MUSKOX DIET AND SEX-AGE COMPOSITION IN THE CENTRAL ARCTIC COASTAL MAINLAND (QUEEN MAUD GULF AREA) 1988 - 1991

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ABSTRACT

We collected muskox fecal samples from 46 sites in the Queen Maud Gulf area between 22 and 31 July 1989 and from 12 sites between 11 and 13 July 1991. A total of 26 plant species were identified in muskox fecal samples collected in both 1989 and 1991. Analyses showed that the summer diet consisted predominately of sedges (*Carex*, *Eriophorum*) and willows (*Salix*) which together comprised 96% (1989) to 99% (1991) of identified plant fragments. In 1989, sedges made up the greatest proportion of the diet with *Salix* second. In 1991, proportions were reversed and *Salix* was the predominant species. The lower proportion of willow compared to sedges in 1989 may reflect differences in phenology, habitat selection and/or climate between years. Grasses were between 1% (1991) and 3% (1989). *Poa* made up the highest percent density of grasses in 1989 and was more predominant in 1989 than 1991. Forbs did not appear to be important in muskox summer diet but our results almost certainly underestimated the use of forbs due to their high digestibility.

In August 1988 and July 1989 to collect composition data, we flew in a Bell 206B helicopter. In 1988, we classified 1470 muskoxen into seven sex-age categories. In 1989, we counted 1227 individuals but we only classified 796 into the seven sex-age categories. In 1988, the proportion of calves to total population was 10.3% and the mean ratio of calves:100 adult cows (3 years or older) in the mixed herds was 23:100. In 1989, the proportion of calves to total population was 14.7% and mean calf:100 cow ratio in the 24 herds that we completely classified was 31:100. The proportion of yearlings to total population was 7.4% in 1988 and 4.8% in 1989. Single bulls as a proportion of all social units were 35.2% in 1988 and 27.5% in 1989. Bachelor groups were 23.6% in 1988 and 31.3% in 1989.

For both the fecal collection and the composition sites in 1989, a greater proportion of single bulls and bachelor groups were found in the immediate vicinity of water bodies (streams, ponds, rivers and lakes) than mixed sex-age herds. Muskoxen, caribou and geese overlapped in habitat use. In 1989, half of the muskox fecal collection sites (21/42) had caribou or geese present or recent sign. In 1991, three-quarters of the fecal collection sites (9/12) had recent caribou or goose sign present.

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INTRODUCTION

The wetlands of the Queen Maud Gulf area (54 000 km^2) (Fig. 1) support many large and medium size herbivores. Nearly half a million barren-ground caribou (*Rangifer tarandus*) from the Bathurst and Queen Maud Gulf herds calve and summer in the wetlands. The caribou share the area with muskoxen (*Ovibos moschatus*) and over a million Lesser Snow *(Anser caerulescens*), Ross's (*Anser rossii*), Canada (*Branta canadensis*), Brant *(Branta bernicla*) and White-front geese (*Anser albifrons*) (Alexander *et al.* 1991, Alisauskas and Boyd 1994).

Caribou, muskox and goose numbers have rapidly increased since the 1970s (Alisauskas 1992, Alisauskas and Boyd 1994, Gunn *et al.* 1984, Gunn and Dragon in prep., Kerbes 1994). However, the most recent muskox survey has revealed a decline from a 1988 estimate of 8000 muskoxen to 4255 in July 1996 (J. Nishi pers. comm.). Geese, muskoxen and caribou overlap in using the wetlands during the short summer but we have no information concerning whether their high population densities will become a factor in their foraging and population ecology.

The extensive wetlands and the high herbivore numbers have lead to several designations for the area. The area is legally designated as the Queen Maud Gulf Migratory Bird Sanctuary and is being considered a National Wildlife Area (V. Johnston pers. comm.). It was also designated as a Ramsar site - a

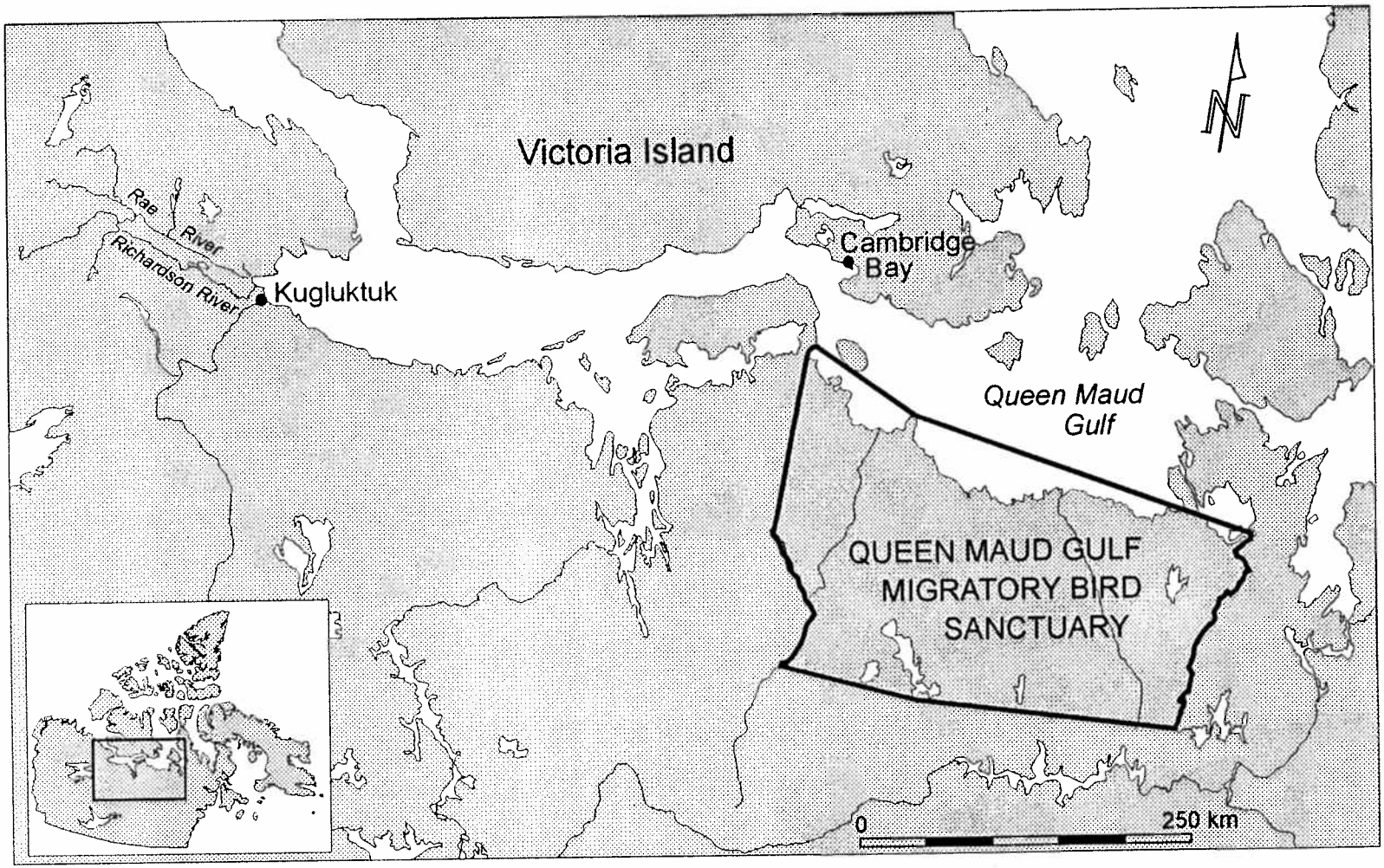

Figure 1. Study area

Wetland of International Importance and an IBP site (Alexander *et al.* 1991). The Department of Resources, Wildlife and Economic Development identified the Queen Maud Gulf area as a potential Wildlife Conservation Area in 1987 (Ferguson 1987).

We chose the area as a study area because of concerns about the future of the caribou and muskoxen and because we would be parallelling the Canadian Wildlife Service's (CWS) ecological studies of geese which included detailed definitions and mapping of habitats using LANDSAT TM data. The habitat mapping was completed and published (Didiuk and Ferguson in press).

Little is known about muskox ecology on the NWT mainland since Tener (1965) reported on diet from the Thelon Game Sanctuary. Studies have focused on the ecology of arctic island muskoxen where a common theme in discussions with hunters is that muskoxen compete with caribou. Most of the interest has focused on Banks Island and with most concerns expressed about winter relationships (Gunn *et al.* 1991).

On the Alaskan mainland, muskoxen forage mostly on willow but favour sedges in the areas where willows are less abundant (Robus 1981). The teeth and digestive anatomy of muskoxen suggest the adaption to a grazing diet and the intake of large amounts of coarse forage. However, such a diet does not preclude selection of specific plants in relation to their phenology. A candidate for key plants in muskox summer nutrition is the legume group (*Oxytropis*, *Hedysarum* and *Astragalus* spp.) and in Alaska, Robus (1981) found that

muskoxen strongly preferred forbs in July and August although forbs were only a relatively small percentage of their diet (Robus 1981). Caribou also selectively forage on forbs which are especially nutritious (Kuropat and Bryant 1983). White (1983) commented on the importance of such selective foraging as having a multiplier effect on fecundity. Caribou on the Alaskan and Yukon coastal mainland also feed on sedges and willows (White *et al.* 1981, Russell *et al.* 1993). An additional factor in the Queen Maud Gulf area for caribou and muskox ecology may be the high numbers of geese (Gunn *et al.* 1984). Canada and snow geese both forage on *Eriophorum* and *Carex aquatilis* as well as grasses (Jefferies 1992). Canada Geese tend to feed on the leaves and apical meristems and Lesser Snow Geese tend to dig down and feed on basal parts including roots (R.G. Bromley pers. comm.).

Our management concern is that a competitive relationship reducing forage quality or quantity would accumulate and reduce fecundity and calf survival and population size would decrease. The steps toward determining if there is a competitive relationship are, first, to describe what the herbivores are eating and then, to ascertain whether the amount available is sufficient for a particular rate of change in population size.

In the late 1980s when we planned this research, we focused on muskoxen, as little was known about their foraging ecology on the mainland, and we were interested in managing the muskoxen for the communities of Gjoa Haven and Cambridge Bay. Our first step was to describe diet and habitat use.

At the same time as collecting diet information, we realised that it would be logistically opportune to collect data on muskox herd composition. Muskoxen lend themselves to this because body size, coat and horn development are sufficiently different between the sexes and the first three cohorts of muskoxen to facilitate field classifications into sex and age classes (Gray 1987, Henrichson and Grue 1980 and Tener 1965).

Published data on the sex and age composition of muskox herds in the NWT are few and widely scattered in space and time. Not only would we estimate calf production and survival, but we would also collect data on the sex-age composition of muskox herds to describe herd dynamics. Muskoxen depend on replenishing their body reserves prior to the rut during a very short plant-growing season and may have developed social strategies to minimize intra-group competition for forage during the season of plant growth. Intra-group competition for forage may be reduced by seasonal shifts in herd size and sex-age composition. We predict, then, that single bulls and bachelor groups would select habitat types characterised by smaller patches of plant communities.

Our preliminary study objectives were: 1) to describe muskox diet on summer mainland ranges and; 2) to describe the sex-age composition of the muskox herds. Our intention was to develop a proposal for a cooperative project with a university to describe ecological relationships and the role of key plant species in muskox and caribou foraging strategies. The research did not develop and it did not progress beyond the preliminary stage. However, in this

report, we present those preliminary results: the data collected on the sex and age composition of muskox herds in August 1988 and July 1989, preliminary data on habitat use and the analysis of fecal plant fragments collected in July 1989 and July 1991. We have also included, for comparison, the results of a collection of fecal pellets from muskox herds in the Rae-Richardson River valleys, 160 km west of Kugluktuk. The fecal samples were collected during a research project on lungworm in July 1990 (Gunn and Wobeser 1992).

