			
6	16	3	11
Between Prince of Wales and Prescott islands			
Westward crossings:			
6	16	20	65
7	16	12	42
Eastward crossings:			
6	16	1	1
7	16	1	2
Between Prince of Wales and Pandora islands			
Westward crossings:			
7	16	25	69
Eastward crossings:			
7	16	5	7
Between Prescott and Pandora islands			
Westward crossings:			
7	16	3	12
Eastward crossings:			
7	16	3	3
Between Prescott and Vivian islands			
Westward crossings:			
6	16	17	67
Between Vivian and Lock islands			
Westward crossings:			
6	16	10	33
Franklin Strait			
Between Prince of Wales Island and the Boothia Peninsula			
Westward crossings:			
8	19	2	8
9	14	16	44
9	19	8	29
9	22	5	5

*See Figures 3 and 4.

Table 20
Summary of evidence for inter-island movements of Peary caribou within the Prince of Wales Island – Somerset Island – Boothia Peninsula complex, NWT, June 1980, along east sides of Peel Sound and Franklin Strait

Zones*	Date	Trails seen on sea-ice	Tracks of individuals discerned
Peel Sound			
Between Somerset and Prince of Wales islands			
Westward crossings:			
5	16	15	51
5	22	4	9
8	14	7	28
8	22	10	16
Eastward crossings:			
6	16	1	3
Between Somerset and Prince of Wales islands (or the satellite islands of Lock, Vivian, Prescott and Pandora)			
Westward crossings:			
6	16	35	131
6	22	17	50
7	14	5	24
7	16	37	103
7	22	18	55
Franklin Strait			
Between Prince of Wales Island and the Boothia Peninsula			
Westward crossings:			
9	14	4	8
9	19	15	43
9	22	10	19
10	19	1	7
10	22	1	2

*See Figures 3 and 4.

Table 21
Comparison of mean percentage cover, mean percentage frequency of occurrence, and prominence values (PV) of plant species and plant groups in the feeding areas and respective plant community for range type 1: *Alectoria ochroleuca – Umbilicaria* spp. – crustose lichen stony ridge

	Feeding areas†			Plant community‡		
Species*	% cover $\bar{x}$ ± SD	% freq. of occ.	PV	% cover $\bar{x}$ ± SD	% freq. of occ.	PV
Alectoria ochroleuca	3.2 ± 4.9	98	32	5.6 ± 5.3	99	56
Umbilicaria spp.	11.6 ± 7.3	99	116	10.3 ± 7.2	100	103
Crustose lichen	45.9 ± 14.0	100	459	54.0 ± 12.0	100	540
Unvegetated surface	37.3 ± 13.0	100	373	26.4 ± 14.5	100	264
Mosses	1.2 ± 3.3	45	8	3.1 ± 4.8	63	25

*Plant species that had prominence values <1.0 are given in Appendix 7.
†Three feeding areas; 130 quadrats sampled.
‡One plant community (100 quadrats) sampled.

Table 22
Comparison of mean percentage cover, mean percentage frequency of occurrence, and prominence values (PV) of plant species and plant groups in the feeding areas and respective plant communities for range type 2: *Dryas integrifolia – Saxifraga oppositifolia* – crustose lichen gravel ridge

	Feeding areas†			Plant communities‡		
Species*	% cover $\bar{x}$ ± SD	% freq. of occ.	PV	% cover $\bar{x}$ ± SD	% freq. of occ.	PV
Dryas integrifolia	20.5 ± 21.5	73	175	12.3 ± 16.7	59	95
Saxifraga oppositifolia	3.8 ± 6.2	81	34	3.6 ± 6.9	78	32
Thamnolia vermicularis	1.9 ± 3.2	96	19	2.5 ± 3.8	94	24
Cetraria spp.	1.6 ± 3.3	98	16	2.2 ± 4.4	84	20
Crustose lichen	33.1 ± 17.6	99	333	29.9 ± 17.6	100	299
Mosses	11.8 ± 17.3	78	105	11.2 ± 19.1	79	99
Unvegetated surface	28.6 ± 23.1	99	286	39.2 ± 27.3	100	392

*Plant species that had prominence values <1.0 are given in Appendix 7.
†Twelve feeding areas; 41 feeding craters; 188 quadrats sampled.
‡Five plant communities (250 quadrats) sampled.

5. Vegetation sampling 1980

We used percentage cover and frequency values for each feeding area to determine and compare the plant communities used by caribou in May and June. Sample size was determined for each plant community by calculating the standard error for the dominant species. The sample size was considered to be adequate, when the sample error was 20% or less of the sample mean. The large number of sites to be sampled in a limited amount of time did not allow for greater accuracy.

5.1. Range types

5.1.1. Type 1. *Alectoria ochroleuca – Umbilicaria* spp. – crustose lichen stony ridge

This range type was found only on the southeast corner of Savage Point where a series of stony beach ridges descended gradually from 30 m asl to sea level. The well drained substrate was rounded stones (usually 10–25 cm in diameter) and angular rocks (usually 40–90 cm in diameter) of gneissic origin. Frost action had caused patterns of cracks or rills (15–30 cm deep and 30–40 cm across) in which snow collected and the vegetational cover was slightly increased. This improved vegetational cover occurred in other slight depressions but, generally, the vegetation was poor with almost no vascular plants. Large expanses of higher ground bordered by rills were mainly snow free throughout May and June. The three feeding areas in this range type were located on higher ground.

Crustose lichens were the dominant ground cover (Table 21) and the lichens *Alectoria ochroleuca* and *Umbilicaria* spp. were the only other plants present in any quantity. The percentage cover of *A. ochroleuca* on the feeding areas was only half as great as its percentage cover on the entire range type (Table 21).

5.1.2. Type 2. *Dryas integrifolia – Saxifraga oppositifolia* – crustose lichen gravel ridge

Twelve of the 27 observed feeding areas were found in this commonly occurring range type (Table 22). This range type was extensive in the upland ridges along the east coast of Savage Point and was also common on the beach-ridge systems on the west side of the study area. The extent of cratering varied in the 12 feeding areas: a few had only two or three small feeding craters (0.125 m^2) whereas three of the feeding areas had large areas (up to 12 m^2) completely cratered.

Most often found at higher elevations (120–180 m asl), the type 2 gravel ridges were sparsely vegetated with crustose lichens as the dominant plant form (Table 22). *Dryas integrifolia* had a mean cover of about 12% and *Saxifraga oppositifolia*, though more common, had a mean cover of about 4%. *Thamnolia vermicularis* and *Cetraria* spp. had a combined mean cover of about 5%. The xeric conditions, due to shallow snow cover and a well drained gravel substrate, limited vegetational cover to 61%.

The 12 feeding areas (total of 41 feeding craters) had considerably greater mean cover and mean frequency of occurrence of *Dryas integrifolia* than the plant community as a whole (Table 22). Means of percentage cover and frequency of occurrence of *Saxifraga oppositifolia*, *Thamnolia vermicularis*, and *Cetraria* spp. showed little difference between feeding areas and the range type as a whole. Bare ground was 11% less in the feeding areas than in the plant communities.

When the ground was snow covered, the caribou seemed to consistently pick the relatively well vegetated patches in this sparsely vegetated range type. Maximum snow depth on all the feeding areas was relatively shallow: 10 cm on 10 sites, 20 cm on 10 sites, 30 cm on 2 sites, 31 cm on one site, and 33 cm on one site. Maximum snow cover on adjacent sites where no feeding occurred was often 100 cm or more.

Many of the feeding craters in range type 2 had fragments of *Saxifraga oppositifolia* and occasionally *Dryas integrifolia* scattered within them, possibly dropped during feeding or broken off by pawing action when the craters were dug.

Table 23
Comparison of mean percentage cover, mean percentage frequency of occurrence, and prominence values (PV) of plant species and plant groups in the feeding areas and respective plant community for range type 3: *Dryas integrifolia – Salix arctica* – crustose lichen bedrock outcrop ledge

	Feeding areas†			Plant community‡		
Species*	% cover $\bar{x}$ ± SD	% freq. of occ.	PV	% cover $\bar{x}$ ± SD	% freq. of occ.	PV
Dryas integrifolia	19.5 ± 18.0	88	182	12.5 ± 16.5	62	98
Salix arctica	4.5 ± 8.3	44	30	3.3 ± 8.5	44	22
Saxifraga oppositifolia	1.6 ± 3.5	78	14	2.1 ± 5.2	56	16
Thamnolia vermicularis	2.4 ± 3.5	100	24	1.6 ± 2.5	96	16
Bryoria nitidula	2.8 ± 3.2	84	26	1.1 ± 2.3	71	9
Crustose lichen	32.0 ± 17.1	100	320	35.1 ± 21.2	100	351
Unvegetated surface	25.0 ± 24.0	98	247	25.4 ± 23.5	96	248
Mosses	17.6 ± 21.5	98	174	17.4 ± 25.0	91	165

*Plant species that had prominence values <1.0 are given in Appendix 7.
†One feeding area; 8 feeding craters; 50 quadrats sampled.
‡One plant community (55 quadrats) sampled.

5.1.3. Type 3. *Dryas integrifolia – Salix arctica* – crustose lichen bedrock outcrop ledge.

One of the feeding areas was located on a ledge on the west side of a relatively steep boulder ridge (Table 23). The feeding area was a jumble of large boulders (averaging 0.3–1-m high) and rocks with flat gravel areas in between. Range type 3 was similar to range type 2 but the more protected nature of range type 3 resulted in a greater mean cover of mosses (17%) and *Salix arctica* (3%), while *Dryas integrifolia* remained about the same. *Cassiope tetragona* was found growing around the larger rocks and boulders, reflecting a deeper snow cover and more mesic conditions in those spots. The feeding craters, were, however, located on level, gravel areas forming a step-like pattern through the feeding area. *Dryas integrifolia* was again the dominant vascular species in the feeding craters (Table 23) but *Salix arctica* was the next most abundant with 4.5% cover and the lichens, *Thamnolia vermicularis* and *Bryoria nitidula*, had a combined cover of about 5%. *Dryas integrifolia* and lichens had a higher mean cover in the feeding area than elsewhere in the plant community but the sum of the vegetational cover means was only slightly higher in the feeding areas (80%) than in the plant community sample site (73%).

The single feeding area in this range type was extensively cratered: caribou had fed in eight craters ranging from approximately 0.25 to 2 m^2. The animals had remained there during a storm and there were groups of fresh pellets around the craters.

5.1.4. Type 4. Drainage patch

The high cliffs along the east coast of Savage Point were dominated by bare bedrock outcrops and *Dryas* gravel barrens (range type 2). Mesic plant communities also occurred in localized patchy areas of seepage or in slight depressions. The moisture regime varied from hydric to mesic so plant species were diverse and variable in cover. Two feeding areas were situated in this range type but each was in a different plant community and so they were treated as two range subtypes (Tables 24 and 25).

5.1.4.1. Subtype 4.1. *Dryas integrifolia* – mixed sedge – *Salix arctica* – crustose lichen – moss depression

The feeding area located in this subtype was highly variable in plant cover and composition and the moisture regime varied from mesic to hydric. *Dryas integrifolia, Salix arctica*, and crustose lichens dominated the mesic gravelly substrate while the sedges, *Eriophorum triste* and *Carex misandra*, and mosses were growing in mesic to hydric, poorly drained portions. *Saxifraga oppositifolia* was common. Unvegetated surface was still prevalent in this range subtype (31% bare ground) due to frost action which had turned the soil and rocks and scattered them throughout.

The sites of feeding craters were more vegetated than the plant community as a whole (Table 24). Total means of percentage plant cover in the feeding areas was 108 and 78% in the plant community; *Dryas integrifolia* had three times more cover, mosses almost twice as much, and *Saxifraga oppositifolia* and non-crustose lichens slightly more cover than in the plant community.

The one feeding area located in this subtype was lightly cratered: five craters ranged from approximately 0.125 to 0.50 m^2 (Table 24).

5.1.4.2. Subtype 4.2. *Salix arctica – Saxifraga oppositifolia* – mixed lichen – moss drainage path

This drainage path broken by boulders and rocks ran approximately 75 m in an east–west direction from a rock ridge to the cliff edge. The six feeding craters in the one feeding area were scattered through and around this drainage path on well vegetated level patches of soil and small rock (Table 25). Again the vegetative cover and composition was highly variable and the moisture regime was mesic. *Salix arctica* and *Saxifraga oppositifolia* supplied the dominant vascular cover (Table 25) and total non-crustose lichen cover was approximately 7%. High moss cover reflected the mesic conditions and, though boulders were scattered throughout this range subtype, bare ground accounted for only 11% of the surface area.

The feeding craters had considerably greater cover of *Salix arctica, Dryas integrifolia*, and mosses than the plant community (Table 25) but the sums of the vegetational cover means were similar — 100 and 94%, respectively.