METHODS

Muskox diet

In July 1989 and 1991, we collected summer fecal samples from the vicinity of foraging muskox herds from as many individual fresh pellet deposits as found at each site. Grouped samples from each herd, ranging in size from solitary bulls to mixed sex-age herds, were mixed with copious amounts of table salt to prevent deterioration. The samples were sent for analysis of plant fragments to the Composition Analysis Laboratory (Ft. Collins, Colorado). The contractor read 5 slides from each of 60 samples and 20 fields from each slide to identify plant fragments to the lowest taxonomic group possible. The vegetation at the collection sites was broadly classified into range types and the presence of caribou or geese or their sign was recorded.

Similar procedures were followed for fecal sample collection in the Rae-Richardson River valleys in 1990, although range type and the presence of caribou and goose sign were not observed.

We compared plant fragment results between sample groups with arcsin-square root- transformed data using Student's t tests (or Mann-Whitney Rank Sums test when data was not normally distributed) and one-way ANOVAs (or Kruskal-Wallis one-way ANOVAs when data was not normally distributed). When an ANOVA showed a significant difference, multiple pairwise comparisons were performed using the Student-Newman-Keuls test for equal sample sizes or

Dunn's test for unequal sample sizes. All statistical tests were considered significant at $P<0.05$.

Sex and age composition

In August 1988 and July 1989 to collect composition data, we flew in a Bell 206B helicopter to search for muskoxen at variable altitudes depending on the terrain but usually at less than 100 m above ground level. If the herd was less than 10 muskoxen, the helicopter flew slowly past them and it was possible to classify them as they grouped together and faced the helicopter. The helicopter would land 500 - 1000 m away from larger herds using the terrain as cover to remain out of sight whenever possible. We would approach on foot to within 300 m and observe the muskoxen through a 20x spotting scope.

Calves, yearlings, 2-year-olds and 3-year-old bulls were classified on the basis of body size, guard-hair length and horn development. We were not confident of always separating 3-year-old cows from cows >3 years old so they were classified together. Calves and yearlings were not sexed because their smaller horns were not always readily visible at a distance. Additionally, calves and yearlings were more likely to be partially concealed by other herd members when responding to the observer or the helicopter.

In this paper, the term "social unit" refers to any solitary muskox or aggregation of muskoxen that were separated by at least an arbitrary distance of 250 m from the nearest muskoxen. "Single bulls" are bulls that remained at least 250 m from the nearest herd even though on occasion they may have galloped

toward another social unit in response to the helicopter. "Bachelor groups" are groups without cows and "mixed herds" are herds with cows and subadults and usually one or more adult bull. "Adult" muskoxen are aged 3 years or older and "sub-adult" refers to muskoxen aged 2 years or younger.

We recorded the habitat type for the sites where we classified composition in 1988 and 1989. We tried to record the habitat at the location where the muskoxen were first seen from the air rather than where they sometimes moved to in response to the helicopter. We did not land at all sites and as we were focused on classifying muskoxen when we did land, we did not attempt to record the presence of caribou or goose sign at the classification sites.

RESULTS

Muskox diet

We collected muskox fecal samples from 46 sites between 22 and 31 July 1989 and from 12 sites (Fig. 2) between 11 and 13 July 1991.

A total of 26 plant species were identified in muskox fecal samples (Appendices A and B) collected in the Queen Maud Gulf area in both 1989 and 1991. Twenty-three species were identified in 1989 (plus fragments from 8 unidentified species) and 11 in 1991 (plus 1 unknown). Nine of the 26 species were found in both years (*Carex*, *Eriophorum*, *Arctophila, Poa, Ledum*, *Salix*, *Astragalus* - *Oxytropis*, moss, *Cladonia*) and only 2 species were found in every sample (*Carex*, *Salix*).

Sixteen species were identified (plus 1 unknown) from fecal samples collected in the Rae-Richardson River valleys from 8 to 10 July 1990. Only 1 of the 16 species (*Lesquerella*) was not present in samples from the Queen Maud Gulf area and it was found in only 1 fecal sample out of the 8 collected in the Rae-Richardson River valleys (Appendix B).

Analyses of muskox fecal samples from the Queen Maud Gulf show that the summer diet in 1989 and 1991 consisted predominately of sedges and willows. In 1989, sedges, mainly *Carex*, made up the greatest proportion of the diet with *Salix* second (Table 1, Fig. 3). In 1991, proportions were reversed and *Salix* was the predominant species (Mann-Whitney Rank Sums (MW): T=585.0,

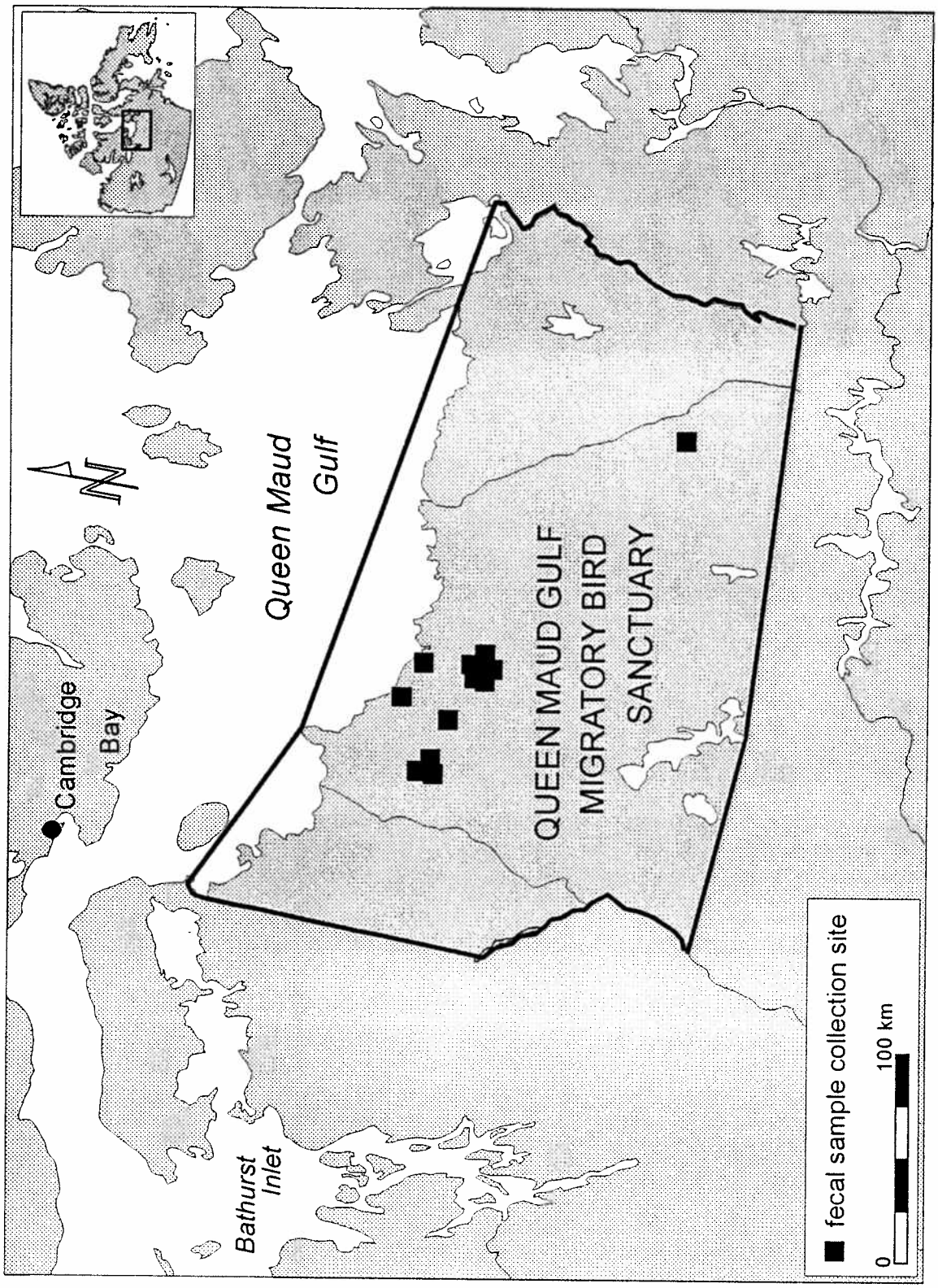

Figure 2. Fecal sample collection sites, July 1991.

Table 1. Mean % relative density ($\bar{x}$) and standard deviation (sd) of plant fragments* from muskox fecal samples collected in the Queen Maud Gulf area and the Rae-Richardson River valleys in the summers of 1989-1991.

Location	Queen Maud Gulf		Rae-Richardson R.
Date	22-31 July 1989	11-13 July 1991	8-10 July 1990
	$\bar{x}$ (sd), n=46	$\bar{x}$ (sd), n=12	$\bar{x}$ (sd), n=8
Sedges			
Carex	78.6 (20.4)	19.4 (14.6)	23.0 (22.6)
Eriophorum	1.4 (1.7)	13.8 (10.7)	0.5 (0.6)
Total	**80.0**	**33.2**	**23.5**
Shrubs			
Dryas	<0.1	–	0.9 (1.3)
Ledum	0.7 (1.7)	0.4 (0.5)	0.1 (0.1)
Salix	15.3 (19.7)	65.1 (24.1)	70.7 (29.9)
Total	**16.0**	**65.5**	**71.7**
Grasses			
Arctophila	–	0.8 (2.1)	0.9 (1.7)
Colpodium	<0.1	–	0.2 (0.5)
Deschampsia	<0.1	–	0.2 (0.5)
Festuca	0.1 (0.2)	–	0.1 (0.3)
Hierochloë	0.8 (2.9)	–	–
Poa	1.3 (1.6)	0.2 (0.5)	2.1 (5.6)
grass seed & glume	0.5 (1.3)	–	–
Total	**2.7**	**1.0**	**3.5**
Forbs			
Astragalus - Oxytropis	<0.1	<0.1	0.6 (0.7)
Hedysarum	<0.1	–	0.2 (0.3)
unknown forb	0.2 (0.4)	–	–
Total	**0.2**	**0.0**	**0.8**
Other:			
Ferns			
Equisetum	–	–	0.3 (0.5)
Moss			
Sphagnum	–	0.1 (0.5)	–
unknown moss	0.3 (1.0)	0.1 (0.2)	<0.1
Lichen		–	
Cladonia	0.2 (0.6)	0.1 (0.2)	–
Total	**0.5**	**0.3**	**0.3**

* Only species that comprised a mean percent density of plant fragments equalling 0.1 or greater in at least one of the 3 years were included in the table.