5.1.5. Type 5. *Saxifraga oppositifolia* – crustose lichen – moss sedimentary slope

The southern boundary of the study area was a high ridge (150 m asl) of sandstone bedrock with a surface veneer of silty sand and pebbles (Netterville *et al.* 1976). One feeding area was situated on the northeast-facing slope of the

Table 24
Comparison of mean percentage cover, mean percentage frequency of occurrence, and prominence values (PV) of plant species and plant groups in the feeding areas and respective plant community for range subtype 4.1: *Dryas integrifolia* – mixed sedge — *Salix arctica* – crustose lichen – moss depression

	Feeding areas†					
Species*	% cover $\bar{x} \pm$ SD	% freq. of occ.	PV	% cover $\bar{x} \pm$ SD	% freq. of occ.	PV
Dryas integrifolia	26.9 ± 25.9	88	252	8.8 ± 16.5	46	60
Salix arctica	3.8 ± 3.5	63	30	4.9 ± 9.6	62	39
Eriophorum triste	3.1 ± 8.8	13	12	3.7 ± 8.6	32	21
Carex misandra	3.8 ± 5.2	88	36	3.3 ± 5.4	60	26
Saxifraga oppositifolia	5.0 ± 7.1	50	35	2.8 ± 5.5	58	21
Thamnolia vermicularis	2.5 ± 2.7	100	25	1.3 ± 2.8	66	11
Cetraria nivalis	2.5 ± 4.6	100	25	0.6 ± 1.9	42	4
Mosses	41.3 ± 30.3	100	413	24.5 ± 23.4	98	242
Crustose lichen	19.4 ± 18.9	100	194	27.7 ± 21.6	98	274
Unvegetated surface	8.1 ± 12.8	100	81	3.1 ± 22.0	100	311

*Plant species that had prominence values <1.0 are given in Appendix 7.
†One feeding area; 5 feeding craters; 8 quadrats sampled.
‡One plant community (50 quadrats) sampled.

Table 25
Comparison of mean percentage cover, mean percentage frequency of occurrence, and prominence values (PV) of plant species and plant groups in the feeding areas and respective plant community for range subtype 4.2: *Salix arctica – Saxifraga oppositifolia* – mixed lichen–moss drainage path

	Feeding area†			Plant community‡		
Species*	% cover $\bar{x} \pm$ SD	% freq. of occ.	PV	% cover $\bar{x} \pm$ SD	% freq. of occ.	PV
Salix arctica	12.9 ± 15.1	82	117	6.0 ± 9.1	63	47
Saxifraga oppositifolia	1.3 ± 3.5	43	9	5.2 ± 8.8	73	44
Dryas integrifolia	5.2 ± 10.7	3631		0.8 ± 3.7	20	3
Thamnolia vermicularis	1.3 ± 2.6	86	12	2.2 ± 3.9	83	20
Cetraria spp.	3.4 ± 6.1	82	31	5.2 ± 7.4	93	50
Mosses	65.4 ± 24.2	100	654	49.7 ± 23.6	100	497
Crustose lichen	11.5 ± 12.5	100	115	25.1 ± 17.8	100	251
Unvegetated surface	15.5 ± 16.0	93	150	10.7 ± 13.4	100	107

*Plant species that had prominence values <1.0 are given in Appendix 7.
†One feeding area; 6 feeding craters; 28 quadrats sampled.
‡One plant community (30 quadrats) sampled.

Table 26
Comparison of mean percentage cover, mean percentage frequency of occurrence, and prominence values (PV) of plant species and plant groups in the feeding areas and respective plant community for range type 5: *Saxifraga oppositifolia* – crustose lichen – moss sedimentary slope

	Feeding area†			Plant community‡		
Species*	% cover $\bar{x} \pm$ SD	% freq. of occ.	PV	% cover $\bar{x} \pm$ SD	% freq. of occ.	PV
Saxifraga oppositifolia	11.9 ± 16.6	94	115	10.2 ± 10.8	87	95
Luzula nivalis	8.1 ± 12.9	94	78	1.9 ± 3.2	97	18
Thamnolia vermicularis	2.8 ± 3.9	100	28	1.9 ± 2.9	100	19
Salix arctica	3.9 ± 6.5	33	22	1.8 ± 5.6	16	7
Mosses	76.8 ± 17.4	100	768	54.2 ± 26.3	100	542
Crustose lichen	13.6 ± 13.1	89	128	21.4 ± 14.7	100	214
Unvegetated surface	3.9 ± 5.8	61	31	18.3 ± 24.4	97	180

*Plant species that had prominence values <1.0 are given in Appendix 7.
†Two feeding areas; 10 feeding craters; 18 quadrats sampled.
‡One plant community (38 quadrats) sampled.

Table 27
Comparison of mean percentage cover, mean percentage frequency of occurrence, and prominence values (PV) of plant species and plant groups in the feeding areas and respective plant communities for range subtype 6.1: *Eriophorum triste – Salix arctica – Arctagrostis latifolia* – moss seepage slope

	Feeding areas†			Plant communities‡		
Species*	% cover $\bar{x} \pm$ SD	% freq. of occ.	PV	% cover $\bar{x} \pm$ SD	% freq. of occ.	PV
Eriophorum triste	7.2 ± 8.4	87	67	7.9 ± 11.3	72	67
Salix arctica	5.9 ± 8.4	63	46	4.8 ± 9.4	57	36
Arctagrostis latifolia	3.8 ± 5.4	82	34	3.5 ± 6.6	68	28
Thamnolia vermicularis	1.5 ± 2.5	93	14	1.3 ± 2.6	78	12
Mosses	71.2 ± 32.0	99	712	59.6 ± 34.4	97	586
Crustose lichen	13.1 ± 18.6	69	109	20.8 ± 23.1	86	192
Unvegetated surface	5.8 ± 14.5	47	39	9.4 ± 17.1	65	21
Dryas integrifolia	7.7 ± 13.3	48	53	5.0 ± 11.3	37	30
Carex misandra	1.3 ± 4.0	39	8	2.9 ± 6.3	49	20
Polygonum viviparum	1.5 ± 3.1	66	12	1.3 ± 4.7	57	9
Saxifraga oppositifolia	0.8 ± 3.1	24	3	2.4 ± 5.8	42	16

*Plant species that had prominence values <1.0 are given in Appendix 7.
†Five feeding areas; 16 feeding craters; 83 quadrats sampled.
‡Four plant communities (134 quadrats) sampled.

ridge. This site was extensively cratered, with 10 feeding craters varying in size from approximately 0.125 to 1 m^2. The substrate was silty and mesic, and supported a rich, diverse plant community. *Saxifraga oppositifolia* was the dominant vascular plant (Table 26). The rush, *Luzula nivalis*, had a mean cover of 2%, as did *Thamnolia vermicularis*. A wide variety of forbs and grasses (16 species) were common, due to the availability of moisture throughout the growing season (even in August the poorly drained soil was damp), but low in cover (Table 26). Rocks and bare soil were common, the result of frost action, and together they gave an unvegetated surface area of about 18%. The slope was stable but some drainage stripe patterns were discernible.

Mean vegetational cover in the feeding craters was higher than in the plant community, 117 and 91% respectively; in particular *Luzula nivalis* was four times and mosses were 23% more abundant. *Salix arctica* was twice as abundant in the feeding area as in the plant community (Table 26).

5.1.6. Type 6. Sedge–moss slope or meadow

Large areas of sedge–moss seepage slopes were common in the study area. Sedge-dominated seepage areas were also scattered throughout the more barren highlands and beach ridges, and those smaller well vegetated pockets were used by caribou. Seven of the 27 feeding areas (26%) were located in this range type and four of the seven feeding areas were in small pockets of sedge–moss meadows, surrounded by poorly vegetated terrain. The two sedge meadow range subtypes used differed in species composition and abundance, moisture, and microtopography (Tables 27 and 28).

5.1.6.1. Subtype 6.1. *Eriophorum triste – Salix arctica – Arctagrostis latifolia* – moss seepage meadow

Seepage meadows, whether patchy or extensive, ran downslope from a ridge or boulder outcrop. The substrate was poorly drained soil and rock, remaining mesic to hydric through the growing season. Drainage patterned ground with strips of bare ground and rock accounted for about 9% of the surface area. *Eriophorum triste* was the dominant vascular plant (Table 27) and combined with *Carex misandra* to give a total mean sedge cover of 10.8%. Moss cover was high (Table 27), as was the combined crustose lichen and algal cover (21%). *Salix arctica* was the most abundant dwarf shrub but *Dryas integrifolia* was also common in those sites where raised strips of vegetation allowed for mesic conditions. *Thamnolia vermicularis* was the only non-crustose lichen present in any quantity (Table 27) and the grass *Arctagrostis latifolia* averaged almost 4% cover and was a characteristic species of this range subtype.

The feeding areas were similar in species cover and composition to the plant communities (Table 27), only moss had a substantially higher cover in the feeding areas and *Saxifraga oppositifolia* was lower. Three of the five feeding areas in this range subtype were extensively cratered and in three of the five, *Eriophorum triste* had been grazed.

5.1.6.2. Type 6.2. Mixed sedge – *Salix arctica – Dryas integrifolia* – moss hummock

The seepage tongues of wet sedge meadow described in the previous range subtype 6.1 were commonly found at the base of rocky ridges. Adjacent to those meadows was a narrow band of mesic hummocky terrain on the downhill edge of the seepage area. The change of moisture conditions and the raised microtopography produced a different but restricted plant community.

The raised hummocks were dominated by sedges, dwarf shrubs, and mosses (Table 28). The sedges, *Carex membranacea* and *Eriophorum triste* had a combined mean cover of 14%, *Salix arctica* and *Dryas integrifolia*, 15%, and mosses, the most abundant vegetation type, comprised about 76%. The mesic environment encouraged the growth of a variety of forbs and grasses but none was abundant (Table 28). Lichen cover was low (Table 28).

Table 28
Comparison of mean percentage cover, mean percentage frequency of occurrence, and prominence values (PV) of plant species and plant groups in the feeding areas and respective plant communities for range subtype 6.2: Mixed sedge – *Salix arctica – Dryas integrifolia* – moss hummock

	Feeding areas†			Plant communities‡		
Species*	% cover $\bar{x} \pm$ SD	% freq. of occ.	PV	% cover $\bar{x} \pm$ SD	% freq. of occ.	PV
Salix arctica	11.6 ± 13.9	83	106	6.6 ± 10.5	58	50
Dryas integrifolia	15.3 ± 21.8	50	108	9.0 ± 17.9	38	55
Carex membranacea	13.3 ± 13.0	100	133	6.2 ± 11.7	49	43
Eriophorum triste	4.7 ± 7.1	89	44	7.8 ± 11.8	69	65
Mosses	68.3 ± 27.7	100	683	75.8 ± 34.5	100	758
Crustose lichen	8.3 ± 15.6	56	62	8.0 ± 15.2	62	63
Unvegetated surface	4.7 ± 6.9	50	33	7.4 ± 15.7	40	46
Saxifraga oppositifolia	1.9 ± 4.2	39	12	0.5 ± 2.2	16	2
Arctagrostis latifolia	1.3 ± 2.9	50	9	1.7 ± 4.1	56	13

*Plant species that had prominence values <1.0 are given in Appendix 7.
†Two feeding areas; 9 feeding craters; 18 quadrats sampled.
‡Two plant communities (55 quadrats) sampled.

The feeding areas were similar in total vegetation cover to the plant communities, with percentage cover means totalling 125 and 113%, respectively. However, *Carex membranacea, Salix arctica*, and *Saxifraga oppositifolia* were more abundant in the feeding areas and mosses were more abundant in the plant communities (Table 28). The two feeding areas in this range subtype were moderately cratered relative to other feeding areas and had a total of nine feeding craters, mostly 0.125–0.25 m^2 in size.

5.2. Feeding-area data

5.2.1. Vegetation

The 27 feeding areas have some similarities despite being on different range types. Sixteen (59.3%) of the feeding areas were on poorly vegetated range types (unvegetated surface and crustose lichens had a combined average cover of 60%). Those poorly vegetated feeding areas were xeric due to well drained, predominately gravel and rock substrate. Also, 68.8% (11/16) of the poorly vegetated feeding areas were at higher elevations (120 m or more).

Nine (33.3%) of the feeding areas were located in moderately vegetated range types (unvegetated surface and crustose lichens had a combined average cover between 30 and 60%). Moisture conditions were mesic or occasionally hydric. Well developed, poorly drained soil, mixed with small rocks was the common substrate of the moderately vegetated feeding areas. They were found at relatively high elevations: 77.8% at 120 m asl or higher.

Overall, 67% of all the feeding areas were found at relatively higher elevations in the study area (120 m asl) and 86% had aspects N 140° W and N 40° E (SW to NE). About 20% of the landmass of Savage Point is above 120 m asl. The majority of the feeding areas were on level to gently sloping terrain, only two of the 27 feeding areas had a slope > 10°. All feeding areas had shallow snow cover (< 34 cm) and many had snow-free patches in late May and early June.

Dryas integrifolia was the most common and abundant plant species in the feeding areas (Table 29). *Salix arctica* and *Saxifraga oppositifolia* were the next most important species with respect to frequency of occurrence and cover. All three, but especially *Dryas* were the dominant vascular plants in the study area. *Thamnolia vermicularis* was the most frequently occurring plant in the feeding areas, however, its low average cover (2%) lessens its importance. *Thamnolia vermicularis* is a ubiquitous species in high arctic plant communities but is highest in cover on mesic to xeric communities. *Cetraria* spp. were also common in the feeding areas but their overall cover was even less than *Thamnolia* (Table 29). *Eriophorum triste* was the only monocotyledon found with any frequency in the feeding areas. This sedge was found in only 24% of the feeding areas and its mean cover ranged from 5 to 7%. Crustose lichens and mosses were common in all the feeding areas and their cover values varied with the moisture conditions.

Only two (7.4%) were in well vegetated range types (unvegetated surface and crustose lichens had a combined average cover of 30%). Moisture conditions were mesic to hydric, soil development was good, and both sites were at lower elevations (45 m asl).

Savage Point encompasses about 21.5 km^2 (Table 30, Fig. 8). Only three range types and one range subtype of the four range types and four range subtypes sampled had sufficient contiguous area coverage to be mapped at a scale of 1:60 000 and thus used as map units (I, II, IV, and V: Table 30, Fig. 8). The remaining one range type and three range subtypes were too small in contiguous area to be recognizeable at 1:60 000 on a black-and-white aerial photograph; so they could not be measured, but only 19% of the marked feeding areas were found on those locations.

Table 29
Mean frequency of occurrence, mean percentage cover, and mean prominence values (PV) of dominant plant species and plant groups in all the caribou feeding areas (n = 27) on Savage Point, Prince of Wales Island, NWT, 1980

Species	$\bar{x}$ % freq. of occ.	$\bar{x}$ % cover	$\bar{x}$PV
Dryas integrifolia	51	14	100
Salix arctica	37	9	24
Saxifraga oppositifolia	55	3	22
Thamnolia vermicularis	79	2	18
Eriophorum triste	24	2	10
Cetraria spp.	68	1	8
Crustose lichens	89	23	213
Mosses	89	36	339

Table 30
Area occupied and percentage distribution of range types, range subtypes, or ecosites (when range types or subtypes could not be mapped, ecosites were used as the map unit) on Savage Point, Prince of Wales Island, NWT, 1980: distribution given in Figure 8. (range type 3 and range subtypes 4.1, 4.2, and 6.2 could not be mapped because of their discontinuous coverage.)

Map unit	Range types, range subtypes or ecosites	Area km^2	% total area	Relative % frequency of feeding areas
I	Range type 1: *Alectoria-Umbilicaria* ridge	1.6	7.4	11.1
II	Range type 2: *Dryas-Saxifraga*-lichen gravel ridge	3.3	15.4	44.5*
III	Precambrian outcrop or *Dryas-Saxifraga*-lichen ridge	3.5	16.3	
IV	Range type 5: *Saxifraga*-lichen-moss slope	1.8	8.4	7.4
V	Range subtype 6.1: Sedge-willow seepage slope	7.5	34.9	18.5
VI	Sedge meadow	1.0	4.6	
VII	Limestone *Saxifraga* ridge	1.0	4.6	
VIII	Barren	1.8	8.4	

*Value is for map units II and III combined.

Range type 2 occurred in map unit II and extensively in map unit III (Fig. 8). Thus, the areas of those two map units were combined to determine a more extensive measure of the level of importance of range type 2 for use as caribou feeding areas: 31.7% of the total land area, with a 44.5% frequency of occurrence of feeding areas.

Frequencies of occurrence of feeding areas in each map unit relative to the total land area of that map unit were greatest for range types 2 and 1 and relatively less than expected for range type 5, and especially low for range subtype 6.1 (Table 30: map units II and I versus IV and V).

Three ecosite map units (VI–VIII) comprising 17.6% of the study area received no detected use for foraging by Peary caribou.

5.2.2. Observations of caribou

We observed 88 caribou (number of different individuals unknown) foraging while in 36 groups (9 of 1, 12 of 2, 9 of 3, 3 of 4, 2 of 5, and 1 of 6) on Savage Point, Prince of Wales Island, between 24 May and 11 June 1980. The observations allowed us to qualitatively describe spring foraging behaviour of those Peary caribou.

All caribou observed foraged either directly on windblown patches of snow-free ground or cratered along the peripheries of such patches in shallow snow cover (mostly < 30 cm). Caribou cratered by breaking blocks of hard-packed snow off edges of windblown areas and pushing the loose chunks of snow backwards between their front legs. In that manner the caribou could forage on exposed vegetation as they moved further from the edge of the snow-free area.

Snow cover at cratering sites characteristically had a 1- to 4-cm air space between the surface of the ground and the bottom of the snow cover. Thus, most vegetation was not encased by the snow pack and remained undisturbed when the chunks of snow were broken off.

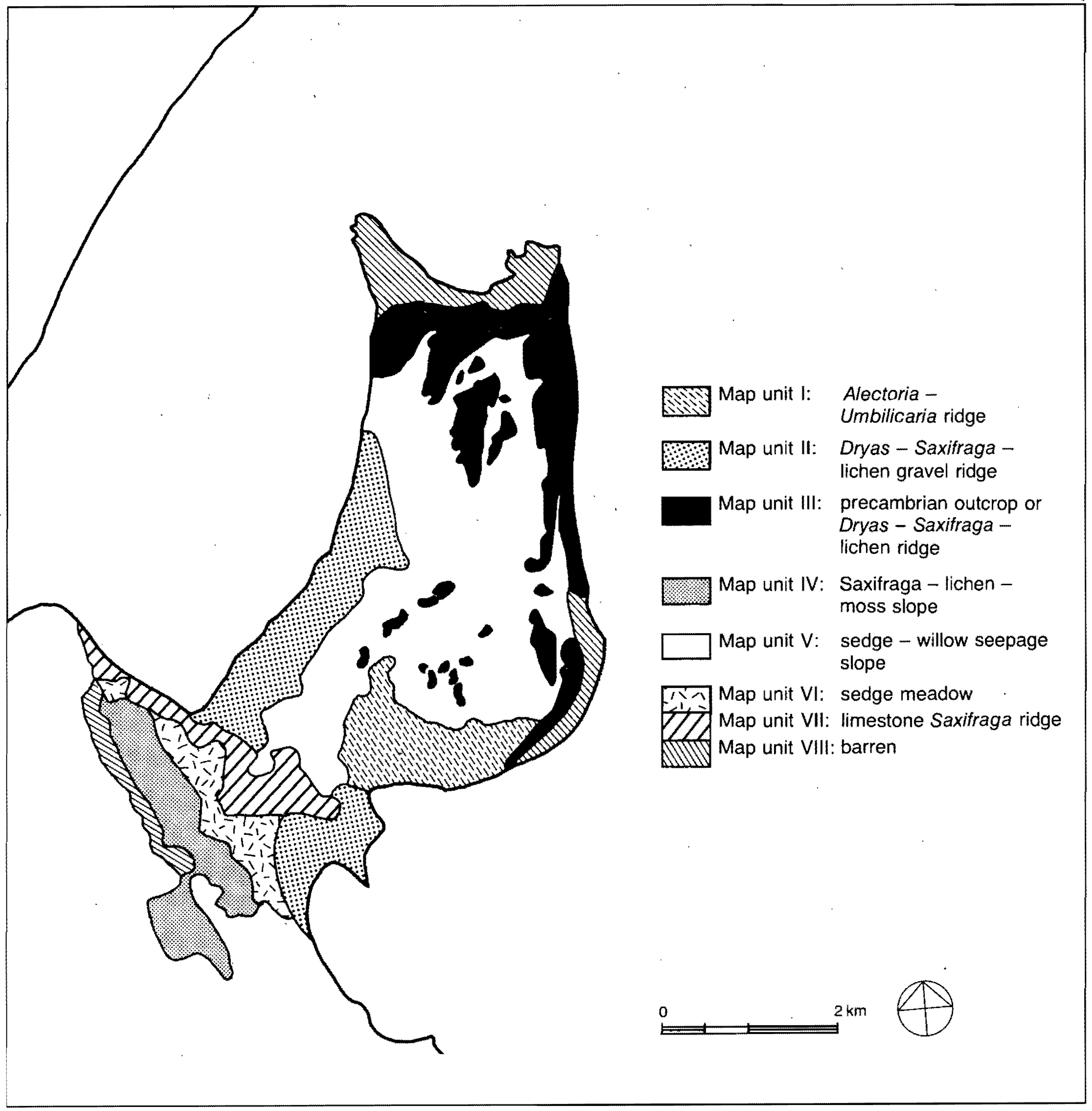
No craters were extended into snow over 33 cm deep, although the air cavities at the base of the snow pack allowed caribou to smell vegetation under even deeper snow cover by lateral ventilation. Most craters terminated in much shallower snow cover (usually 10–20 cm). Most cratering occurred during or shortly after fresh snowfall covered up or greatly reduced snow-free areas. Wind action quickly removed fresh snow cover from exposed patches along beach ridges within hours. On other less exposed areas wind action removed fresh snow within a few days of storms.

We observed no cratering by caribou in snow-covered areas that were not connected to patches of snow-free ground or ground that was just recently covered with fresh snow.

The most prevalent pattern of foraging by Peary caribou was of movements from one snow-free patch to the next. Detection of accessible patches appeared to be by visual searching only: We did not see caribou "test" for forage through the snow cover by smelling or attempted cratering. Holding its head higher than when foraging, the animal lined up on the next patch, and then walked or trotted directly to it. On occasion, caribou licked snow as they walked between foraging sites, but, with only one exception, the caribou never broke stride when doing so. On the one occasion when a caribou did stop, it remained in place for less than 10 sec, before walking directly to the next snow-free patch. Successive feeding sites were often 50–100 m or more apart. Caribou trotted when other caribou, especially individuals from another group, were moving toward the same patch, and it appeared that the caribou were actually racing each other to the new foraging site.

The snow-free foraging sites were usually only several square metres in size or less, most often with relatively

Figure 8
Distribution of range types or range subtypes or ecosites (when range types could not be mapped) on Savage Point, Prince of Wales Island, NWT, 1980: area and percentage distribution given in Table 30 (range type 3, and range subtypes 4.1, 4.2, and 6.2 could not be mapped at this scale because of their discontinuous coverage).



long primary axes following crests of beach ridges and narrow secondary axes running above and below the crests. The foraging sites were sometimes in series and sometimes isolated.

When a caribou came onto a new foraging area it usually walked along the primary axis of the site with relatively little lateral searching on the area, unless the site was one of the few that were relatively extensive and of nearly equal length and width. Where there was no snow caribou used both smell and vision to detect forage; however, they often walked across snow-free sites without even lowering their heads and continued on to the next promising area. When we inspected the "untested" sites, we found them totally devoid of vegetation. On other sites caribou tested for vegetation by smell at several points but did not appear to feed before leaving the site for the next one.

We observed no aggression on the foraging sites, unless a second animal attempted to feed on the very spot where another was feeding. In those encounters, some feeding animals were displaced and some intruding animals were prevented from beginning to feed.

Foraging periods on each patch were very brief, usually only seconds and seldom more than 1–3 min. We never saw a caribou stand still and forage for more than 5 min and that long only once. Even an adult male caribou that we saw foraging immediately after it came off the sea-ice of Peel Sound (apparently having crossed from Somerset Island to Prince of Wales Island — about 40 km straightline distance) exhibited the same temporal and spatial patterns of foraging. He did not linger on any foraging sites and showed no signs of intensive feeding after his sea-ice crossing. We never observed any caribou remaining on any one snow-free foraging site for more than several minutes regardless of the relative abundance of forage, with one exception. Caribou foraging on the extensive (several large areas of more than 100 m^2 each) snow-free sites of range type 1 "*Alectoria ochroleuca–Umbilicaria* spp. – crustose lichen stony ridge" did so for several hours or more. We observed those caribou during late May before many other snow-free sites were available on Savage Point. On 26 May, 16 caribou in 6 groups (1, 1, 2, 3, 4, and 5) foraged on snowless patches of range type 1 for periods of 2–3 h broken by bedded periods of only 10–20 min. All of those caribou remained upright on their briskets and ruminated during those bedded periods.