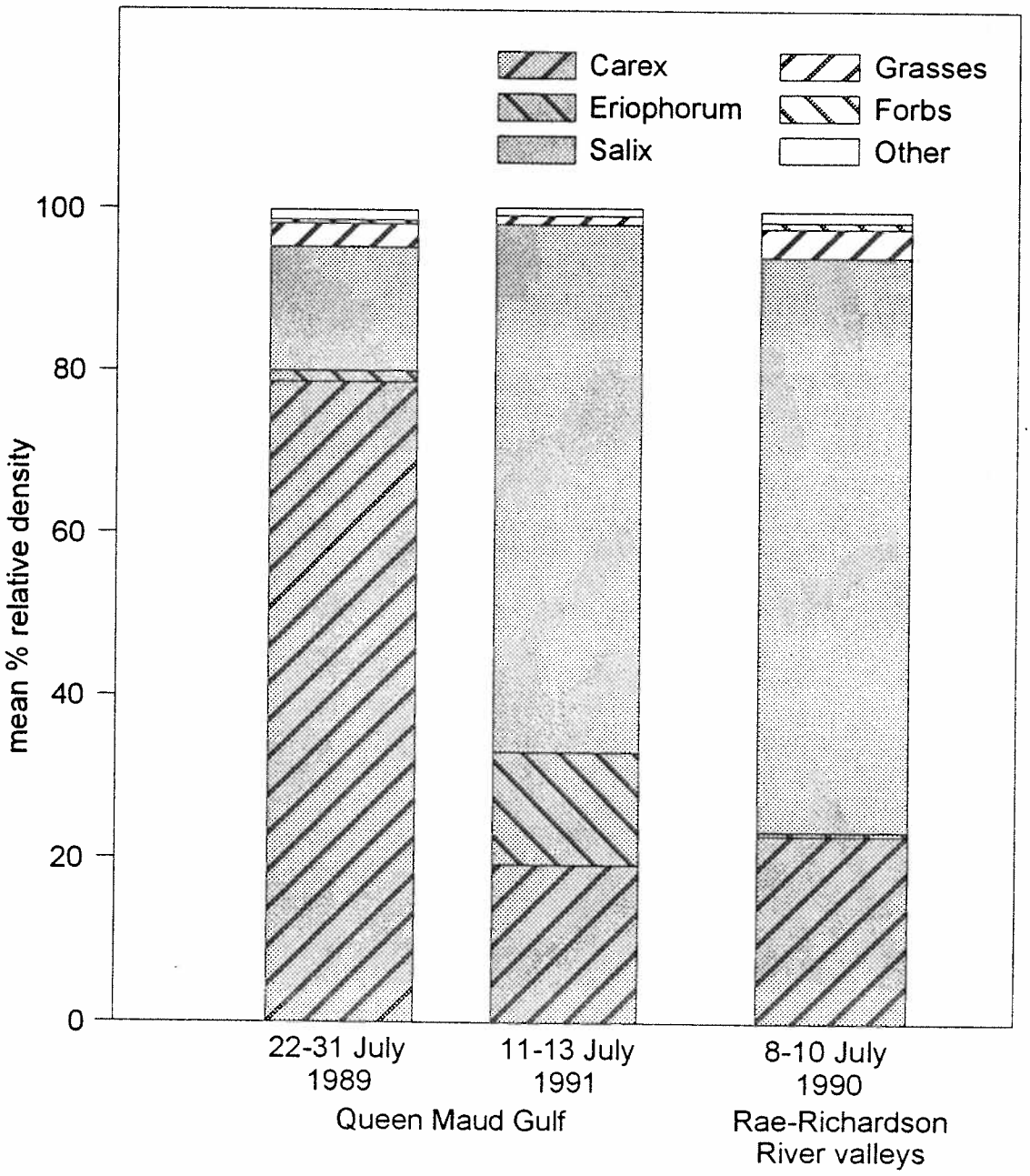

Figure 3. Mean % relative density of plant fragments from muskox fecal samples collected in the Queen Maud Gulf area, July 1989 and 1991 and from the Rae-Richardson River valleys in July 1990.

P<0.0001). Sedges comprised most of the remainder of plant fragments found in fecal samples. Proportions of *Carex* were lower than in 1989 (MW: T=96.0, P<0.0001) but *Eriophorum* was significantly higher (MW: T=571.0, P<0.0001). Sedges and willows were 96% (1989) - 98.7% (1991) of plant fragments and grasses were between 1% (1991) and 3% (1989) (Table 1). *Poa* made up the highest percent density of grasses in 1989 and was more predominant in 1989 than 1991 (MW: T=185.5, P=0.0013). Forbs, such as *Astragalus, Oxytropis* and *Hedysarum*, did not appear to be important in the diet in either year based on plant fragments in fecal pellets.

From fecal samples from the Rae-Richardson River valleys in 1990, *Salix* comprised the highest proportion of plant fragments, similar to the Queen Maud Gulf samples in 1991, and sedges comprised most of the remainder. The proportion of *Carex* was also similar to results from the Queen Maud Gulf in 1991, but *Eriophorum* was significantly lower (MW: T=42.5, P=0.0016) similar to 1989. Grasses were again the next most important food source. Forbs were slightly more important in the Rae-Richardson area and *Astragalus - Oxytropis* was more predominant here than in the other two years in the Queen Maud Gulf (Kruskal-Wallis One-way ANOVA on ranks (KW): P<0.05) but was still less than 1% density.

In 1989, we collected the fecal samples from 4 sites with a single bull, 12 sites with bachelor groups and 21 sites with mixed sex-age herds. Nine sites have no herd size information (Appendix B). A comparison of grouped fecal

samples from July 1989 between herds, bull pairs and lone bulls showed no significant difference in diet with varying group size.

In 1991, the fecal samples were from 1 site with a single bull, 4 sites with bachelor groups and 7 sites with mixed sex-age herds (Appendix C).

Sex and Age composition

We classified 1470 muskoxen in 1988 into seven sex-age categories (Tables 2 and 3, Appendix D) and we saw only six individual muskoxen that we could not classify because either the herd moved away (1 herd, 4 muskoxen) or we could not see the individual clearly (2 individuals).

In 1989, we counted 1227 individuals but we only classified 796 into the seven sex-age categories (Tables 2 and 3, Appendix E). We were sharing the helicopter with another project and thus we had less time to watch the herds, waiting for individuals to move enough that we had a sufficient look at them. We are confident that we counted all calves and yearlings as their body size was conspicuous.

In 1988, the proportion of calves to total population was 10.3% and the mean ratio of calves:100 adult cows (3 years or older) in the mixed herds was 23:100 (Table 3). In 1989, the proportion of calves to total population was 14.7% and mean calf:100 cow ratio in the 24 herds that we completely classified was 31:100. The proportion of yearlings to total population was 7.4% in 1988 and 4.8% in 1989.

We have reported elsewhere (Gunn 1992) on herd composition in 1988.

Table 2. Sex and age classes of muskox herds in Queen Maud Gulf area, NWT, August 1988 and July 1989.

Year	Sex and age classes							
	3+ bull	3-y bull	3+ cow	2-y bull	2-y cow	year-ling	calf	unknown
1988	401	25	653	54	76	109	152	6
1989[a]	298	12	218	12	17	59	180	431
1989[b]	53	12	186	9	21	37	57	0

[a] composition of total sample. [b] composition of 24 herds that were completely classified.

Table 3. Mean size and standard deviation (sd) of muskox social units in Queen Maud Gulf area, NWT, August, 1988 and July 1989.

	August 1988	July 1989
Single bulls	58	44
Bachelor Groups	39	50
mean ± sd (range)	3.9 ± 3.38 (2-9)	3.3 ± 1.6 (2-10)
Mixed herds	68	66
mean ± sd (range)	19.2 ± 9.52 (4-39)	15.4 ± 8.87 (2-45)
Total herds (bachelor + mixed)	107	116
mean ± sd (range)	13.3 ± 10.94 (2-39)	10.0 ± 9.03 (2-45)

Comparisons with the 1989 data are limited by the relatively small sample of herds that were fully classified and by the seasonal difference. The difference of 2-3 weeks covers the time when the herd composition changes as the rut approaches. Single bulls as a proportion of all social units were 35.2% in 1988 and 27.5% in 1989. Bachelor groups were 23.6% in 1988 and 31.3% in 1989 (Table 3). Table 4 shows the sex-age types of mixed herds in 1988 and 1989.

Table 4. Sex-age types of mixed herds in Queen Maud Gulf area, NWT, August 1988 and July 1989.

Sex-age types	August 1988	July 1989
Herds without adult bulls	0	2
Herds with 1 adult bull	18	9
Herds with >1 adult bull	50	15
Herds with no calves	22	4
Herds with no calves or yearlings	7	4
Herds with no calves, yearlings or 2-year-olds	5	4

Habitat use

We recorded the habitat type for 42 sites where we collected muskox fecal samples in 1989. Our sampling preceded CWS's habitat mapping which meant that subsequently we assigned our habitat types as far as possible to Didiuk and Ferguson's (in press) categories. However, 15 of the 42 sites were within 30 m of a stream, river, pond or lake and the vegetation transitions were abrupt within that 30 m. Consequently we classified them within the one class which is then a habitat type not delimited in the satellite mapped habitats. We noted that 12 of the 15 stream/pond edges were conspicuously heavily trampled and grazed by the muskoxen and also by geese (7 sites).

For both the fecal collection and the composition sites in 1989, a greater proportion of single bulls and bachelor groups were found in the immediate vicinity of water bodies (streams, ponds, rivers and lakes) than mixed sex-age herds (Table 5). We were not able to make similar comparisons in 1991 with only a small sample of fecal collection sites (Table 6).

Half of the muskox fecal collection sites (21/42) in 1989 had caribou or geese present or recent sign (Table 7). Goose sign was seen at 13 sites and caribou at 3 sites and 5 sites had both caribou and geese sign. Four sites also had geese (white-fronts and lesser snow geese) and six sites had scattered caribou present as well as fecal sign. In 1991, three-quarters of the fecal collection sites (9/12) had recent caribou or goose sign present (Table 8). Goose sign was seen at 6 sites and caribou sign at 6 sites, but only 3 sites

Table 5. Number of muskox composition sites and fecal collection sites by habitat type and herd size, July 1989, Queen Maud Gulf.

Habitat Type	Single bulls	Bachelor groups	Mixed sex-age herds	Total
Lake/stream Bank	26+2* (64%)	26+4 (60%)	20+9 (44%)	72+15
Tussock/Hummock Tundra	8+1 (20%)	6+4 (20%)	11+3 (21%)	25+8
Wet Sedge Meadow	2+0 (4.5%)	1+1 (4%)	4+1 (7.5%)	7+2
Low Shrub Tundra	1+1 (4.5%)	0+1 (2%)	2+3 (7.5%)	3+5
Shrub Thicket	0+1 (2.3%)	0+1 (2%)	--	0+2
Eroded Clay Bank	0+1 (2.3%)	1+4 (10%)	0+1 (1.5%)	1+6
Dry lichen Heath	--	--	7+1 (12%)	7+1
Coastal Graminoid Turf	--	0+1 (2%)	2+2 (6%)	2+3
Total	38+6 / 44	34+16 / 50	46+20 / 66	

* Number of composition sites + number of fecal collection sites (% of total sites from a particular herd size found at each habitat type) - eg. 64% of sites with single bulls were collected by lakes/stream banks.

Table 6. Number of muskox fecal collection sites by habitat type and herd size, July 1991, Queen Maud Gulf.

Habitat Type	Single bull	Bachelor group	Mixed sex-age herd
Lake/stream Bank	0	2	2
Tussock/Hummock Tundra	1	0	3
Wet Sedge Meadow	0	2	2
Total	1	4	7

Table 7. Number of muskox fecal collection sites by habitat type and presence of goose and caribou fecal pellets, July 1989, Queen Maud Gulf.

Habitat type	Caribou	Geese	Caribou + geese
Tussock/Hummock Graminoid Tundra	2	0	0
Wet Sedge Meadow	0	0	2
Low Shrub Tundra	0	1	1
Shrub Thicket	0	0	0
Eroded Clay Bank	0	1	1
Lake/stream Bank	0	9	1
Dry lichen Heath	1	0	0
Coastal Graminoid Turf	0	2	0

Table 8. Number of muskox fecal collection sites by habitat type and presence of goose and caribou fecal pellets, July 1991, Queen Maud Gulf.

Habitat type	Caribou	Geese	Caribou + geese
Tussock/Hummock Graminoid Tundra	2	0	0
Wet Sedge Meadow	1	1	1
Lake/stream Bank	0	2	2

showed an indication of use by both caribou and geese.

In 1988 we had not recorded habitat type when we were classifying the muskoxen but we did record when we saw geese or caribou in close proximity to the muskoxen. We saw caribou with muskoxen at six sites; geese (Canadas and white geese) at five sites and caribou and geese at one site.