We were able to measure the rates of travel for three groups of foraging caribou, as they traversed broken, rolling terrain typical of Savage Point and Prince of Wales Island. On 3 June, 3 caribou walked across a flat-beach-ridge area then upslope for 2356 m in 35 min. Once, they stopped for 0.5–1 min to feed enroute. They then fed on a beach area for about 8 min before moving on upslope, slowly walking another 372 m in 9 min. Their average rate of travel was (2728 m/44 min) 3720 m/h. On 5 June another group of 3 caribou walked 2377 m across rolling beach ridges and generally upslope in 54 min. They lingered for only a few seconds at a time on several occasions to feed on small snow-free patches along their route. They averaged (2377 m/54 min) 2641 m/h. Also on 5 June, a group of 2 caribou walked over approximately the same route as the group of 3 caribou on that date. They stopped briefly for a few seconds at a time on several occasions to feed on small snowless patches while walking 1692 m in 35 min. They then fed more or less continuously in a small area (100 m^2) for 7 min; then they walked another 320 m upslope in 6 min. Their average rate of travel was (2012 m/48 min) 2515 m/h.

Caribou in the three groups usually sank 10–30 cm into the snow cover, sometimes they sank only 5–10 cm for short distances, and on some occasions remained more or less on top of hard-packed snow for one or several steps at a time.

Discussion

At the end of winter, Peary caribou are in their worst physical condition, and ice conditions during melt and run-off can render much forage unavailable. Our observations of their migrations and feeding behaviour during spring describe the caribou's strategy to cope with the snow and ice conditions at the lowest point in their annual cycle. During melt and run-off both reindeer and caribou tend to forage where there is little or no snow. Such behaviour is obligatory for Peary caribou because of the phenomenon of ground-fast-ice formation in the High Arctic. The ground-fast ice forms under all but the shallowest snow cover and prevents foraging of most plants.

We observed Peary caribou use snow-free or shallow-snow areas shortly before and during the melt and run-off periods. Shallow snow is relatively easily cratered even when compacted, and rapidly melts to expose the ground. It is, however, also usually associated with poor plant protection in winter and relatively dry summer conditions — hence poorly vegetated range types. Well vegetated range types generally have deep snow though some areas dominated by sedges and mosses did have shallow snow. The relatively poorly vegetated range types (more than 25% snow free) had been cratered twice as much as the well vegetated types (less than 11% snow free). Those poorly vegetated range types tended to be dominated by plants of lower nutritional value.

Peary caribou used range type 2 (*Dryas integrifolia – Saxifraga oppositifolia* – crustose lichen gravel ridge) the most of all range types in May and June. *Dryas integrifolia* was the most abundant probable forage item, but it has a poor apparent digestibility of 22% in winter (Thomas and Kroeger 1980), and the protein content is low even in summer at 5% of dry weight (Tener 1965). *Saxifraga oppositifolia* also has low digestibility: 11% in winter (Thomas and Kroeger 1980).

The non-crustose lichens commonly found in this range type (though low in cover) have high digestibility. *Thamnolia vermicularis* has 62% apparent digestibility in winter and *Cetraria nivalis, C. cucullata, C. delisei*, and *C. islandica* average 69% apparent digestibility in winter (Thomas and Kroeger 1980). *Thamnolia vermicularis* has 4.4 kcal/g gross energy and 2.7% crude protein (Parker 1975) and the *Cetraria* spp. average 4.0 kcal/g gross energy and 3% crude protein (Parker 1975). The non-crustose lichen component with its high digestibility and moderate nutritional value would seem to be the important forage item in this range type. *Dryas integrifolia*, by its quantity alone, and *Saxifraga oppositifolia* could supply some additional nutritional benefit to the caribou. Thomas and Edmonds (in prep.) analyzed the proportionate occurrence of plant species in 53 caribou rumens collected on Prince of Wales Island in March–April, 1974–77 and found that *Dryas* had a mean occurrence of 4%; *Thamnolia vermicularis*, 8%; *Cetraria* spp., 6%; and *Saxifraga oppositifolia*, 32%. The relatively easy access to the vegetation through shallow snow on those feeding areas, perhaps, compensated for the low quality of forage.

Range type 1 (*Alectoria ochroleuca – Umbilicaria* spp. – crustose lichen stony ridge) feeding areas were snow-free when the caribou used them intensively for several days during late May and early June. The lichens *Alectoria ochroleuca* and *Umbilicaria* spp. were the only plants of any quantity and quality, thus the most likely forage. *Alectoria ochroleuca* grew between the rocks and stones while *Umbilicaria* spp. grew directly on the rocks. We could see in the feeding areas that stones and small rocks had been disturbed and overturned. Caribou were observed turning rocks by striking them with their front feet while foraging in this area in late May. *Alectoria ochroleuca* has high apparent digestibility, 83% in winter (Thomas and Kroeger 1980), but is low in protein, 1.93% of oven-dried weight, and gross energy, 4.45 kcal/g (Parker 1975). Kelsall (1968) noted *Umbilicaria* spp. as being an important lichen in the barren-ground caribou's diet.

The reduced cover of *Alectoria ochroleuca* on the feeding areas compared to the plant community (Table 21) would be expected from the drier, more exposed conditions on the raised areas (i.e. the feeding areas) compared to the rills and depressions commonly found throughout the whole community. The intensive feeding by caribou on the raised areas may have contributed to the lower cover of *Alectoria ochroleuca*. The readily available lichens may make those raised areas important to caribou in May and June. Range type 1 is, however, unique to the southeast end of Savage Point.

Only one feeding area was found on range type 3 (*Dryas integrifolia – Salix arctica* – crustose lichen bedrock outcrop ledge) and it had been used during a storm. *Dryas integrifolia, Salix arctica, Bryoria nitidula*, and *Thamnolia vermicularis* were the most likely forage available to caribou in the feeding craters. The poor digestibility and nutritional quality of *Dryas* has already been discussed but *Salix arctica* has 49% apparent digestibility in winter (Thomas and Kroeger 1980), and the woody portions (no green parts in May or early June) have 6% crude protein content (Parker 1975). The non-crustose lichen component supplies an easily digested source of forage with some protein. The forage available in this range type was slightly more abundant and nutritious than the forage available in the previous two range types.

Only one, lightly cratered feeding area was found in range subtype 4.1, *Dryas integrifolia* – mixed sedge – *Salix arctica* – crustose lichen – moss depression. The neglect of this range subtype is surprising, as the snow was shallow at this site, and sedges were a good forage. The sedges, *Eriophorum triste* and *Carex misandra*, retain green leaf parts over the winter. Those green portions supply a higher quality of winter forage (Glinka 1939 *in* Courtright 1959) and *Carex misandra* green leaf parts have a 65% apparent digestibility in winter (Thomas and Kroeger 1980).

Only one feeding area was also found in range subtype 4.2 (*Salix arctica* – *Saxifraga oppositifolia* – mixed lichen – moss drainage path) despite relatively plentiful forage but the range subtype was local and patchy. The lichens (*Thamnolia vermicularis* and *Cetraria* spp.) and willow content seem to be the most likely forage items in the feeding craters, both having good digestibility rates, as mentioned previously. Together they supply a fairly nutritious source of food, willow supplying some of the proteins and lichens most of the carbohydrates.

Range type 5 (*Saxifraga oppositifolia* – crustose lichen – moss sedimentary slope) was also limited in extent, and we observed two feeding areas. The most probable forage species in the feeding craters of this range type were *Saxifraga oppositifolia, Salix arctica, Luzula nivalis*, and *Thamnolia vermicularis*. *Luzula nivalis* retains a centre portion of green leaves through the winter which increases its nutritional quality. No data are available on the winter digestibility of *Luzula*. In summer the last year's growth (dead leaves) has 28% apparent digestibility (Thomas, in press), which indicates the minimum digestibility of *Luzula nivalis* in winter. Range type 5 occurred in small patches in the highland region on the east coast of Savage Point but was only cratered once (feeding area < 0.5 m^2). Russell *et al.* (1978) reported that a similar range type "*Saxifraga oppositifolia* – moss – lichen slopes," was the second most commonly used range type in winter on eastern Prince of Wales Island.

Eriophorum triste and the less abundant *Carex misandra* are the dominant vascular plants in range subtype 6.1 (*Eriophorum triste* – *Salix arctica* – *Arctagrostis latifolia* – moss seepage meadows) and offer a nutritious, easily digested source of forage. Both retain green portions over the winter. *Salix arctica* would also be an important food item, but *Arctagrostis latifolia* dies completely back in winter with no green parts and likely has lower nutritional quality. However, despite the relative abundance of good forage available in this range subtype, the caribou did not appear to stay in or return to those sites. Those feeding areas showed no greater intensity of use than many of the more barren feeding sites.

In range subtype 6.2 (Mixed sedge – *Salix arctica* – *Dryas integrifolia* – moss hummocks), *Salix arctica* and sedges offered a good source of forage in the feeding craters; *Dryas integrifolia*, though low in nutrition and apparent digestibility, was at least plentiful. The two feeding areas in this range subtype were moderately cratered and, again, though they supplied a good source of food items, the caribou did not appear to forage for long on those sites or return to them.

The highest cover of mosses, *Salix arctica* and *Eriophorum triste*, was found in those feeding areas that were located in moderately to well vegetated range types or subtypes which were not used as much as the poorly vegetated ones. *Dryas integrifolia, Saxifraga oppositifolia, Thamnolia vermicularis*, and *Cetraria* spp. are all species commonly found and most abundant in poorly vegetated plant communities and in the most poorly vegetated feeding areas on Savage Point.

The frequencies of occurrence of feeding areas in range types 1 and 2 (Fig. 8: map units I and II, Table 30) suggest more intensive foraging in those areas than would be expected proportional to the percentage of the total land

Table 31
Comparison of the relative importance of some plant species and plant groups in caribou fecal samples and rumen samples collected on Prince of Wales Island and in caribou feeding areas located on the Savage Point study area

Fecal pellet samples* (% relative density of plant fragments)	Rumen analysis† (% proportionate occurrence)	Feeding areas‡ (prominence values)
Mosses (56)	*Saxifraga oppositifolia* (32)	Mosses (339)
Lichens§ (22)	Lichens§ (15)	*Dryas integrifolia* (100)
Saxifraga spp. (11)	Mosses (13)	Lichens§ (31)
Salix arctica (5)	*Luzula* spp. (12)	*Salix arctica* (24)
Sedges & grasses (2)	*Salix arctica* (10)	*Saxifraga oppositifolia* (22)
	Unidentified sedges and grasses (7)	*Eriophorum triste* (10)
	Dryas integrifolia (4)	
	Saxifraga caespitosa (4)	
	Eriophorum spp. (1)	

*From Fischer and Duncan, 1975.
†From Thomas and Edmonds (in prep.).
‡This study.
§Non-crustose lichens only.

area occupied by each of those two range types. Thus, it appears that Peary caribou selected those two poorly vegetated range types for their relatively shallow snow cover or snow-free characteristics. The relative lack of feeding areas in range subtype 6.1 further supports the contention that feeding sites were chosen mainly on the basis of shallow snow cover or snow-free ground rather than for the quantity or quality of the forage. Range subtype 6.1 was relatively well vegetated but heavily snow covered. When shallow snow or snow-free microsites became available in range subtype 6.1, however, caribou foraged there. Our impression was that such foraging was in response to snow ablation and improved forage availability, rather than an active selection for sites with more vegetation of higher quality. Caribou foraging on subtype 6.1 did not linger any longer than did caribou foraging on other sites with less and poorer quality (in terms of composition) vegetation. More caribou foraged in range subtype 6.1 as the season advanced and melt water on the slopes freshened the vegetation at the lower edges of the snow banks at the bases of seepage slopes.

Thomas and Edmonds (in prep.) analysed the percentage proportionate occurrence of plant species in 53 caribou rumens collected on Prince of Wales Island in March and April, 1974–77; Fischer and Duncan (1976) determined from 58 winter fecal samples collected on Prince of Wales Island the percentage relative densities of discerned plant fragments. We compared the plant species and plant groups found in caribou rumens and fecal pellets from Prince of Wales Island and feeding craters on Savage Point (Table 31). Five of the range types found on Savage Point are representative of the plant communities described in habitat studies on other parts of the island (Fischer and Duncan 1976; Russell *et al.* 1978). A comparison of the three sets of data (Table 31) suggests that caribou select certain plants. The high content of mosses in fecal pellets and to a lesser extent in the rumens may be explained partially by the thick cuticles of mosses and their low digestibility (Person *et al.* 1980; Thomas and Kroeger 1980), which would increase the discernable moss fragments in the fecal pellets. Two points suggest accidental ingestion of mosses. *Saxifraga oppositifolia* is frequently found in the rumen and fecal samples, and we have found that moss grows in close association with *Saxifraga oppositifolia*: moss always had to be carefully removed from within the compact clumps of purple saxifrage collected for nutritional analysis. Mosses also grow in close association with the lichen species that in high arctic habitats grow close to the ground and do not form thick uniform mats as on the mainland. Fischer and Duncan (1976) point out, however, that accidental ingestion might not be the only reason for the relatively large proportion of moss in the diets of caribou. Possibly moss is a filler during winter, or it has some yet unknown nutritional value.