STORE & FORWARD REPORT

DATE/TIME 7-20-99 9:15AM
LOCAL TERMINAL ID. 4038730293
LOCAL NAME Wildlife Mgmt Div.
COMPANY LOGO GNWT RES., WLDLF&ECDV

No.	REMOTE STATION	START TIME	DURATION	#PAGES	MODE	RESULTS
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008	NORTHZSLAVE	8:52AM	1.08"	3/ 3	EC SF	COMPLETED 14400
010	SIMPSON	8:53AM	1.04"	3/ 3	EC SF	COMPLETED 14400
004	INUVIKZSUPT	9:00AM	1.03"	3/ 3	EC SF	COMPLETED 14400
003	FORTzSMITH	9:11AM	2.42"	3/ 3	EC SF	COMPLETED 9600
		TOTAL 0:07.48" 15				

DIAL GROUP

No.	DIRECTORY NUMBERS
038	003 007 008 010 004

NOTE:
No : DIRECTORY NUMBER 48 : 4800BPS SELECTED EC : ERROR CORRECT G2 : G2 COMMUNICATION
PD : POLLED BY REMOTE SF : STORE & FORWARD RI : RELAY INITIATE RS : RELAY STATION
MB : SEND TO MAILBOX PG : POLLING A REMOTE MP : MULTI-POLLING RM : RECEIVE TO MEMORY

DISCUSSION

Summer muskox diet in the Queen Maud Gulf area was similar to the Alaskan coastal mainland (Robus 1981). The diet in mid-July 1991 (and also early July 1990 near Kugluktuk) was largely willow with 20-35% *Carex* and *Eriophorum*. Further north, on the arctic islands, the summer diet is less willow and more graminoids which reflects their relative availability. Parker (1978:14) stated that in summer on High Arctic islands, "muskoxen normally consume near equal amounts of willow and sedges" and that "these two plant groups normally account for 65% to 75% of summer diet of muskoxen".

The lower proportion of willows in July 1989 was unexpected. The sedges reach their nutritional peak before the shrubs (Robus 1981, Kuropat and Bryant 1983). Consequently, muskoxen shift their foraging in July from *Carex* and *Eriophorum* to willow in Alaska (Robus 1981) and the High Arctic (Parker 1978, Tener 1965). Sampling was 1-2 weeks later (late July) in 1989 and the lower proportion of willow compared to the sedges may reflect a difference in phenology between years. Alternatively, the difference between years may also reflect habitat selection and late July 1989 was exceptionally warm (field-notes) which may have influenced muskoxen to select sites close to water-bodies.

Plants vary by species and growth phase in their passage through the digestive tracts. Highly digestible plants will be almost undetectable in fecal pellets and Robus (1981) discusses this limitation with respect to legumes. Her

comments suggest that our results almost certainly underestimated the use of forbs. Observing foraging behaviour and sampling for browsed plants will be necessary to document preference for forbs.

We did not find an expected difference in the diet of single bulls and bull pairs compared to mixed sex herd although we had predicted that the single bulls and small bachelor groups might be able to exploit smaller high quality habitat patches. The tendency for single bulls and bachelor groups to be close to water bodies where several plant communities were within a few metres of each other is, however, suggestive. Didiuk and Ferguson's (in press) habitat mapping identifies available habitat types which could be compared with use to determine habitat preferences. However, we would have to define and document finer-scale habitat types to test if the bulls were selecting for smaller patches.

Muskoxen, caribou and geese overlapped in habitat use and our information on muskox diet compared to published accounts of caribou and goose diet suggests that those herbivores also forage on *Eriophorum* and sedges. The most conspicuous overlap from our preliminary findings is between geese and muskoxen along and around water bodies. Our documentation of habitat use is preliminary and requires further investigation to determine if and under what conditions the overlap in habitat use and possible overlap in diet constitute competition between the herbivores. The significance of overlap in habitat use is not restricted, however, to diet. As herbivore densities increase,

so does the potential for parasitic or disease transmission and this could include host switching.

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APPENDIX A. A list of the species and family names of plants found in muskox fecal samples collected on the arctic coastal mainland in the summers of 1989 - 1991.

General grouping *Species* (common name)	FAMILY
Sedges	
Carex	CYPERACEAE
Eriophorum (Cotton Grass)	
Rushes	
Luzula (Wood Rush)	JUNCACEAE
Grasses	
Arctophila fulva	GRAMINEAE
Calamagrostis (Reed-Bentgrass)	
Colpodium	
Deschampsia (Hairgrass)	
Poa (Bluegrass)	
Festuca (Fescue)	
Dupontia	
Agropyron (Wheat Grass)	
Hierochloë (Holy Grass)	
Trisetum	
Shrubs	
Salix (Willow)	SALICACEAE
Dryas (Mountain Aven)	ROSACEAE
Arctostaphylos (Bear Berry)	ERICACEAE
Cassiope (White Heather)	
Ledum (Labrador-tea)	
Forbs	
Astragalus (Milk-Vetch)	LEGUMINOSAE
Hedysarum (Licorice-Root)	
Oxytropis	
Lesquerella	CRUCIFERAE
Stellaria (Chickweed)	CARYOPHYLLACEAE
Cerastium (Mouse-ear chickweed)	

General grouping *Species* (common name)	FAMILY
Ferns	
Equisetum (Horsetail)	EQUISETACEAE
Mosses	
Sphagnum	
Lichen	
Alectoria	ALECTORIACEAE
Bryoria	
Cetraria	PARMELIACEAE
Cladonia	CLADONIACEAE

APPENDIX B. Tables reporting mean percent relative density (□) and standard deviation (sd) of discerned fragments from muskox fecal samples collected in the Queen Maud Gulf, July 1989 and 1991 and from the Rae-Richardson River valleys in July 1990.

Table B1. Mean percent relative density ($\bar{x}$) and standard deviation (sd) of discerned fragments from muskox fecal samples collected in the Queen Maud Gulf Region, Northwest Territories in July 1989. Means based on 5 slides of 20 fields each.

Sample number	#51		#52		#06B		#01		#02B		#04		#04B		#05		#06	
Herd size	9		16		--		--		1 bull		2 bulls		--		12		11	
Range type	CT		CA		--		CT		CA		CA		--		CA		CT	
	$\bar{x}$	sd	$\bar{x}$	sd	$\bar{x}$	sd	$\bar{x}$	sd	$\bar{x}$	sd	$\bar{x}$	sd	$\bar{x}$	sd	$\bar{x}$	sd	$\bar{x}$	sd
Carex	85.85	2.88	94.83	2.19	77.71	6.39	93.95	4.53	1.65	1.66	69.65	8.05	49.85	11.82	44.11	7.11	77.70	7.58
Eriophorum	2.37	2.38	--	--	3.54	3.22	2.11	3.04	--	--	--	--	0.69	1.55	--	--	0.88	1.22
Luzula	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Agropyron	--	--	--	--	--	--	0.33	0.74	--	--	--	--	--	--	--	--	--	--
Arctophila fulva	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Calamagrostis	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Colpodium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Deschampsia	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dupontia	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Festuca	0.48	1.06	--	--	0.39	0.88	--	--	--	--	--	--	--	--	--	--	--	--
Hierachloë	--	--	--	--	1.89	1.09	--	--	--	--	--	--	--	--	--	--	0.37	0.83
Poa	0.40	0.89	--	--	1.89	1.09	1.12	1.74	0.33	0.73	--	--	--	--	--	--	--	--
Trisetum spicatum	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.60	1.34
Grass seed and glume	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Unknown grass	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cassiope	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dryas	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ericaceae	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ledum (type)	0.46	1.04	--	--	0.52	1.39	--	--	2.06	0.71	5.74	4.46	6.29	5.94	7.21	5.04	--	--
Salix	8.11	4.24	5.17	2.19	7.44	4.18	1.45	1.62	95.12	1.94	22.77	6.84	37.33	12.84	46.98	9.73	18.94	8.16
Astragalus - Oxytropis	--	--	--	--	--	--	--	--	--	--	0.56	1.25	--	--	--	--	--	--
Cerastium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hedysarum	--	--	--	--	--	--	0.33	0.74	--	--	0.64	1.44	0.62	1.39	0.38	0.85	--	--
Lupinus	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Oxyria digyna	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Saxifraga	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Seed	0.45	1.01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Stellaria	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Unknown forb	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Unknown forb I	1.88	2.00	--	--	--	--	0.33	0.74	--	--	--	--	1.30	1.79	--	--	0.98	1.40
Equisetum	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Fern	--	--	--	--	--	--	0.38	0.86	--	--	--	--	--	--	--	--	--	--
Moss	--	--	--	--	6.62	3.30	--	--	--	--	--	--	--	--	--	--	--	--
Alectoria - Bryoria	--	--	--	--	--	--	--	--	0.42	0.93	--	--	--	--	--	--	--	--
Cladonia (type)	--	--	--	--	--	--	--	--	0.42	0.93	0.64	1.44	3.92	0.99	1.32	1.24	0.53	1.18

CT-cottongrass tussock; CA-*Carex aquatilis*; WS-willow shrub; SBG-stream bank; MIS-miscellaneous

Table B1 continued.

Sample number	#07		#09B		#10B		#11		#12		#13		#14		#15		#16	
Herd size	11		2 bulls		2 bulls		25		28		12		2 bulls		30		25	
Range type	CT		CA		WS		SBG		CA		MIS		SBG		CT		CT	
	$\bar{x}$	sd	$\bar{x}$	sd	$\bar{x}$	sd	$\bar{x}$	sd	$\bar{x}$	sd	$\bar{x}$	sd	$\bar{x}$	sd	$\bar{x}$	sd	$\bar{x}$	sd
Carex	83.96	3.38	81.99	6.17	22.96	12.00	82.07	5.42	74.68	6.31	80.34	5.28	77.64	6.73	78.78	4.20	82.63	7.11
Eriophorum	1.66	2.28	5.16	5.19	--	--	1.80	1.04	1.36	1.29	0.53	1.19	1.03	2.31	0.44	0.98	0.53	1.19
Luzula	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Agropyron	--	--	--	--	--	--	0.44	0.99	--	--	--	--	--	--	0.48	1.07	--	--
Arctophila fulva	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Calamagrostis	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Colpodium	--	--	--	--	--	--	0.98	1.35	--	--	--	--	--	--	--	--	--	--
Deschampsia	--	--	--	--	--	--	--	--	0.56	1.26	--	--	--	--	--	--	--	--
Dupontia	0.81	1.12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Festuca	--	--	--	--	--	--	--	--	--	--	0.37	0.83	--	--	--	--	--	--
Hierachloë	--	--	--	--	--	--	2.31	1.76	--	--	--	--	--	--	0.44	0.98	3.09	2.32
Poa	--	--	1.00	1.39	0.73	1.64	3.07	2.02	1.68	1.65	0.37	0.83	6.86	1.38	2.03	2.80	0.44	0.98
Trisetum spicatum	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Grass seed and glume	--	--	0.56	1.26	--	--	--	--	--	--	--	--	2.63	2.75	--	--	1.54	1.41
Unknown grass	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cassiope	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dryas	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ericaceae	0.37	0.82	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ledum (type)	--	--	--	--	3.26	3.37	--	--	--	--	--	--	--	--	--	--	--	--
Salix	11.59	4.30	10.29	3.33	71.85	13.59	7.49	2.19	21.72	6.31	16.99	4.12	11.28	4.77	14.92	3.95	8.70	3.90
Astragalus - Oxytropis	--	--	--	--	--	--	--	--	--	--	0.53	1.19	--	--	--	--	--	--
Cerastium	--	--	--	--	--	--	0.92	1.26	--	--	--	--	--	--	--	--	--	--
Hedysarum	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Lupinus	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Oxyria digyna	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Saxifraga	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Seed	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.02	1.40
Stellaria	--	--	--	--	--	--	--	--	--	--	0.87	1.24	--	--	0.92	1.29	--	--
Unknown forb	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Unknown forb I	--	--	0.48	0.88	1.20	1.65	--	--	--	--	--	--	--	--	--	--	0.52	1.16
Equisetum	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Fern	--	--	--	--	--	--	0.48	1.07	--	--	--	--	--	--	--	--	--	--
Moss	1.21	1.11	0.56	0.26	--	--	0.44	0.99	--	--	--	--	--	--	1.99	1.19	1.00	1.39
Alectoria - Bryoria	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cladonia (type)	0.40	0.89	--	--	--	--	--	--	--	--	--	--	0.56	1.26	--	--	0.53	1.19

Table B1 continued.

Sample number	#17		#19		#20		#21		#22		#23		#24		#26		#27	
Herd size	--		45		3 bulls		--		3 bulls		1 bull		--		5		7 bulls	
Range type	--		SBG		MIS		--		CA		CA		--		CT		CT	
	x̄	sd	x̄	sd	x̄	sd	x̄	sd	x̄	sd	x̄	sd	x̄	sd	x̄	sd	x̄	sd
Carex	86.47	2.79	25.84	7.10	78.38	8.70	71.16	10.91	82.01	6.92	88.14	4.68	84.56	5.65	69.23	9.67	65.69	7.26
Eriophorum	3.74	1.72	--	--	0.45	1.00	--	--	3.31	2.72	1.38	1.28	2.91	3.13	0.49	1.10	0.74	1.65
Luzula	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Agropyron	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Arctophila fulva	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Calamagrostis	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Colpodium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Deschampsia	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dupontia	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.64	1.44
Festuca	--	--	--	--	0.40	0.89	--	--	--	--	--	--	0.58	1.31	--	--	--	--
Hierachloë	--	--	0.48	1.07	--	--	0.48	1.07	0.52	1.16	--	--	--	--	1.10	2.47	18.86	4.47
Poa	0.49	1.09	1.64	2.34	3.04	3.11	3.04	2.23	3.48	2.60	0.87	1.19	1.07	0.99	7.21	3.15	0.62	1.38
Trisetum spicatum	--	--	--	--	--	--	0.55	1.23	--	--	--	--	--	--	--	--	0.62	1.38
Grass seed and glume	--	--	0.48	1.07	2.85	3.92	--	--	--	--	--	--	--	--	2.41	1.81	7.50	4.99
Unknown grass	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.74	1.65
Cassiope	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dryas	--	--	--	--	--	--	0.55	1.23	--	--	--	--	--	--	--	--	--	--
Ericaceae	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ledum (type)	0.46	1.03	--	--	--	--	1.46	2.19	1.60	1.47	--	--	1.58	2.60	--	--	--	--
Salix	8.84	3.23	70.38	9.01	14.37	5.26	22.76	8.45	9.08	1.68	8.63	2.68	8.40	3.44	19.14	9.82	4.59	3.06
Astragalus - Oxytropis	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cerastium	--	--	--	--	0.51	1.13	--	--	--	--	--	--	--	--	0.42	0.93	--	--
Hedysarum	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Lupinus	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Oxyria digyna	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Saxifraga	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Seed	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Stellaria	--	--	0.63	1.42	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Unknown forb	--	--	--	--	--	--	--	--	--	--	--	--	0.52	1.15	--	--	--	--
Unknown forb I	--	--	0.55	1.23	--	--	--	--	--	--	--	--	0.38	0.85	--	--	--	--
Equisetum	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Fern	--	--	--	--	--	--	--	--	--	--	0.45	1.01	--	--	--	--	--	--
Moss	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Alectoria - Bryoria	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cladonia (type)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table B1 continued.

Sample number	#28		#29		#30		#31		#32		#33		#34		#35		#36	
Herd size	2 bulls		2 bulls		15		12		8		28		23		--		5	
Range type	SBG		MIS		MIS		CA		MIS		CT		MIS		--		CT	
	x̄	sd	x̄	sd	x̄	sd	x̄	sd	x̄	sd	x̄	sd	x̄	sd	x̄	sd	x̄	sd
Carex	92.53	6.27	92.29	2.03	84.58	5.23	96.30	2.75	90.02	6.62	91.18	3.34	83.25	5.19	92.07	4.24	92.35	3.22
Eriophorum	1.59	2.22	0.41	0.91	3.17	2.05	--	--	3.37	2.61	5.13	3.86	1.26	1.16	0.71	0.98	2.81	1.24
Luzula	--	--	--	--	--	--	--	--	--	--	0.41	0.91	--	--	--	--	--	--
Agropyron	--	--	0.41	0.91	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Arctophila fulva	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Calamagrostis	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Colpodium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Deschampsia	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dupontia	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Festuca	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hierachloë	--	--	--	--	0.50	1.12	--	--	--	--	--	--	1.97	1.27	--	--	0.41	0.92
Poa	--	--	0.42	0.93	1.77	1.86	1.51	1.72	0.77	1.08	--	--	2.80	2.98	1.84	1.44	1.63	0.91
Trisetum spicatum	--	--	0.40	0.89	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Grass seed and glume	--	--	1.66	0.75	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Unknown grass	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cassiope	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dryas	--	--	--	--	0.43	0.96	--	--	--	--	--	--	--	--	--	--	--	--
Ericaceae	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ledum (type)	--	--	--	--	--	--	--	--	0.86	1.18	--	--	--	--	--	--	--	--
Salix	5.39	4.71	4.41	2.22	9.55	1.06	2.19	1.64	4.98	4.40	2.87	0.90	9.98	5.05	4.99	3.31	2.39	2.29
Astragalus - Oxytropis	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cerastium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hedysarum	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Lupinus	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Oxyria digyna	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Saxifraga	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Seed	--	--	--	--	--	--	--	--	--	--	0.41	0.91	0.40	0.89	--	--	--	--
Stellaria	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.39	0.88	--	--
Unknown forb	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.41	0.92
Unknown forb I	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Equisetum	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Fern	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Moss	0.49	1.09	--	--	--	--	--	--	--	--	--	--	0.34	0.77	--	--	--	--
Alectoria - Bryoria	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cladonia (type)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table B1 continued.

Sample number	#38		#39		#40		#43		#44		#45		#46		#47		#48		#49	
Herd size	3 bulls		1 bull		3 bulls		15		3 bulls		1 bull		33		27		--		--	
Range type	SBG		SBG		CT		CT		WS		CT		CT		CT		--		MIS	
	x̄	sd	x̄	sd	x̄	sd	x̄	sd	x̄	sd	x̄	sd	x̄	sd	x̄	sd	x̄	sd	x̄	sd
Carex	87.34	7.63	92.22	1.68	63.19	7.01	93.01	2.23	76.64	8.47	92.26	2.42	95.62	2.28	97.32	0.91	96.40	2.01	96.33	4.01
Eriophorum	5.11	3.79	--	--	5.95	2.02	0.49	1.09	--	--	--	--	--	--	--	--	0.33	0.73	--	--
Luzula	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Agropyron	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Arctophila fulva	--	--	--	--	--	--	--	--	--	--	--	--	0.33	0.74	--	--	--	--	--	--
Calamagrostis	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Colpodium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Deschampsia	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dupontia	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.33	0.73	--	--
Festuca	0.45	1.01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hierachloë	3.98	2.25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.48	1.69
Poa	0.41	0.92	1.44	2.25	2.92	3.58	0.33	0.73	1.57	2.35	--	--	--	--	--	--	0.42	0.93	--	--
Trisetum spicatum	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Grass seed and glume	0.49	1.10	--	--	0.54	1.21	--	--	1.62	2.44	--	--	--	--	--	--	--	--	1.06	0.98
Unknown grass	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cassiope	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.33	0.74	--	--	--	--
Dryas	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.42	0.93	0.33	0.73
Ericaceae	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ledum (type)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Salix	2.22	2.29	5.92	3.60	25.69	7.32	5.02	2.34	19.18	6.09	7.74	2.42	4.05	2.58	2.02	0.77	2.10	0.76	--	--
Astragalus - Oxytropis	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cerastium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hedysarum	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Lupinus	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Oxyria digyna	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Saxifraga	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Seed	--	--	--	--	--	--	0.42	0.93	--	--	--	--	--	--	--	--	--	--	0.40	0.89
Stellaria	--	--	--	--	0.54	1.21	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Unknown forb	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.40	0.89
Unknown forb I	--	--	--	--	0.62	1.40	--	--	0.99	1.36	--	--	--	--	--	--	--	--	--	--
Equisetum	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Fern	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Moss	--	--	0.42	0.93	0.55	1.23	0.42	0.93	--	--	--	--	--	--	0.33	0.74	--	--	--	--
Alectoria - Bryoria	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cladonia (type)	--	--	--	--	--	--	0.31	0.70	--	--	--	--	--	--	--	--	--	--	--	--

Table B2. Mean percent relative density ($\bar{x}$) and standard deviation (sd) of discerned fragments from muskox fecal samples collected in the Queen Maud Gulf Region, Northwest Territories in July 1991. Means based on 5 slides of 20 fields each.

Sample number	1271F		1272F		1273F		1274F		1275F		1276F	
	$\bar{x}$	sd	$\bar{x}$	sd	$\bar{x}$	sd	$\bar{x}$	sd	$\bar{x}$	sd	$\bar{x}$	sd
Carex	13.85	4.06	10.72	3.44	17.17	6.65	15.23	5.46	7.16	4.10	22.47	4.89
Eriophorum	–	–	9.13	3.08	23.01	6.12	19.60	5.23	21.65	5.44	16.93	6.36
Juncus	–	–	–	–	–	–	–	–	–	–	–	–
Arctophila fulva	–	–	–	–	1.57	2.15	–	–	–	–	7.16	4.10
Calamagrostis	–	–	–	–	–	–	–	–	–	–	–	–
Colpodium	–	–	–	–	–	–	–	–	–	–	–	–
Deschampsia	–	–	–	–	–	–	–	–	–	–	–	–
Poa	–	–	–	–	1.53	2.10	–	–	–	–	0.73	1.62
Unknown grass	–	–	–	–	–	–	–	–	–	–	–	–
Arctostaphylos	–	–	–	–	–	–	–	–	0.67	1.5	–	–
Cassiope	–	–	–	–	–	–	–	–	–	–	–	–
Dryas	–	–	–	–	–	–	–	–	–	–	–	–
Ledum (type)	–	–	–	–	0.78	1.74	1.38	1.88	0.49	1.09	0.85	1.89
Salix	86.15	4.06	80.15	3.58	54.37	9.04	63.79	9.18	70.03	4.26	51.86	8.17
Astragalus - Oxytropis	–	–	–	–	–	–	–	–	–	–	–	–
Draba	–	–	–	–	–	–	–	–	–	–	–	–
Lesquerella	–	–	–	–	–	–	–	–	–	–	–	–
Saxifraga	–	–	–	–	–	–	–	–	–	–	–	–
Equisetum	–	–	–	–	–	–	–	–	–	–	–	–
Moss	–	–	–	–	–	–	–	–	–	–	–	–
Sphagnum	–	–	–	–	1.57	2.15	–	–	–	–	–	–
Cetraria (type)	–	–	–	–	–	–	–	–	–	–	–	–
Cladonia (type)	–	–	–	–	–	–	–	–	–	–	–	–