The relatively low importance of lichens, *Saxifraga oppositifolia* and *Salix arctica*, in the feeding craters compared to their higher importance in rumen and fecal samples suggests that caribou seek them out. The opposite seems to be true for *Dryas integrifolia*, especially when we consider the low protein content and low digestibility of *Dryas*.

The low occurrence of sedge and grass fragments in the fecal pellets may result from relatively high digestibility that would reduce the numbers of identifiable fragments. Graminoids are important, especially *Luzula* spp., in the rumen samples, and at one feeding site on Savage Point *Luzula nivalis* accounted for 8% of the plant cover. *Eriophorum triste* covered 3–7% of the surface when it occurred in a feeding site. The higher protein content of the green portions of sedges and rushes may increase the digestibility of lichens (when combined in the rumen). Person *et al.* (1980) used *in vitro* digestibility by reindeer to show that with some species of lichens, digestibility was decreased by as much as 18% when nitrogen levels were low in the rumen juice. A high percentage of protein-poor lichen in the rumen would result in low rumen nitrogen levels. Nitrogen from sedges could improve digestibility of lichens. Although lichens make up a large proportion of the winter diets of caribou, at least some protein-rich food items are needed to improve the value of lichens in those diets.

We chose point cover as the quantitative measure of vegetation as it is a useful, objective method for low herbaceous vegetation (Hutchings and Pase 1963), especially arctic vegetation (Wein and Rencz 1976). There are problems associated with frequency of occurrence sampling (Kershaw 1964), but it is a quick and easy method. Frequency is useful for comparing plant composition of one site with another and is especially valuable when used with other characteristics, such as cover (American Society of Range Management and Agriculture Board 1962).

Peary caribou choose areas with shallow snow or no snow at all, even when forage quality is poor, because in snow-covered areas ground-fast ice builds up as the snow starts to melt. We found a significant direct relationship between maximum snow depth and subsequent maximum accumulation of ice at sites on eastern coastal Prince of Wales Island in 1979 and on the Savage Point area of Prince of Wales Island in 1980. The lack of a significant correlation between maximum snow depth and maximum accumulation of ice on western coastal Somerset Island in 1979 was probably because snow–ice measurements ended before snow melt had advanced enough to sufficiently reduce snow cover and accumulate sufficient ice to give a direct relationship. We also found a significantly higher proportion of snow-free sites and shallower average snow depths on Prince of Wales Island than on Somerset Island during the run-off period on Prince of Wales.

This suggests that more range would become snow free and available for foraging sooner on Prince of Wales Island. Thus, there should be relatively more range available for foraging by Peary caribou at that time of the year on Prince of Wales Island than on Somerset Island. Any snow-covered range on either island would most likely be iced over and unavailable to Peary caribou during most of the melt and throughout the run-off.

In 1979 ground-fast ice persisted from, at least, mid June into the first week of July. The peak of calving for Peary caribou on Prince of Wales Island appeared to be during the third week of June in 1977, 1978, and 1979 (Miller and Gunn 1978, 1980). In years when ground-fast ice persists into July, maternal cows must forage on greatly restricted and relatively poorly vegetated portions of their ranges during the energy demanding initial stage of lactation. In years when Peary caribou have suffered severe winter conditions and extreme shortages of forage, that additional springtime nutritional stress on maternal cows would be marked. In such years, mortality of newborn calves would likely be high; maternal cows would experience physical deterioration that, in extreme cases, could lead to their failure to conceive the following autumn (Thomas *et al.* 1976, 1977; Thomas and Broughton, 1978).

Calving on Prince of Wales Island from 1977 to 1980 was during the 3rd week of June (18th ± 3 days). This calving period is 1–2+ weeks later than for other subspecies of North American *Rangifer*. We suggest that relatively late calving has evolved in Peary caribou because forage is so limited in mid to late June each year. The long-term survival of calves would be better, if they were not born until new vegetation would be readily available within 1–3 weeks of birth rather than having to depend on the dam's milk production through a 3–5 week period of severely restricted forage availability. It appears that Peary caribou have evolved relatively late calving when compared to other forms of *Rangifer* around the world.

Whether or not Peary caribou have discrete calving grounds has not been proven; on Prince of Wales Island they, at least, show affinities for specific calving areas. It is unlikely that those areas could consistently support high densities of lactating cows with newborn calves during early June.

The comparisons that we made between Prince of Wales and Somerset islands of snow depths (Table 1), thicknesses of ground-fast ice (Table 1), and thicknesses of superimposed ice lenses in the snow cover (Table 1) also support our empirically based supposition of more rapid snow loss and ice accumulation on Prince of Wales than on Somerset Island. Those data support our belief that Peary caribou escape more extreme conditions of forage unavailability by moving from winter ranges on Somerset Island to spring ranges on Prince of Wales Island. Those springtime intra- and inter-island movements are from relatively well vegetated, traditional winter ranges to areas of poorer vegetation but with more readily available foraging sites.

Our finding that the most inter-island movements were in zones 6 and 7 in 1979 and 1980, agrees with Miller and Gunn's (1978 and 1980) findings for both June 1977 and May–July 1978. The most marked differences between the inter-island movements of caribou observed in May–July 1979 compared to those in June 1977 and May–July 1978 are the eastward sea–ice crossings of Peel Sound and Franklin Strait. Thirty-one percent (25) of the trails found on Peel Sound and 45% (9) of the trails found on Franklin Strait were from west to east. No eastward movements of caribou across Peel Sound and Franklin Strait were detected by Miller and Gunn (1978, 1980).

Winter 1978–79 was relatively mild with little snow until April–May 1979, when snow-fall and snow cover increased markedly, and A. Gunn and D.C. Thomas (pers. comms.) observed that in March 1979 there were more caribou on eastern Prince of Wales Island than there had been in March–April in 1977 and in 1978. Perhaps the accumulation of snow on Prince of Wales Island in April–May 1979 triggered movements of caribou eastward off the island that would have occurred earlier during winters with early snowfalls and accumulation. Whether the caribou that moved eastwards to Somerset Island or the Boothia Peninsula stayed there for the summer or returned to Prince of Wales Island remains unknown.

We observed proportional increases in the number of caribou trails in zone 8 in 1980 comparable with the number found in 1977 and greater than the numbers found there in the springs of 1978 and 1979. Thus, if no searching bias exists, relatively more caribou came off the southwest coast of Somerset Island, or more from the Boothia Peninsula swung north onto Somerset Island before crossing to Prince of Wales Island in the springs of 1977 and 1980 than in springs of 1978 and 1979. All crossings by caribou were westward with Prince of Wales Island as the final destination, except for 31 trails and 78 tracks of individual caribou. Seven of the 15 caribou that we saw making inter-island crossings were on Peel Sound and eight on northern Franklin Strait. All 15 were travelling westwards toward Prince of Wales Island.

The 4 years of observations of springtime inter-island movements of caribou, usually from Somerset Island and/or Boothia Peninsula to Prince of Wales Island, indicate, at the least, that most of the caribou of the area function as an inter-island population within the Prince of Wales Island – Somerset Island – Boothia Peninsula complex. Prince of Wales Island serves as the major summering island for most of the caribou that winter on Somerset Island and some that winter on northern Boothia Peninsula. The various wintering segments appear to stay discrete even though they may share some ranges, especially in summer. The springtime inter-island movements in the area appear to be traditional, annual migrations, probably established in the distant past under environmental stress when the caribou were more numerous and occurred at higher densities.

Our observations of springtime inter-island movements of Peary caribou within the Prince of Wales Island – Somerset Island – Boothia Peninsula complex support and expand the observations of Miller and Gunn (1978; 1980). Our findings also compare with Miller *et al.*'s (1977*b*) description of springtime inter-island movements of Peary caribou in the western Queen Elizabeth Islands. Those data suggest the probable existence of inter-island populations of Peary caribou throughout the Canadian Arctic.

The number of islands, expecially small islands, used and the magnitudes of inter-island movements are most likely both governed by density dependent responses. Thus, several systems of inter-island populations of Peary caribou probably existed throughout the Arctic when Peary caribou were numerous. Some of those systems may have disappeared during the current period of low numbers of Peary caribou, while other systems are maintained by only low numbers of Peary caribou. Future investigations of inter-island movements of Peary caribou should reveal, however, still more inter-island populations of Peary caribou.

Inter-island movements, special springtime foraging behaviour, and late calving are some of the adaptive strategies that Peary caribou have evolved in response to restricted forage availability. Those restrictions are caused by the annually prevailing snow and ice conditions on springtime ranges. In spring, snow-free foraging sites and, during stormy periods, sites with shallow fresh snow are apparently a key to survival for Peary caribou in the Canadian High Arctic.

Conclusions

1. Peary caribou annually migrate in spring over the sea-ice of Peel Sound and northern Franklin Strait between western Somerset Island and Prince of Wales Island, and between northwestern Boothia Peninsula and Prince of Wales Island.
2. Peary caribou within the Prince of Wales Island – Somerset Island – Boothia Peninsula complex function as an inter-island population with apparently discrete segments or herds within the population.
3. Western and southern Somerset Island are the major wintering areas and Prince of Wales Island (mainly eastern and northern) is the primary summering area for the inter-island population of Peary caribou in the Prince of Wales Island–Somerset Island–Boothia Peninsula complex.
4. Forage will be unavailable to Peary caribou for one to several weeks (depending on conditions in any given year) on any site covered by more than several centimetres of snow during the spring melt, due to the accumulation of ground-fast ice.
5. Springtime forage conditions for Peary caribou during the period of snow melt are more favourable on eastern Prince of Wales Island than on western Somerset Island.
6. Peary caribou select poorly vegetated, windblown snow-free patches or cratering areas with shallow snow at the edge of snow-free sites or with shallow fresh snow for springtime foraging sites because of the relative availability of forage on those sites compared to better vegetated but ice-bound foraging sites.
7. Peary caribou have evolved adaptive springtime movement, foraging, and calving strategies in response to annually prevailing snow and ice conditions just before and during the period of snow melt.

Recommendations

The CWS should continue to investigate the existence of intra- and inter-island populations of Peary caribou and study their behaviour, dynamics, and ecology throughout the High Arctic. Such information is necessary for proper management on a biologically sound basis.

The Peary caribou is recognized as a "threatened" form of wildlife by the Committee On The Status of Endangered Wildlife in Canada. Recent aerial surveys of Melville and Prince Patrick islands (Thomas and Joly 1981) and Bathurst Island (Fergerson and Decker, pers. comms.), and empirical information from several biologists who are familiar with previous distributions and numbers of Peary caribou on the Queen Elizabeth Islands all suggest that the total number of Peary caribou on the Queen Elizabeth Islands has dropped even lower than it was in 1974. Thus, Peary caribou are most likely a truly "endangered" form of wildlife in the Canadian High Arctic.

This probable condition warrants special consideration by Environment Canada through the CWS. The CWS is responsible for the conservation and preservation of "threatened, endangered, or rare" forms of wildlife in Canada under the Canada Wildlife Act and the CWS cannot discharge its responsibility for Peary caribou with only the existing data.

Literature cited

American Society of Range Management and Agriculture Board. 1962. Chapt. 3. Methods of studying vegetation. Pages 45–84 *in* Range research—basic problems and techniques. Natl. Acad. Sci. Natl. Res. Counc. Publ. No. 890. Washington, D.C., 341 pp.

Courtright, A.M. 1959. Range management and the genus *Rangifer*: A review of selected literature. M.Sc. thesis. Univ. Alaska. 172 pp.

Douglas, G.W. 1974. Montane zone vegetation of the Alsek River region, southwestern Yukon. Can. J. Bot. 52(12):2505–2532.

Fischer, C.A.; Duncan, E.A. 1976. Ecological studies of caribou and muskoxen in the arctic archipelago and northern Keewatin, 1975. Rep. for Polar Gas Environ. Prog. 1975. 194 pp.

Hutchings, S.S.; Pase, C.P. 1963. Measurement of plant cover—basal, crown, leaf area. Pages 22–30 in Range Research Methods. U.S. Dep. Agric. For. Serv. Misc. Publ. No. 940. 172 pp.

Kelsall, J.P. 1968. The migratory barren-ground caribou of Canada. Can. Wildl. Serv. Monogr. No. 3, Queen's Printer, Ottawa. 340 pp.

Kershaw, K.A. 1964. Quantitative and dynamic ecology. Edward Arnold Ltd., London. 183 pp.

Maxwell, J.B. 1980. The climate of the Canadian Arctic Islands and adjacent waters. Vol. 1. Climatological Studies 30. Atmospheric Environ. Serv. Toronto. 531 pp.

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

Miller, F.L.; Gunn, A. 1978. Inter-island movements of Peary caribou south of Viscount Melville Sound, Northwest Territories. Can. Field-Nat. 91(4):327–333.