Sample number	1277F		1278F		1279F		1280F		1281F		1282F	
	$\bar{x}$	sd	$\bar{x}$	sd	$\bar{x}$	sd	$\bar{x}$	sd	$\bar{x}$	sd	$\bar{x}$	sd
Carex	20.79	5.29	56.11	11.86	39.74	8.92	9.59	2.45	7.86	3.46	11.46	2.26
Eriophorum	4.96	3.58	33.62	9.76	24.43	7.96	4.80	3.97	2.54	1.71	5.21	2.21
Juncus	–	–	–	–	–	–	–	–	–	–	–	–
Arctophila fulva	–	–	–	–	–	–	0.30	0.68	–	–	–	–
Calamagrostis	–	–	–	–	–	–	–	–	0.37	0.84	–	–
Colpodium	–	–	–	–	–	–	–	–	–	–	–	–
Deschampsia	–	–	–	–	–	–	–	–	–	–	–	–
Poa	–	–	–	–	–	–	–	–	–	–	–	–
Unknown grass	–	–	–	–	–	–	–	–	–	–	–	–
Arctostaphylos	–	–	–	–	–	–	–	–	–	–	–	–
Cassiope	–	–	–	–	–	–	–	–	–	–	–	–
Dryas	–	–	–	–	–	–	–	–	–	–	–	–
Ledum (type)	0.51	1.15	–	–	–	–	–	–	–	–	0.86	1.17
Salix	73.74	3.32	8.75	2.77	35.83	9.34	85.31	5.52	88.84	3.78	82.47	3.82
Astragalus - Oxytropis	–	–	–	–	–	–	–	–	0.39	0.88	–	–
Draba	–	–	–	–	–	–	–	–	–	–	–	–
Lesquerella	–	–	–	–	–	–	–	–	–	–	–	–
Saxifraga	–	–	–	–	–	–	–	–	–	–	–	–
Equisetum	–	–	–	–	–	–	–	–	–	–	–	–
Moss	–	–	0.80	1.79	–	–	–	–	–	–	–	–
Sphagnum	–	–	–	–	–	–	–	–	–	–	–	–
Cetraria (type)	–	–	–	–	–	–	–	–	–	–	–	–
Cladonia (type)	–	–	0.72	1.61	–	–	–	–	–	–	–	–

Table B3. Mean percent relative density ($\bar{x}$) and standard deviation (sd) of discerned fragments from muskox fecal samples collected in the Rae-Richardson River valleys, 160 kilometres west of Kugluktuk, Northwest Territories in July 1990. Means based on 5 slides of 20 fields each.

Sample number	.200		#1		#1 calf		.050		120	
	$\bar{x}$	sd	$\bar{x}$	sd	$\bar{x}$	sd	$\bar{x}$	sd	$\bar{x}$	sd
Carex	46.74	5.98	0.43	0.95	–	–	49.75	12.97	2.17	1.62
Eriophorum	0.40	0.90	–	–	–	–	1.48	3.30	0.33	0.74
Agropyron	–	–	–	–	–	–	0.72	1.61	–	–
Arctophila fulva	–	–	0.42	0.93	–	–	4.81	3.98	–	–
Colpodium	–	–	0.42	0.93	0.67	0.92	1.38	1.91	–	–
Deschampsia	–	–	–	–	–	–	1.34	1.84	0.40	0.89
Festuca	–	–	–	–	–	–	0.72	1.61	–	–
Poa	–	–	–	–	0.34	0.75	15.91	7.42	0.40	0.89
Dryas	2.20	2.62	0.84	1.16	–	–	–	–	–	–
Ledum (type)	–	–	–	–	–	–	–	–	–	–
Salix	48.02	7.02	97.89	2.97	98.99	0.92	20.59	9.01	96.30	3.84
Astragalus - Oxytropis	0.62	1.39	–	–	–	–	1.98	1.82	0.40	0.89
Hedysarum	0.49	1.09	–	–	–	–	–	–	–	–
Lesquerella	0.52	1.15	–	–	–	–	–	–	–	–
Equisetum	0.52	1.15	–	–	–	–	1.32	1.80	–	–
Moss	–	–	–	–	–	–	–	–	–	–
Cetraria (type)	0.49	1.09	–	–	–	–	–	–	–	–

Sample number	140		200		260		280	
	$\bar{x}$	sd	$\bar{x}$	sd	$\bar{x}$	sd	$\bar{x}$	sd
Carex	16.54	7.32	52.04	8.31	8.07	2.28	7.82	1.83
Eriophorum	1.54	1.65	–	–	0.40	0.89	–	–
Agropyron	–	–	–	–	–	–	–	–
Arctophila fulva	–	–	1.52	1.40	–	–	0.61	0.84
Colpodium	–	–	–	–	–	–	–	–
Deschampsia	–	–	–	–	–	–	–	–
Festuca	–	–	0.44	0.98	–	–	–	–
Poa	0.30	0.68	–	–	–	–	–	–
Dryas	–	–	3.34	2.04	–	–	0.38	0.85
Ledum (type)	–	–	–	–	–	–	0.38	0.85
Salix	81.62	7.76	40.33	4.10	91.53	2.57	89.18	2.26
Astragalus - Oxytropis	–	–	1.45	2.08	–	–	0.61	0.84
Hedysarum	–	–	–	–	–	–	0.71	0.99
Lesquerella	–	–	–	–	–	–	–	–
Equisetum	–	–	0.44	0.98	–	–	0.31	0.69
Moss	–	–	0.44	0.98	–	–	–	–
Cetraria (type)	–	–	–	–	–	–	–	–

APPENDIX C. Muskox data sheets from field observations carried out in the Queen Maud Gulf from 11-13 July 1991.

MUSKOX DATA SHEET

DATE 11 July 1991 GROUP NUMBER 1 67°30'30"N 102°10'E
TIME OF OBSERVATIONS: 09:40 - 12:15 OBSERVERS: Fleck/Angohiatok
WEATHER: strong N wind; patchy overcast; 10-12° C

GROUP SIZE 10

Adult bulls	4	Adult cows	4	Calves	
Yearlings	1	Subadults?		Subadult males	1

ACTIVITY:
Most lying down adjacent to south bank of creek; 1 large adult bull slightly separated from group; 1-2 animals feeding from time to time in wet willow and sedge meadow, in the hummock area and in cotton grass tussock

HABITAT DESCRIPTION:
Slightly sloping north aspect
Narrow band of wet willow and sedge meadow adjacent to creek
Upslope hummock area with mountain avens and willow on hummocks
Upslope to this below rock outcrop is wide area of cottongrass tussock
(Drawing in field book)

PIXEL COLOUR: orange in hummock area and yellow? in cottongrass tussock

PELLET SAMPLE NO. 1 COMPOSITE OF 10 GROUPS
Saw at least 20 slightly older pellet groups in area. Suspect muskox here at least overnight.

EVIDENCE OF FEEDING:
Muskox - Carex aquatilis; Castilleja; red-stemmed willow near creek (sample taken of carex and willow)
Saw long stalks hanging from mouths of feeding muskox; Also appeared to pull head up occasionally as if stripping leaves off a branch
Although we watched 2 cows feeding by pink rock in tussock area, could not see any evidence of feeding.

EVIDENCE OF OTHER WILDLIFE:
Goose - droppings evident
Caribou - some summer droppings
Other - lemming tunnels

Muskox Group 1 cont'd

FILM TYPE Ektachrome 100 PHOTO NUMBER

1. Group photos 15-19
2. Fresh pellet - Label 1 20
3. Habitat - Label 1 21
4. Habitat by pink rock where cow feeding; tussocks 22
5. Habitat - label 1 23,24
6. Habitat - label 1; by river side 25
7. Habitat - aerial looking S 26,27

(Check these habitat descriptions again when photos return)

COMMENTS: This was first group of muskox classified and it took a long time to decide which animals were females. Perhaps check group photos for confirmation. It seemed like there were too many adult males to be in a group like this.

Group did not leave until we approached within 100 m and circled upwind so they could catch our scent.

MUSKOX DATA SHEET

DATE 11 July 1991 GROUP NUMBER 2 67°25'30"N 102°19'E
TIME OF OBSERVATIONS: 12:40-14:30 OBSERVERS: Fleck/Angohiatok
WEATHER: strong N wind; 10-12° C; patchy overcast

GROUP SIZE 8
Adult bulls Adult cows 5 Calves
Yearlings 2 Subadults? Subadult males 1

ACTIVITY:

12:40	4 feeding; 4 resting
12:48	1 feeding; 7 resting
12:52	all resting
12:55	yearling feeding
12:56	all resting
12:57	1 cow feeding; others resting
13:15	cow still feeding; others still resting
13:16	all resting; at this time we approached

HABITAT DESCRIPTION:
Cottongrass tussock with Carex aquatilis in damp flat areas between tussocks. Red stemmed willow growing on tussock.

PIXEL COLOUR: Orange

PELLET SAMPLE NO. 2 COMPOSITE OF 7 GROUPS

EVIDENCE OF FEEDING:
In places almost 100% of Carex eaten (see photo)
Also feeding on red-stemmed willow by stripping leaves and leaving stem behind. Could see green wound where leaves had been attached to stem.
Also some leaves only half eaten.
Sampled 3 willows to look at number of branches stripped:

Sample 1	5 stripped	3 untouched
Sample 2	5 stripped	3 untouched
Sample 3	4 stripped	2 untouched

EVIDENCE OF OTHER WILDLIFE:
Goose -
Caribou - lots of winter pellet groups of adults and calves
- lots of shed female caribou antlers in area
Other -

Muskox Group 2 cont'd

FILM TYPE Ektachrome 100 PHOTO NUMBER

1. Group 2 in cottongrass tussock 27, 28
2. Feeding on sedge in damp area between tussock; label 2 29, 30
3. Feeding on red stem willow; showing eaten and uneaten 31
4. Cotton grass tussock habitat 32
5. Aerial of site 33

COMMENTS: Group did not leave until we were within 100 m of them and had circled upwind to allow them to catch our scent. Continued to observe us from 300-400 m as we searched for signs of feeding and pellet groups.

MUSKOX DATA SHEET

DATE 11 July 1991 GROUP NUMBER 3 67°24' "N 102°32'E
TIME OF OBSERVATIONS: 15:10 - 16:15 OBSERVERS Fleck/Angohiatok
WEATHER: slight N wind; temperature increased to 16° C; mosquitoes very evident

GROUP SIZE 5
Adult bulls 5 Adult cows Calves
Yearlings Subadults? Subadult males

ACTIVITY:
When seen were feeding in wet sedge meadow area. As helicopter approached, bulls left. Later seen walking slowly and feeding in cottongrass tussock area by side of lake. Continued to walk into the wind and feed until out of sight.

HABITAT DESCRIPTION:
Wet sedge meadow where first seen; surrounded by cottongrass tussock and boulder outcrop on ridge
Cotton grass tussock with willow on tussock around lake edge

PIXEL COLOUR: orange by lake where feeding in tussock area

PELLET SAMPLE NO. 3 COMPOSITE OF 1 GROUPS
Searched for 45 minutes, including area where bulls spotted from air but no additional pellet groups could be found

EVIDENCE OF FEEDING:
None looking for. Bulls were feeding as they walked. Not observed long enough in wet sedge meadow (WSM) to look for sign

EVIDENCE OF OTHER WILDLIFE:
not collected

FILM TYPE Ektachrome PHOTO NUMBER

1. Aerial of site showing WSM, and cottongrass tussock and boulder 34,35

COMMENTS:

Mosquitoes were very evident.

MUSKOX DATA SHEET

DATE 11 July 1991 GROUP NUMBER 4 67°29' "N 102°38'E
TIME OF OBSERVATIONS: 16:30 - 18:30 OBSERVERS: Fleck/Angohiatok
WEATHER: Slight N wind; some rain; patchy overcast

GROUP SIZE 22
Adult bulls Adult cows 13 Calves 4
Yearlings 3 Subadults? 2 Subadult males

ACTIVITY:
Slowly walking and feeding out of sight after disturbed by helicopter.

HABITAT DESCRIPTION:
Huge area of slightly sloping ground with following cover types hummock mixed with cottongrass tussock and small patches of dwarf birch and willow Creek edged with narrow strip of WSM

PIXEL COLOUR: orange

PELLET SAMPLE NO. 4 COMPOSITE OF 2 GROUPS

EVIDENCE OF FEEDING:
Not collected

EVIDENCE OF OTHER WILDLIFE:
not collected

FILM TYPE Kodacolour 100 PHOTO NUMBER

1. Habitat? 1-6?

COMMENTS:

This cow/calf group was within 400 m of group 5, which was all adult males. When disturbed by us walking in area, group 5 waded small creek and foraged on opposite hillside. However, cow/calf group walked northwest over hill and stayed on west side of creek.