Miller, F.L.; Gunn, A. 1980. Inter-island movements of Peary caribou (*Rangifer tarandus pearyi*) south of Viscount Melville Sound and Barrow Strait, Northwest Territories, Canada. Pages 99–114 *in* Reindeer/Caribou Symp. Røros, Norway, 1979. Direktoratet for vilt og ferskvannsfisk, Trondheim. 799 pp.

Miller, F.L.; Russell, R.H.; Gunn, A. 1977*a*. Distributions, movements and numbers of Peary caribou and muskoxen on western Queen Elizabeth Islands, Northwest Territories, 1972–74. Can. Wildl. Servl Rep. Ser. No. 40, 55 pp.

Miller, F.L.; Russell, R.H.; Gunn, A. 1977*b*. Inter-island movements of Peary caribou (*Rangifer tarandus pearyi*) on western Queen Elizabeth Islands, arctic Canada. Can. J. Zool. 55(6):1029–1037.

Netterville, J.A.; Dyke, A.S.; Thomas, R.D.; Drabinsky; K.A. 1976. Terrain inventory and quaternary geology, Somerset, Prince of Wales and adjacent islands. Geol. Surv. Can. Rep., Proj. 75001. 29 pp.

Parker, G.R. 1975. An investigation of caribou range on Southampton Island, N.W.T. Can. Wildl. Serv. Rep. Ser. No. 33. 83 pp.

Parker, G.R.; Thomas, D.C.; Madore, P.L.; Gray, D.R.; 1975. Crashes of muskox and Peary caribou populations in 1973–74 in the Parry Islands, arctic Canada. Can. Wildl. Serv. Prog. Note No. 56. 10 pp.

Person, S.J.; Pegau, R.E.; White, R.G.; Luick, J.R. 1980. *In vitro* and nylon-bag digestibilities of reindeer and caribou forages. J. Wildl. Manage. 44(3):613–622.

Russell, R.H., Edmonds, E.J.; Roland; J. 1978. Caribou and muskoxen habitat studies. Arct. Isl. Pipeline Rep. ESCOM Rep. No. A1–26. 140 pp.

Tener, J.S. 1965. Muskoxen in Canada. Can. Wildl. Serv. Monogr. No. 2. Queen's Printer, Ottawa. 166 pp.

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

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

Thomas, D.C.; Kroeger, P. 1980. *In vitro* digestibilities of plants in rumen fluids of Peary caribou. Arctic 33(4):757–767.

Thomas, D.C.; Russell, R.H.; Broughton, E.; Edmonds, E.J.; Gunn, A. 1977. Further studies of two populations of Peary caribou in the Canadian Arctic. Can. Wildl. Serv. Prog. Note No. 80. 13 pp.

Thomas, D.C.; Russell, R.H.; Broughton, E.; Madore, P.L. 1976. Investigations of Peary caribou populations on Canadian Arctic Islands. Can. Wildl. Serv. Prog. Note No. 64. 13 pp.

Wein, R.W.; Rencz, A.N. 1976. Plant cover and standing crop sampling procedures for the Canadian High Arctic. Arct. and Alp. Res. 8(2):139–150.

Woo, V.; Zoltai, S. 1977. Reconnaissance of the soils and vegetation of Somerset and Prince of Wales islands. North West Territ. Inf. Rep. NOX-X-186. Nor. For. Res. Centre. Edmonton, Alberta. 127 pp.

Appendices

Appendix 1
Locations, site characteristics, and dates of measurements at snow–ice sample sites on Prince of Wales Island and its satellite islands of Prescott, Pandora, Vivian, and Lock, NWT, May–July 1979

Snow–ice sample site no.*	Lat.†	Long.†	Slopes‡	Aspect§	Altitude class‖ of site, m	Dist. to seacoast,# km	Dates of readings 1st	2nd	3rd	4th
Prince of Wales Island										
1A	7233	9644	6–7	N	181–210	13.0	7 May	22 June	1 July	
1B	7233	9644	4–5	E	181–210	13.0	7	22	1	
1C	7233	9644	4–5	S	181–210	13.0	7	22	1	
1D	7233	9644	9–10	W	181–210	13.0	7	22	1	
1E	7233	9644		F	181–210	13.0	7	(22 June)**		
2	7246	9636	4–5	N	1–30	0.1	10	18 June	22 June	1 July
3	7242	9641	4–5	N	91–120	2.0	20	18	24	(1 July)
4	7241	9656	3–4	W	31–60	0.8	11	11	22	(1)
5A	7236	9703	1–2	N	31–60	3.0	6	11	(22 June)	
5B	7236	9703	1–2	E	31–60	3.0	6	11	22 June	(1)
5C	7236	9703	1–4	S	31–60	3.0	6	11	22	(1)
5D	7236	9703	1–3	W	31–60	3.0	6	11	22	(1)
5E	7236	9703		F	31–60	3.0	6	11	(22 June)	
6	7231	9727	2–3	S	61–90	15.0	11	11	22 June	1 July
7	7232	9814		F	1–30	38.0	11	12	22	1
8	7235	9813	4–4	W	31–60	35.0	12	12	22	1
9	7239	9817	4–4	S	61–90	30.0	12	12	(22 June)	
10A	7238	9840	4–7	W	31–60	33.0	13	12	22 June	1 July
10B	7239	9834	1–2	S	1–30	30.0	12	12	22	(1 July)
11	7244	9837	3–4	W	31–60	23.0	14	14	22	1 July
12	7248	9839	1–1	N	1–30	18.0	15	14	22	1
13	7252	9825	2–4	E	1–30	12.0	22	14	22	1
14	7257	9823		F	1–30	0.3	16	14	22	(1 July)
15	7302	9748	2–3	N	1–30	0.6	22	22	(1 July)	
16	7248	9735	6–7	W	31–60	10.0	22	22	(1)	
17A	7247	9717	3–5	N	1–30	5.0	9	22	1 July	
17B	7247	9717	2–4	E	1–30	5.0	9	22	1	
17C	7247	9717	1–2	S	1–30	5.0	9	(22 June)		
17D	7247	9717	2–4	W	1–30	5.0	9	22 June	(1 July)	
17E	7247	9717		F	1–30	5.0	9	(22 June)		
18	7304	9818	1–2	E	1–30	1.0	16	15 June	22 June	(1)
19	7310	9807	4–6	E	1–30	2.0	16	15	22	(1)
20	7314	9753		F	1–30	0.5	16	15	(22 June)	
21A	7323	9728	5–6	W	61–90	5.0	16			
21B	7323	9728	5–6	W	61–90	5.0	16 June	22	1 July	
22	7322	9715	1–2	S	1–30	0.4	22 May	16	22 June	1 July
23	7328	9713	3–3	N	1–30	0.3	22	16	22	1
24	7328	9729	3–4	S	1–30	0.4	22	16	22	(1 July)
25	7329	9737		F	1–30	0.3	22	16	22	(1)
38	7242	9635	3–3	S	31–60	0.5	19	24	27	2 July
39	7341	9742		F	91–120	15.0	22	8	22	(1 July)
Prescott Island										
30	7307	9645	5–7	S	1–30	0.5	22 May	22 June	(1 July)	
31A	7259	9640	5–7	E	181–210	1.5	22			
31B	7259	9640	4–4	E	181–210	1.5	22 June	1 July		
32A	7256	9653	3–7	N	91–120	0.4	8 May	17 June	22 June	1 July
32B	7256	9653	7–9	E	91–120	0.4	8	(17 June)		
32C	7256	9653	8–13	S	91–120	0.4	8	17 June	22	(1 July)
32D	7256	9653	15–17	W	91–120	0.4	8	17	22	(1)
32E	7256	9653		F	91–120	0.4	8	(17 June)		
33	7259	9701	3–4	N	31–60	2.0	18	17 June	22	(1)

(cont'd next page)

Appendix 1 (cont'd)
Locations, site characteristics, and dates of measurements at snow–ice sample sites on Prince of Wales Island and its satellite islands of Prescott, Pandora, Vivian, and Lock, NWT, May–July 1979

Snow–ice sample site no.*	Lat.†	Long.†	Slopes‡	Aspect§	Altitude class‖ of site, m	Dist. to seacoast,# km	Dates of readings 1st	2nd	3rd	4th
Pandora Island										
34	7252	9644		F	61–90	2.5	22 May	9 June	22 June	(1 July)
35A	7248	9637	1–3	N	31–60	1.0	5	18	24	(1)
35B	7248	9637	7–9	E	31–60	1.0	5	18	24	1 July
35C	7248	9637	5–6	S	31–60	1.0	5	18	24	(1 July)
35D	7248	9637	3–8	W	31–60	1.0	5	18	24	1 July
35E	7248	9637		F	31–60	1.0	5	(18 June)		
36	7244	9645	3–4	S	1–30	0.3	19	18 June	(22 June)	
37	7249	9648	3–5	E	121–150	2.5	19	9	22 June	(1 July)
Vivian Island										
27	7317	9702	3–3	N	1–30	0.4	18 May	17 June	22 June	(1 July)
28	7314	9702	3–4	W	1–30	1.0	18	17	22	1 July
29	7314	9657	3–3	S	1–30	0.5	18	17	22	1
Lock Island										
26	7318	9713	4–6	S	31–60	0.4	18 May	17 June	22 June	(1 July)

*Fig. 2 shows locations of sample sites by number only.
†Example, latitude 7233 and longitude 9644 are read as latitude 72°33′N, longitude 96°44′W.
‡Range of slopes at each of the six digs along the 100-m transect at each location: all slopes measured from 20-m distance and always upgrade.
§F, Flat; N, North; E, East; S, South; W, West.
‖From a 1:250 000 topographical map using 30-m contours.
#Closest distance to the sea-ice was measured on a horizontal plane from a 1:250 000 topographical map.
**Parentheses indicate no snow remained.

Appendix 2
Locations, site characteristics, and dates of measurements at snow–ice sample sites on Somerset Island and its satellite islands of Wadworth and three unnamed islands, NWT, May–June 1979

Snow–ice sample location	Lat.*	Long.*	Slopes†	Aspects‡	Altitude class§ of site, m	Dist. to seacoast,‖ km	Dates of readings 1st	2nd	3rd
Somerset Island									
101	7232	9512		F	1–30	0.3	21 May	(20 June)	
102	7237	9517	8–9	N	31–60	1.5	23	(20)	
103	7240	9526	4–4	S	1–30	0.3	23	20 June	(1 July)
104	7243	9509	6–6	N	151–180	2.3	23	20	1 July
105	7242	9530	6–8	E	1–30	2.5	28	20	1
106	7246	9533	7–7	W	31–60	1.0	28	(20 June)	
107	7248	9532		F	1–30	2.5	28	(20)	
108	7249	9513	6–6	W	121–150	3.5	23	20 June	1
109	7252	9519	9–11	S	31–60	5.0	23	20	1
110	7249	9537	3–4	N	1–30	2.0	28	20	(1 July)
112	7254	9532	4–5	W	121–150	3.5	23	20	1 July
114	7302	9539	5–5	N	31–60	0.5	29	20	1
116	7307	9538	7–8	W	91–120	0.1	29	20	1
117	7307	9519	7–8	E	241–270	11.0	23	20	1
118	7312	9532		F	31–60	0.5	29	(20 June)	
119	7309	9511	9–11	S	271–300	10.0	23	20 June	1
120	7314	9532	6–6	W	31–60	1.0	29	20	1
121	7314	9507	7–8	E	241–270	15.0	23	20	1
122	7317	9530	5–6	E	61–90	1.0	30	20	(1 July)
123	7318	9513	5–7	W	391–420	10.0	23	21	1 July
124	7320	9535	8–8	E	31–60	1.0	2 June	20	1
125	7322	9519	6–8	N	241–270	13.0	23 May	20	1
126	7328	9532	8–8	N	31–60	1.0	2 June	20	(1 July)
127	7324	9524	3–5	S	301–330	6.0	23 May	20	1 July
129	7331	9537		F	1–30	0.5	2 June	20	1
130	7329	9529		F	301–330	11.0	23 May	20	1
"South" Island									
111	7249	9546	3–3	S	1–30	0.5	29 May	20 June	1 July
"Central" Island									
113	7256	9545	3–4	S	91–120	0.8	29 May	20 June	1 July
"North" Island									
115	7306	9542	4–5	E	1–30	0.5	29 May	20 June	(1 July)
Wadworth Island									
128	7328	9543	2–3	N	1–30	0.5	2 June	20 June	1 July

*Example, latitude 7233 and longitude 9644 are read as latitude 72°33′N, Longitude 96°44′W.
†Range of slopes at each of the six digs along the 100-m transect at each location: all slopes measured from 20-m distance and always upgrade.
‡Aspects: F, Flat; N, North; E, East; S, South; and W, West.
§From a 1:250 000 topographical map using 30-m contours.
‖Closest distance to the seacoast was measured on a horizontal plane from a 1:250 000 topographical map.
#Parentheses indicate no snow remained.

Appendix 3
Elevational profile of 76 snow–ice stations along a 3.7-km transect, Savage Point, Prince of Wales Island, NWT, May–July 1980

Station	Elevation, m asl	Station	Elevation, m asl
0 − 20	132	0	130
100	116	100 + 20	110
200 − 20	100	200	96
300	70	300 + 20	64
400 − 20	48	400	44
500	33	500 + 20	31
600 − 20	28	600	26
700	19	700 + 20	18
800 − 20	15	800	14
900	9	900 + 20	9
Creek bottom	5	Creek bottom	5
1000	11	1000 + 20	12
1100 − 20	19	1100	19
1200	19	1200 − 20	19
1300 + 20	16	1300	16
1400	15	1400 − 20	15
1500 + 20	14	1500	14
1600	14	1600 − 20	14
1700 − 20	12	1700	12
1800	14	1800 + 20	14
1900 − 20	16	1900	16
2000	18	2000 + 20	18
2100 − 20	19	2100	21
2200	23	2200 + 20	24
2300 − 20	27	2300	27
2400	31	2400 + 20	32
2500 − 20	34	2500	36
2600	42	2600 + 20	45
2700 − 20	49	2700	50
2800	56	2800 + 20	57
2900 − 20	61	2900	62
3000	68	3000 + 20	70
3100 − 20	75	3100	77
3200	87	3200 + 20	89
3300 − 20	94	3300	95
3400	101	3400 + 20	102
3500 − 20	107	3500	108
3600	117	3600 + 20	118
3700 − 20	121	3700	123

Appendix 4
Elevational changes (m asl) within and between 38 pairs of snow–ice stations on a 3.7-km transect, Savage Point, Prince of Wales Island, NWT, May–July 1980

Elevational class, m asl	Elevational difference within each pair of stations		Elevational difference between pairs of stations	
	n	%	n	%
0–0.9	18	47.3	2	5.3
1–3.9	16	42.1	14	36.9
4–6.9	4	10.6	10	26.3
7–10.9			8	21.1
11–16			3	7.8
26			1	2.6

Appendix 5
Snow-free aspects and slopes at eight major points of the compass for 76 snow–ice stations along a 3.7-km transect, Savage Point, Prince of Wales Island, NWT, 1980 (based on measurements taken along 20-m-radius periphery around each station)

Snow–ice stations	Aspect	Zero points*	Slopes† N	NE	E	SE	S	SW	W	NW
0	NE	315°–150°	−6	−9	−6	0	+5	+7	+4	0
0 − 20	NE	315°–150°	−5	−7	−5	0	+4	+6	+4	0
100 + 20	NE	315°–140°	−12	−14	−11	−1	+11	+15	+12	0
100	NE	300°–150°	−13	−15	−12	0	+11	+15	+12	−2
200	NE	315°–165°	−11	−14	−11	−5	+7	+12	+7	0
200 − 20	NE	310°–150°	−10	−13	−10	−2	+12	+13	+7	−1
300 + 20	NE	295°–125°	−9	−12	−6	+1	+12	+14	+7	−4
300	NE	315°–120°	−14	−14	−10	+5	+19	+22	+12	0
400	N	285°–100°	−8	−9	−5	+1	+11	+10	+2	−7
400 − 20	NE	285°–125°	−11	−10	−4	+1	+10	+11	+3	−7
500 + 20	NE	295°–120°	−6	−6	−3	+3	+6	+6	+2	−2
500	NE	290°–120°	−7	−7	−4	+2	+6	+7	+3	−4
600	NE	280°–125°	−4	−5	−3	+1	+7	+6	+2	−5
600 − 20	N	290°–120°	−7	−6	−1	+2	+6	+6	+4	−5
700 + 20	N	280°–100°	−4	−3	−1	+1	+2	+2	0	−3
700	N	270°–110°	−2	−2	−1	+1	+1	+1	0	−2
800	N	285°–110°	−4	−4	−1	+2	+5	+4	+1	−2
800 − 20	N	270°–110°	−5	−4	−1	+1	+4	+3	0	−3
900 + 20	N	270°–150°	−6	−7	−6	−4	+2	+1	0	−1
900	N	250°–120°	−4	−2	+1	+1	+2	+2	−1	−2
1000	W	135°–0°	0	+2	+1	−1	−2	−2	−3	−2
1000 − 20	SW	150°–340°	+1	+3	+3	+1	−2	−2	−2	−1
1100 + 20	S	45°–300°	+1	0	−1	−2	−3	−3	−1	+1
1100	S	90°–300°	+1	+1	0	−1	−1	−1	−1	+1
1200	SE	15°–180°	+1	+1	−1	−1	0	+1	+1	+1
1200 − 20	SE	15°–180°	0	−1	−1	−1	0	+1	+1	+2
1300 + 20	SE	(in pond, no readings)								
1300	SE	320°–270°	−1	−1	−1	−1	0	0	0	+1
1400	S	90°–90°	−1	−1	0	−1	−2	−1	−1	−1
1400 − 20	SW	70°–315°	0	+1	−1	−2	−2	−2	−1	0
1500 + 20	E	0°–180°	0	−1	−1	−1	0	+1	+2	+1
1500	E	315°–150°	−1	−1	−1	−1	0	+1	+1	0
1600	SE	0°–270°	0	−1	−1	−1	−1	−1	0	0
1600 − 20	SE	none	−1	−1	−2	−2	−2	−1	−1	−1
1700 + 20	SE	30°–200°	+1	−1	−2	−2	−1	+1	+1	+1
1700	SE	45°–225°	+1	0	−2	−3	−2	0	+1	+2
1800	S	80°–285°	+4	+3	−1	−3	−4	−4	−1	+2
1800 + 20	S	70°–285°	+3	+2	−1	−3	−5	−3	−1	+1
1900 − 20	S	45°–285°	+1	0	−2	−2	−3	−2	−1	+1
1900	SE	20°–255°	+1	−1	−2	−2	−1	−1	+1	+1
2000	S	75°–300°	+2	+1	−1	−5	−6	−4	−4	+1
2000 + 20	S	25°–270°	+2	−2	−3	−3	−4	−2	0	+1
2100 − 20	SW	135°–270°	+2	+6	+3	0	−1	−4	0	+1
2100	SW	115°–340°	+3	+2	+2	−1	−4	−6	−5	−3
2200	SW	110°–335°	+1	+3	+2	−2	−3	−3	−2	−1
2200 + 20	S	100°–315°	+2	+2	+1	−3	−4	−4	−2	0
2300 − 20	SW	115°–295°	+1	+1	+1	−1	−2	−3	−2	+1
2300	SW	135°–315°	+1	+1	+1	0	−2	−2	−1	0
2400	SW	150°–300°	+2	+4	+2	+1	−1	−2	−2	−1
2400 + 20	SW	110°–30°	−3	+2	+1	−1	−4	−5	−6	−5
2500 − 20	SW	135°–290°	+6	+6	+2	0	−1	−2	−1	+1
2500	SW	90°–315°	+1	+2	0	−1	−4	−6	−2	0
2600	SW	170°–300°	+5	+8	+5	+1	−2	−4	−2	+1
2600 + 20	SW	100°–340°	+3	+3	+6	−2	−7	−9	−8	−1
2700 − 20	SW	135°–320°	+2	+3	+2	0	−3	−4	−3	−1
2700	SW	160°–335°	+1	+2	+2	+1	−2	−4	−3	−1
2800	W	165°–0°	0	+4	+4	+3	−1	−5	−4	−3
2800 + 20	W	160°–350°	+1	+4	+5	+4	−1	−4	−5	−3
2900 − 20	W	170°–20°	−1	+3	+5	+4	−1	−4	−4	−3

Appendix 5 (cont'd)
Snow-free aspects and slopes at eight major points of the compass for 76 snow–ice stations along a 3.7-km transect, Savage Point, Prince of Wales Island, NWT, 1980 (based on measurements taken along 20-m-radius periphery around each station)

Snow–ice stations	Aspect	Zero points*	Slopes† N	NE	E	SE	S	SW	W	NW
2900	W	170°–20°	−1	+4	+6	+4	−1	−6	−6	−5
3000	W	190°–20°	−1	+4	+7	+5	+1	−4	−6	−5
3000 + 20	W	180°–20°	−1	+4	+8	+4	0	−5	−8	−7
3100 − 20	W	190°–0°	0	+5	+8	+6	+1	−6	−9	−8
3100	W	195°–20°	−1	+4	+9	+7	+1	−6	−9	−8
3200	W	190°–20°	−2	+3	+7	+5	+1	−5	−8	−6
3200 + 20	W	190°–20°	−3	+4	+7	+6	+4	−5	−7	−7
3300 − 20	W	180°–20°	−5	+2	+7	+7	0	−4	−7	−7
3300	NW	205°–35°	−4	+1	+6	+7	+3	−3	−8	−7
3400	NW	200°–25°	−4	+2	+7	+7	+2	−4	−8	−10
3400 + 20	NW	200°–20°	−5	+3	+7	+7	+3	−4	−8	−10
3500 − 20	NW	210°–30°	−5	+2	+6	+8	+5	−2	−8	−10
3500	NW	220°–20°	−2	+4	+9	+10	+4	−1	−7	−6
3600	NW	210°–25°	−5	+3	+7	+10	+6	−3	−6	−7
3600 + 20	NW	215°–20°	−4	+2	+7	+11	+8	−2	−4	−8
3700 − 20	NW	215°–20°	−2	+4	+7	+8	+6	−3	−7	−8
3700	NW	210°–10°	−5	+3	+6	+7	+4	−2	−6	−6

*Zero degree points on 20-m-radius periphery around each snow–ice station: portion of each periphery within the range of degree values is down slope and the remaining portion is up slope (e.g. snow–ice station 0-m = 315°–150°; which equals a down slope portion of the periphery of 195° from 315°–150°; and a remaining up slope portion of 165° from 150°–315°).
†Slopes of snow–ice stations are based on readings taken at eight major points of the compass: N = 0°; NE = 45°; E = 90°; SE = 135°; S = 180°; SW = 225°; W = 270°; and NW = 315°.

Appendix 6
Summary of searches for evidence of inter-island movements of Peary caribou within the Prince of Wales Island – Somerset Island – Boothia Peninsula complex, NWT, May–July 1979

Zones*	Snowmobile travel, km	Helicopter flights, km	Search dates
1	—	56	8 June
2	—	125	25 May; 8 June
3	—	357	25 May; 8 June
4	—	465	25 May; 8 June
5	15		30 May; 2 June
		457	21, 25, 26 May; 8, 9, 21, 22 June
6	317		16–18, 29, 30 May; 2, 3, 14–17 June
		1052	21–23, 25, 26 May; 8, 9, 20–22 June; 1 July
7	755		5–11, 13, 16, 18, 24, 28, 29 May; 3, 5–7, 10, 11, 14, 17, 18, 24 June
		1092	21–23, 25, 26 May; 8, 9, 20–22 June; 1 July
8	—	423	21 May; 8, 21 June
9	—	758	21 May
10	—	442	21 May

*See Figures 3 and 4.

Appendix 7
Plant species that occurred in range types or range subtypes but had prominence values <1.0, Savage Point, Prince of Wales Island, NWT

Range type 1. *Alectoria ochroleuca* — *Umbilicariá* spp. – crustose lichen stony ridge: *Cetraria nivalis*, *C. delisei*, *Bryoria nitidula*, *Pseudephebe pubescens*, *B. nigricans*, and *Ramalina* sp.

Range type 2. *Dryas integrifolia* – *Saxifraga oppositifolia* – crustose lichen gravel ridge: *Salix arctica*, *Papaver radicatum*, *Draba* spp., *Carex rupestris*, *Carex misandra*, *Saxifraga caespitosa*, *Cerastium beeringianum*, *Luzula nivalis*, *Arenaria* sp., *Pedicularis lanata*, *Poa* sp., *Oxyria digyna*, *Polygonum viviparum*, *Festuca bracyphylla*, *Stellaria longipes*, *Bryoria nitidula*, *Alectoria ochroleuca*, *Pseudephebe pubescens*, *Ramalina* sp., *Umbilicaria* spp., *Dactylina arctica*, *Cetraria nivalis*, *C. tilisei*, *C. cucullata*, and *C. islandica*.

Range type 3. *Dryas integrifolia* – *Salix arctica* – crustose lichen bedrock outcrop ledge: *Polygonum viviparum*, *Draba* spp., *Luzula confusa*, *Carex misandra*, *C. rupestris*, *Oxyria digyna*, *Luzula nivalis*, *Saxifraga caespitosa*, *Papaver radicatum*, *Cerastium beeringianum*, *Saxifraga cernua*, *Stellaria longipes*, *Eriophorum triste*, *Arctagrostis latifolia*, *Alectoria ochroleuca*, *Pseudephebe pubescens*, *Cetraria nivalis*, *C. cucullata*, *C. tilisei*, *C. delisei*, *Umbilicaria* spp., and *Cetraria islandica*.