MUSKOX DATA SHEET

DATE 11 July 1991 GROUP NUMBER 5 67°29' "N 102°38'E
TIME OF OBSERVATIONS: 16:30-18:30 OBSERVERS: Fleck/Angohiatok
WEATHER: Slight north wind; some rain; patchy overcast

GROUP SIZE 5

Adult bulls	5	Adult cows	Calves
Yearlings		Subadults?	Subadult males

ACTIVITY:
Waded across creek when disturbed by us. Then continued to feed and observe us from opposite hillside. Fed and walked about 1 km in time period.

HABITAT DESCRIPTION:
In hummock area beside creek before we disturbed them. Pellet samples collected from here.

PIXEL COLOUR: orange where first observed from air

PELLET SAMPLE NO. 5 COMPOSITE OF 2 GROUPS

EVIDENCE OF FEEDING:
Saw some sign of feeding on Carex aquatilis between tussocks and on red-stemmed willow.

EVIDENCE OF OTHER WILDLIFE:
Goose - droppings evident
Caribou - some summer droppings

FILM TYPE Kodacolour 100 PHOTO NUMBER

1. See sheet on group 4 --

COMMENTS:

Polygons all through this area on 1:250,000 map sheet

MUSKOX DATA SHEET

DATE 12 July 1991 GROUP NUMBER **6** 67°45' "N 102°45'E
TIME OF OBSERVATIONS: 10:30 - 12:00 OBSERVERS: Fleck/Angohiatok
WEATHER: Strong NW winds; Overcast about 2000'

GROUP SIZE 13

Adult bulls	1	Adult cows	6	Calves	2
Yearlings	4	Subadults?		Subadult males	

ACTIVITY:
Feeding while walking through tussock cottongrass and hummock area

HABITAT DESCRIPTION:
Hummock mixed with some tussock cottongrass on NW side of rock
Between two boulder outcrops, hummock and wet sedge meadow
Other species seen Salix reticulata, Pedicularis sudetica, Eriophorum? with small single head

PIXEL COLOUR: green

PELLET SAMPLE NO. 6 COMPOSITE OF 10 GROUPS
Lots of old muskox droppings in area

EVIDENCE OF FEEDING:
Could see bull with long stems hanging from mouth
Found some stripped willow but different variety (sample taken)
Could see Carex aquatalis that had been eaten

EVIDENCE OF OTHER WILDLIFE:
Caribou - lots of summer droppings and recent caribou trails running east west
Ptarmigan - female seen

FILM TYPE Kodacolour 100 PHOTO NUMBER

1. Group photos 8,9
2. Habitat with label 6 10,11
3. Habitat closeup, label 6 12-14
4. Aerial, see drawing in notebook 15,16

COMMENTS:

MUSKOX DATA SHEET

DATE 12 July 1991 GROUP NUMBER 7 67°46' "N 102°11'E
TIME OF OBSERVATIONS: 12:15 - 1:30 OBSERVERS: Fleck/Angohiatok
WEATHER: Strong NW wind (+30 km) with patchy overcast; 10° C

GROUP SIZE 2

Adult bulls	2	Adult cows	Calves
Yearlings		Subadults?	Subadult males

ACTIVITY:
Feeding in WSM when first spotted from air. As helicopter landed, retreated to rock outcrop for about 5 minutes then returned to feeding WSM.
Fed continuously about 35 minutes until disturbed by us moving closer.
Moved up onto rock/sand outcrop and left.

HABITAT DESCRIPTION:
WSM with some slightly higher ground on which the red stemmed willow grew at about 1 m intervals. Much of area had standing water (up to 10 cm)

PIXEL COLOUR: orange and red

PELLET SAMPLE NO. 7 COMPOSITE OF 2 GROUPS
Ten plus slightly older droppings in slightly drier area. Smelled very strongly of muskox

EVIDENCE OF FEEDING:
Observed only in wet sedge meadow
Heavy grazing on Carex aquatilis
In standing water, have eaten about 50-70% of CAAQ in area.
However, willow growing in slightly drier areas was also being fed upon.
Almost every bush there had been fed upon. Bushes about 2 m apart in area about 20 m by 10 m.
Sampled 3 willows to look at number of branches stripped:

Sample 1	11 stripped	15 untouched
Sample 2	3 stripped	25 untouched
Sample 3	9 stripped	9 untouched

EVIDENCE OF OTHER WILDLIFE:
Goose - droppings evident

Muskox Group 7 cont'd

FILM TYPE Kodacolour 100 PHOTO NUMBER

1. Group feeding 17-23
2. Red stemmed willow fed on 24-25
3. Carex aquatalis fed on 26-31
4. Stripped willow 32
5. Aerials 33,34
6. Old bull by river that would not move (not sampled) 35,36

COMMENTS:
One bull had a broken horn tip that was still hanging there

MUSKOX DATA SHEET

DATE 12 July 1991 GROUP NUMBER 8 67°40'30"N 103°11'E
TIME OF OBSERVATIONS: 14:15-14:30 OBSERVERS: Fleck/Angohiatok
WEATHER: sunny, NW wind

GROUP SIZE

Adult bulls	1	Adult cows	Calves
Yearlings		Subadults?	Subadult males

ACTIVITY:
Feeding in cottongrass tussock. Walked away when we landed

HABITAT DESCRIPTION:
Cottongrass tussock with willow and dwarf birch on tussocks

PIXEL COLOUR: orange

PELLET SAMPLE NO. 8 COMPOSITE OF 1 GROUP

EVIDENCE OF FEEDING:
Carex aquatalis between tussocks
Some red-stemmed willow branches had been stripped

EVIDENCE OF OTHER WILDLIFE:
not collected

FILM TYPE Kodacolour 100 PHOTO NUMBER

1. Cottongrass-tussock habitat 36

Kodachrome 64

2. Aerials of habitat looking NW 2,3

COMMENTS:

MUSKOX DATA SHEET

DATE 12 July 1991 GROUP NUMBER 9 67°39' "N 103°02'E
TIME OF OBSERVATIONS: 14:45-16:00 OBSERVERS: Fleck/Angohiatok
WEATHER: sunny, strong nw wind, some cumulus cloud

GROUP SIZE 7

Adult bulls	3	Adult cows	4	Calves	
Yearlings		Subadults?		Subadult males	

ACTIVITY:
Feeding for over 45 minutes within 40x50 m area
Group was on other side of slight rise where WSM was.

HABITAT DESCRIPTION:
Feeding occurred in wet sedge meadow within an area of cottongrass tussock with willow and dwarf birch on tussocks. Cottongrass area on slight slope with W aspect
Also present in area was hummocky ground and some clay frost boils

PIXEL COLOUR: red and orange

PELLET SAMPLE NO. 9 COMPOSITE OF 4 GROUPS

EVIDENCE OF FEEDING:
Carex aquatilis between tussocks
Red stemmed willow on tussocks
CAAQ in wet sedge meadow

EVIDENCE OF OTHER WILDLIFE
Caribou - some summer droppings
Other - lemming tunnels

FILM TYPE Kodachrome 64 PHOTO NUMBER

1. Looking east across cottongrass tussock 4
2. Aerials looking SW 5,6

COMMENTS:

Bird nest found of small passerine. Four brown speckled eggs

MUSKOX DATA SHEET

DATE 12 July 1991 GROUP NUMBER 10 67°38' "N 103°03'E
TIME OF OBSERVATIONS: 16:30-17:30 OBSERVERS: Fleck/Angohiatok
WEATHER: overcast; N wind

GROUP SIZE at least 47; numbers below are minimum we could do before they disappeared from sight

Adult bulls	4	Adult cows	14	Calves	7
Yearlings	8	Subadults?	4	Subadult males	

ACTIVITY:
Group appeared to be resting and feeding on either side of small creek when first seen. However, by the time we had landed the helicopter and approached from behind a rock outcrop, the animals were moving upslope quickly and disappeared from sight.

HABITAT DESCRIPTION:
On south side of creek, mixture of hummocks and tussocks
On north side of creek by river, shortly cropped grass at edge of river. Within 10-15 m of river, flat graminoid covered in wide swath of hay. Presume hay deposited by river during thaw. Large clay patches, perhapd developed during freeze/thaw cycle and also because of runoff pattern

PIXEL COLOUR: orange and red; but activity of mo unknown

PELLET SAMPLE NO. 10 COMPOSITE OF 12 GROUPS
Slightly older summer muskox pellets present on south side of creek; also winter muskox pellets in this area
Lots of fresh pellet groups, including two that were quite runny in appearance

EVIDENCE OF FEEDING:
Difficult to determine because it could be confused with goose feeding. Also no observations as animals had moved by the time they were spotted.

EVIDENCE OF OTHER WILDLIFE:
Goose - lots of feathers and droppings evident

FILM TYPE Kodachrome 64 PHOTO NUMBER

1. "Hay" bedding site 7-9
2. Aerial looking north with river on east side 10,11

COMMENTS: Suspect rough legged hawk nest on cliff edges lining west fork of river (2 hawks seen and heard calling). Location 67°37'N 103°02'30"E

MUSKOX DATA SHEET

DATE 12 July 1991 GROUP NUMBER 11 approx. 67°38' "N 102°50'E
TIME OF OBSERVATIONS: 18:00-18:15 OBSERVERS: Fleck/Angohiatok
WEATHER: Sunny, NW wind

GROUP SIZE 5

Adult bulls	5	Adult cows	Calves
Yearlings		Subadults?	Subadult males

ACTIVITY:

One bull seen feeding in wet sedge meadow.
Followed bull up to small rock outcrop when looking for fresh pellet groups.

As we gained altitude on leaving, we saw that the "single" bull had joined 4 other bulls who were seen farther up the drainage in the wet sedge area lining the small creek.

HABITAT DESCRIPTION:

Wet sedge meadow on either side of small creek. Varying in width from 3m to 10 m
Cotton grass tussock on north side of creek

PIXEL COLOUR: orange and yellow

PELLET SAMPLE NO. 11 COMPOSITE OF 3 GROUPS

Samples not steaming, but appear to be fresh from earlier in the day. Collected in cottongrass tussock and on rock outcrop

EVIDENCE OF FEEDING:

Carex aquatalis in wet sedge meadow. Suspect it was from muskox rather than geese.

EVIDENCE OF OTHER WILDLIFE:

Goose - feathers and droppings evident
Three sandhill cranes

FILM TYPE PHOTO NUMBER

None taken

COMMENTS:

No time spent observing bull as we just wanted to collect a pellet sample. Other bulls were at least 500 m farther away. Had we not followed bull up the drainage where we saw him join the other group, we would have thought that he was alone.

MUSKOX DATA SHEET

DATE 13 July 1991 GROUP NUMBER **12** 66°45' "N 100°17'E
TIME OF OBSERVATIONS: 15:15-15:45 OBSERVERS: Fleck/Angohiatok
WEATHER: sunny, N wind

GROUP SIZE 11

Adult bulls	3	Adult cows	5	Calves	
Yearlings	2	Subadults?	1	Subadult males	

ACTIVITY:
Feeding in what once was wetter area within hummock area. Watched helicopter land and as we approached, they ran away and did not stop until almost 1 km away.

HABITAT DESCRIPTION:
Small patches of dried up wet sedge meadow. Very few of CAAQ show any seed development
Larger flat areas dominated by graminoid with no hummocks or tussocks or shrubs.
Some areas of cottongrass tussock
Sand/gravel deposits also in area with lichen and ericacious shrubs

PIXEL COLOUR: unknown, this area not within Bob's sampling area

PELLET SAMPLE NO. 12 COMPOSITE OF 3 GROUPS
Old muskox pellet groups from winter time in area

EVIDENCE OF FEEDING:
Heavy feeding on Carex aquatilis in areas where it is in pure stands. Assume it is muskox because hoof prints are in this area. Also lots of goose droppings though.