Range subtype 4.1. *Dryas integrifolia* – mixed sedge – *Salix arctica* – crustose lichen – moss depression: *Juncus biglumis*, *Poa* sp., *Braya purpurescens*, *Polygonum viviparum*, *Arctagrostis latifolia*, *Cetraria cucullata*, *C. islandica*, *C. tilisei*, *Carex rupestris*, *Eutrema edwardsii*, *Luzula nivalis*, *Draba* spp., *Saxifraga cernua*, *Stellaria longipes*, *Carex stans*, *Oxyria digyna*, *Papaver radicatum*, *Bryoria nitidula*, *Alectoria ochroleuca*, *Saxifraga caespitosa*, and *S. nivalis*.

Range subtype 4.2. *Salix arctica* – *Saxifraga oppositifolia* – mixed lichen – moss drainage path: *Poa* sp., *Polygonum viviparum*, *Arctagrostis latifolia*, *Luzula nivalis*, *Carex misandra*, *Festuca bracyphylla*, *Stellaria longipes*, *Oxyria digyna*, *Arenaria* sp., *Papaver radicatum*, *Pedicularis arctica*, *Saxifraga cernua*, *Saxifraga nivalis*, *S. hirculus*, *Cardamine bellidifolia*, *Draba* spp., *Cerastium beeringianum*, *Potentilla hyparctica*, *Melandriam apetalum*, *Saxifraga caespitosa*, *Alopecurus alpinus*, *Braya purpurescens*, *Juncus biglumis*, *Cetraria tilisei*, *C. islandica*, *C. delisei*, *Umbilicaria* spp., *Stereocaulon* sp., *Bryoria nitidula*, and *Alectoria ochroleuca*.

Range type 5. *Saxifraga oppositifolia* – crustose lichen–moss sedimentary slope: *Papaver radicatum*, *Saxifraga caespitosa*, *S. nivalis*, *S. flagellaris*, *S. cernua*, *Juncus biglumis*, *Oxyria digyna*, *Stellaria longipes*, *Cerastium beeringianum*, *Draba* spp., *Ranunculus sulphurous*, *Poa* sp., *Potentilla hyparctica*, *Arenaria* sp., *Festuca bracyphylla*, *Cardamine bellidifolia*, *Cetraria nivalis*, *C. cucullata*, *C. islandica*, *Solorina crocecea*, *Alectoria ochroleuca*, *Bryoria nitidula*, *Dactylina arctica*, *Stereocaulon* sp., and *Peltigera aphthosa*.

Range subtype 6.1. *Eriophorum triste* – *Salix arctica* – *Arctagrostis latifolia* – moss seepage slope: *Luzula nivalis*, *Cardamine bellidifolia*, *Draba* spp., *Saxifraga foliolosa*, *S. hirculus*, *Stellaria longipes*, *Eutrema edwardsii*, *Melandrium apetalum*, *Papaver radicatum*, *Pedicularis arctica*, *Juncus biglumis*, *Oxyria digyna*, *Poa* sp., *Saxifraga flagellaris*, *Braya purpurescens*, *Carex rupestris*, *C. stans*, *Cerastium beeringianum*, *Cetraria nivalis*, *C. islandica*, *C. delisei*, *C. cucullata*, *C. tilisei*, *Alectoria ochroleuca*, *Dactylina ramulosa*, *Bryoria nitidula*, and *Umbilicaria* sp.

Range subtype 6.2. Mixed sedge – *Salix arctica* – *Dryas integrifolia* – moss hummock: *Thamnolia vermicularis*, *Pedicularis lanata*, *Stellaria longipes*, *Carex misandra*, *Melandrium apetalum*, *Luzula nivalis*, *Cardamine bellidifolia*, *Draba* spp., *Saxifraga hirculus*, *Arenaria* sp., *Saxifraga foliolosa*, *Eutrema edwardsii*, *Pedicularis capitata*, *Oxyria digyna*, *Braya purpurescens*, *Carex rupestris*, *Cetraria nivalis*, *C. islandica*, *C. cucullata*, *Bryoria nitidula*, and *Alectoria ochroleuca*.

Other publications in the Occasional Papers Series

No. 1
Birds protected in Canada under the Migratory Birds Convention Act, 4th ed. Disponible également en français.
Cat. No. R69-1/1. Publ. 1957, rev. 1980.
No. 2
Canadian bird names, French, English and scientific.
Publication bilingue.
Cat. No. R69-1/2. Publ. 1964, rev. 1980.
No. 3
Use of aerial surveys by the Canadian Wildlife Service by D.A. Benson.
Out of print.
Cat. No. R69-1/3. Publ. 1966.
No. 4
Queen Elizabeth Islands game survey, 1961 by J.S. Tener.
Cat. No. R69-1/4. Publ. 1963, rev. 1972.
No. 5
Age determination in the polar bears by T.H. Manning.
Cat. No. R69-1/5. Publ. 1964, rev. 1973.
No. 6
A wildlife biologist looks at sampling, data processing and computers by D.A. Benson.
Out of print.
Cat. No. R69-1/6. Publ. 1964.
No. 7
Preliminary report on the effects of phosphamidon on bird populations in New Brunswick by C.D. Fowle. Out of print.
Cat. No. R69-1/7. Publ. 1965.
No. 8
Birds of Nova Scotia – New Brunswick border region by G.F. Boyer.
Cat. No. R69-1/8. Publ. 1966, repr. 1981.
No. 9
Effects of dietary methylmercury on Ring-necked Pheasants, with special reference to reproduction by N. Fimreite.
Cat. No. R69-1/9. Publ. 1971.
No. 10
Trends in populations of barren-ground caribou over the last two decades: a re-evaluation of the evidence by G.R. Parker.
Cat. No. R69-1/10. Publ. 1971, rev. 1972.
No. 11
The Canada migratory game bird hunting permit and related surveys by D.A. Benson.
Cat. No. R69-1/11. Publ. 1971.
No. 12
Observations on duck hunting in eastern Canada in 1968 and 1969 by J.H. Boyd.
Cat. No. R69-1/12. Publ. 1971.
No. 13
Evaluation of ecological effects of recent low water levels in the Peace–Athabasca Delta by H.J. Dirschl.
Cat. No. CW69-1/13. Publ. 1972.
No. 14
The Great Cormorants of eastern Canada by A.J. Erskine.
Cat. No. CW69-1/14. Publ. 1972.
No. 15
Distribution of barren-ground caribou harvest in north-central Canada by G.R. Parker.
Cat. No. CW69-1/15. Publ. 1972.
No. 16
Bird migration forecasts for military air operations by H. Blokpoel.
Cat. No. CW69-1/16. Publ. 1973.
No. 17
Waterfowl populations on the Peace – Athabasca Delta, 1969 and 1970 by D.J. Nieman and H.J. Dirschl.
Cat. No. CW69-1/17. Publ. 1973.
No. 18
Gammarus predation and the possible effects of *Gammarus* and *Chaoborus* feeding on the zooplankton composition in some small lakes and ponds in western Canada by R.S. Anderson and L.G. Raasveldt.
Cat. No. CW69-1/18. Publ. 1974.
No. 19
A summary of DDE and PCB determinations in Canadian birds, 1969 to 1972 by M. Gilbertson and L. Reynolds.
Cat. No. CW69-1/19. Publ. 1974.
No. 20
Development of a simulation model of Mallard Duck populations by C.J. Walters, R. Hilborn, E. Oguss, R.M. Peterman and J.M. Stander.
Cat. No. CW69-1/20. Publ. 1974.
No. 21
Use of museum specimens in toxic chemical research by A.M. Rick.
Cat. No. CW69-1/21. Publ. 1975.
No. 22
Impoundments for waterfowl by W.R. Whitman.
Cat. No. CW69-1/22. Publ. 1976.
No. 23
Minimizing the dangers of nesting studies to raptors and other sensitive species by R.W. Fyfe and R.R. Olendorff.
Cat. No. CW69-1/23. Publ. 1976.
No. 24
Waterfowl damage to Canadian grain: current problems and research needs by L.G. Sugden.
Cat. No. CW69-1/24. Publ. 1976.
No. 25
Census techniques for seabirds of arctic and eastern Canada by D.N. Nettleship.
Cat. No. CW69-1/25. Publ. 1976.
No. 26
Notes on the present status of the polar bear in James Bay and Belcher Islands area by Charles Jonkel, Pauline Smith, Ian Stirling and George B. Kolenosky.
Cat. No. CW69-1/26. Publ. 1976.
No. 27
Limnological and planktonic studies in the Waterton Lakes, Alberta by R. Stewart Anderson and Roderick B. Green.
Cat. No. CW69-1/27. Publ. 1976.
No. 28
Birds and mammals of the Belcher, Sleeper, Ottawa, and King George Islands, Northwest Territories by T.H. Manning.
Cat. No. CW69-1/28. Publ. 1976.
No. 29
Developments in PPS sampling – Impact on current research by A.R. Sen.
Cat. No. CW69-1/29. Publ. 1976.
No. 30
Dynamics of snowshoe hare populations in the Maritime Provinces by Thomas J. Wood and Stanley A. Munroe.
Cat. No. CW69-1/30. Publ. 1977.
No. 31
Migration and population dynamics of the Peace – Athabasca Delta goldeye population by D.B. Donald and A.H. Kooyman.
Cat. No. CW69-1/31. Publ. 1977.
No. 32
The effects of fire on the ecology of the Boreal Forest, with particular reference to the Canadian north; a review and selected bibliography by John P. Kelsall, E.S. Telfer and Thomas D. Wright.
Cat. No. CW69-1/32. Publ. 1977.
No. 33
The ecology of the polar bear (*Ursus maritimus*) along the western coast of Hudson Bay by Ian Stirling, Charles Jonkel, Pauline Smith, Richard Robertson and Dale Cross.
Cat. No. CW69-1/33. Publ. 1977.
No. 34
Canvasback habitat use and production in Saskatchewan parklands by Lawson G. Sugden.
Cat. No. CW69-1/34. Publ. 1978.
No. 35
The diets of muskoxen and Peary caribou on some islands of the Canadian High Arctic by Gerald R. Parker.
Cat. No. CW69-1/35. Publ. 1978.
No. 36
Observations of Mallards in the parkland of Alberta by Michael F. Sorensen.
Cat. No. CW69-1/36. Publ. 1978.
No. 37
The wildlife valuation problem: A critical review of economic approaches by William A. Langford and Donald J. Cocheba.
Cat. No. CW69-1/37. Publ. 1978.
No. 38
Spatial changes in waterfowl habitat, 1964-74, on two land types in the Manitoba Newdale Plain by G.D. Adams and G.G. Gentle.
Cat. No. CW69-1/38. Publ. 1978.
No. 39
Patterns of pelagic distribution of seabirds in western Lancaster Sound and Barrow Strait, Northwest Territories, in August and September 1976 by D.N. Nettleship and A.J. Gaston.
Cat. No. CW69-1/39. Publ. 1978.
No. 40
Responses of Peary caribou and muskoxen to helicopter harassment by Frank L. Miller and Anne Gunn.
Cat. No. CW69-1/40. Publ. 1979.
No. 41
Avian Community structure of six forest stands in La Mauricie National Park, Quebec by J.-L. DesGranges. Disponible également en français.
Cat. No. CW69-1/41E. Publ. 1979.
No. 42
Population ecology studies of the polar bear in northern Labrador by Ian Stirling and H.P.L. Kiliaan. Disponible également en français.
Cat. No. CW69-1/42E. Publ. 1980.
No. 43
Census methods for murres, *Uria* species; a unified approach by T.R. Birkhead and D.N. Nettleship. Disponible également en français.
Cat. No. CW69-1/43E. Publ. 1980.
No. 44
Population ecology studies of the polar bear in the area of southeastern Baffin Island by Ian Stirling, Wendy Calvert, and Dennis Andriashek.
Disponible également en français.
Cat. No. CW69-1/44E. Publ. 1980.
No. 45
Polynyas in the Canadian Arctic by Ian Stirling and Holly Cleator, eds.
Disponible également en français.
Cat. No. CW69-1/45E. Publ. 1981.
No. 46
The Lesser Snow Geese of the eastern Canadian Arctic by H. Boyd, G.E.J. Smith, and F.G. Cooch. Disponible également en français.
Cat. No. CW69-1/46E. Publ. 1982.
No. 47
The distribution and abundance of seals in the eastern Beaufort Sea, 1974-79 by Ian Stirling, Michael Kingsley, and Wendy Calvert. Disponible également en français.
Cat. No. CW69-1/47E. Publ. 1982.