EVIDENCE OF OTHER WILDLIFE:
Goose - droppings evident
Caribou - only two minor caribou trails in this area. Some summer droppings

FILM TYPE Kodachrome 64 PHOTO NUMBER

1. Intense feeding on CAAQ 19-21
2. Untouched CAAQ adjacent to heavy feeding site 22
3. Aerial looking south with dark brown area where muskox were feeding in center 23

COMMENTS: Looks like this area was wetter earlier in the season.

APPENDIX D. Sex and age composition of muskox herds in the Queen Maud Gulf area, 9-12 August 1988.

No.	Bulls		Cows	2-year-olds		Year-lings	Calves	Un-known	Total
	>3 y	3 y		♂♂	♀♀				
135	2		7		2				11
136	1		3		1		2		7
137	1								1
138	6								6
139	10		12		1	2	3		28
140	3								3
141	1								1
142	5								5
143	2								2
144	4								4
145	1								1
146	1		7		2		4		14
147	2								2
148	8		12		2	1	3		26
149	1		7			1	2		11
150	1								1
151	1		10		1		2		14
152	6		16		4	4	2	4	36
153	2								2
154	4	1	13	2	3	4	6	1	34
155	5		7	2	1	2	2		19
156	2								2
157	1								1
158	4		1						5
159	1		5			1			7
160	1								1
Total	**76**	**1**	**100**	**4**	**17**	**15**	**26**	**5**	**244**

No.	Bulls		Cows	2-year-olds		Year-lings	Calves	Un-known	Total
	>3 y	3 y		♂♂	♀♀				
161	1								1
162	8		8	1	1	2	4		24
163	1								1
164	1								1
165	1								1
166	2								2
167	1		10	1					12
168	4		5	1	1	1			12
169	1								1
170	1		4				1		6
171	1								1
172	1								1
173	3	1	17	2	1	2	2		28
174	2								2
175	4	2	12		3	3	5		29
176	2								2
177	1	2	8		1	1	1		14
178	3								3
179	2	2	9		1	3	3		20
180	1								1
181	5		12	1		1	1		20
182	3	1	12			2	5		23
183	1								1
184	5	1	20	2	2	1	8		39
185	3								3
186	6		14	1	3	5	3		32
187	7	1	7	1	1	2	1		20
188	1								1
Total	**72**	**10**	**138**	**10**	**14**	**23**	**34**		**301**

No.	Bulls		Cows	2-year-olds		Year-lings	Calves	Un-known	Total
	>3 y	3 y		♂♂	♀♀				
189	5	1	10	3	2	4	5		30
190	2	1	17	2	1	4	6		33
191	6	1	14	1	2	3	5		32
192	2								2
193	3								3
194	5		9		2	2	3		21
195	2								2
196	6		6	2	1	3	4		22
197	1								1
198	3		8			1	1		13
199	2								2
200	2								2
201	2								2
202	1								1
203	1								1
204	1								1
205	3								3
206	2								2
207	6								6
208	3		2						5
209	1								1
210	2								2
211	1								1
212	1								1
213	6	2	13	2	3	4	8	1	39
214	5								5
215	1								1
216	1								1
Total	**76**	**5**	**79**	**10**	**11**	**21**	**32**	**1**	**235**

No.	Bulls		Cows	2-year-olds		Year-lings	Calves	Un-known	Total
	>3 y	3 y		♂♂	♀♀				
218	4	1	22	1	1	1	3		33
219	2		4	1	2		2		11
220	1								1
221	1								1
222	2								2
223	1		4		1	1			7
224	8		1			1			10
225	4		17	1	1	3	5		31
226	1								1
227	6		16		2	4	2		30
228	1		11	1					13
229	1								1
230	3		10		1	1			15
231	1								1
232	1								1
233	3		16		2	5	2		28
234	1								1
235	1								1
236	1								1
237	1		10	1		1	4		17
238	1		9	2	1	1	4		18
239	2	1	8			1			12
240	6	1	10	1	1	2	2		23
241	1								1
242	1								1
243	1								1
244	3	2	13		1		1		20
245	3								3
Total	**62**	**5**	**151**	**8**	**13**	**21**	**25**		**285**

No.	Bulls		Cows	2-year-olds		Year-lings	Calves	Un-known	Total
	>3 y	3 y		♂♂	♀♀				
246	1								1
247	4								4
248	3		12		2		2		19
249	1								1
250	2								2
251	1		5		1	1	1		9
252	1								1
253	2								2
254	1								1
255	3								3
256	3	1	4			1			9
257	1								1
258	1								1
259	1								1
260	1								1
261	1								1
262	1								1
263	3								3
264	2								2
265	3								3
266	2		4	2	1	2			11
267	9								9
268	2		4						6
269	5								5
270	1		16	2	1	1	4		25
271	1								1
272	1								1
273	3								3
Total	**60**	**1**	**45**	**4**	**5**	**5**	**7**		**127**

No.	Bulls		Cows	2-year-olds		Year-lings	Calves	Un-known	Total
	>3 y	3 y		♂♂	♀♀				
274	3		1						4
275	4		7	1	1	1			14
276	4		15	3		2	3		27
277	1								1
278	3		14	2	3	6	4		32
279	2	1	7	1			3		14
280	4	1	20	4	2	2	5		38
281	2		7	2		2			13
282	1								1
283	5		9[1]	1		3	2		20
284	1		10	2	2	2	2		19
285	1		13[1]	1	2	1	2		20
286	2								2
287	4		12		1		1		18
288	2								2
289	1								1
290	1								1
291	1								1
297	1								1
298	1		6		1	1	1		10
299	1								1
300	1		5[1]		1	1	1		9
301	1								1
302	5		9		2	2	3		21
303	2	1	5	1	1	1	1		12
304	1								1
Total	**55**	**3**	**140**	**18**	**16**	**24**	**28**		**284**
TOTAL	**401**	**25**	**653**	**54**	**76**	**109**	**152**	**6**	**1476**

[1] Blonde cow

APPENDIX E. Sex and age composition of muskox herds in the Queen Maud Gulf area, 22-31 July 1989

No.	Bulls		Cows	2-year-olds		Year-lings	Calves	Un-known	Total
	>3 y	3 y	>3 y	♂♂	♀♀				
1	3		5			2	1		11
2	3								3
3	3								3
4	1								1
5	3								3
6	3								3
7							1	12	13
8	2	3	12	2	1	4	4	1	29
9	2	1	7	1	1	2	2		16
10	1								1
11			4				2		6
12	2								2
13	2								2
14	1								1
15	1								1
16	4		5		1	1	1		12
17	1								1
18							1	13	14
19	1								1
20	1		9				1		11
21	2					1	1	7	11
22	2								2
23	1								1
Total	**39**	**4**	**42**	**3**	**3**	**10**	**14**	**33**	**148**

No.	Bulls		Cows	2-year-olds		Year-lings	Calves	Un-known	Total
	>3 y	3 y	>3 y	♂♂	♀♀				
24	2								2
25	2								2
26	1								1
27	3								3
28	2		18		1	1	3		25
29						2	3	14	19
30	2						3	6	11
31	1								1
32	5		16		2	3	4		30
33	1								1
34	1						1	5	7
35	2								2
36						2	2	8	12
37	3								3
38	2								2
39	3								3
40	1								1
41	1								1
42	1								1
44	4	1	13	1	1	3	4		27
45	2	2	16	1	2	1	3	1	28
46	1		3			2	1		7
47						1	2	10	13
48							2	17	19
49	2		8		2	2	2		16
50						1	2	9	12
51	3		1			3	5	7	19
Total	**45**	**3**	**75**	**2**	**8**	**21**	**37**	**77**	**268**

No.	Bulls		Cows	2-year-olds		Year-lings	Calves	Un-known	Total
	>3 y	3 y	>3 y	♂♂	♀♀				
52	2		1						3
53	1								1
54	3								3
55	1								1
56	6						3	16	25
57	1								1
58	1								1
59	1								1
60	1								1
61	1						1	5	7
62	1								1
63			1				1		2
64	2						4	6	12
65	1								1
66	2								2
67	1								1
68	2								2
69	1								1
71	1		1						2
72	7								7
73	1								1
74	1								1
75	5								5
76	3								3
77	3								3
78	2								2
79	3								3
Total	**54**		**3**				**9**	**27**	**93**

No.	Bulls		Cows	2-year-olds		Year-lings	Calves	Un-known	Total
	>3 y	3 y	>3 y	♂♂	♀♀				
80	2								2
81	1		3			1			5
82	1		6			1	2		10
83	2	2	12	1	2	3	5		27
84	1	2	9	2	2	2	1		19
85							5	11	16
86	1								1
87	1								1
88	3		2						5
89	1								1
90	1								1
91	10								10
91	1								1
92	3								3
93	2								2
94	3								3
95	2								2
96							3	15	18
97	3		8				2		13
98	6								6
99							1	5	6
101	3						4	8	15
102	2								2
103							7	38	45
104	1								1
105	1								1
106	3								3
Total	**54**	**4**	**40**	**3**	**4**	**7**	**30**	**77**	**219**

No.	Bulls		Cows	2-year-olds		Year-lings	Calves	Un-known	Total
	>3 y	3 y	>3 y	♂♂	♀♀				
108	4								4
109	3								3
110	2								2
111	3			1					4
112	6								6
113	5								5
114	3			1					4
115	3								3
116	3								3
117	1								1
118	1								1
119	1								1
120	5								5
121	1		3				1		5
122	2								2
123	3						5	15	23
125	2		5			1	3		11
126	4			1					5
127	1		4			1	2		8
128							2	10	12
129	3	1	16		1	1	6		28
130	1		9			3	2		15
131							6	14	20
132	1								1
133	3								3
134							5	24	29
135						1	2	8	11
Total	**61**	**1**	**37**	**3**	**1**	**7**	**34**	**71**	**215**

No.	Bulls		Cows	2-year-olds		Year-lings	Calves	Un-known	Total
	>3 y	3 y	>3 y	♂♂	♀♀				
136	1								1
137	4								4
138	1					1	3	13	18
139	4								4
140	1								1
141	6								6
142							7	20	27
144							2	10	12
145							2	8	10
146						3	7	13	23
147	1								1
148	3								3
149	3		14		1	2	4[1]		24
151	1								1
152	1								1
153						1	3	9	13
154	1		7			1	2[2]		11
155	1								1
156	1								1
158	6								6
160	3								3
161	1								1
162	3			1		2	6	15	27
163						2	4	6	12
Total	**42**		**21**	**1**	**1**	**12**	**40**	**94**	**211**
164	1					2	5	15	23
165							8	25	33
166							1	6	7
167							2	6	8
168	2								2
Total	**3**					**2**	**16**	**52**	**73**
TOTAL	**298**	**12**	**218**	**12**	**17**	**59**	**180**	**431**	**1227**

[1] Cream-coloured calf

[2] Cream-coloured cow and calf

APPENDIX F. Sex and age classification of muskoxen at fecal collection sites in the Queen Maud Gulf area, 11-13 July 1991.

Group No.	Size	Male		Female	Sex unknown		
		Adult	Subadult	Adult	Subadult	Yearling	Calf
1	10	4	1	4		1	
2	8		1	5		2	
3	5	5					
4	22			13	2	3	4
5	5	5					
6	13	1		6		4	2
7	2	2					
8	1	1					
9	7	3		4			
10	about 20 muskox; bulls, cows, subadults, yearlings, calves						
11	5	5					
12	11	3		5	1	2	
TOTAL	109	29	2	37	3	12	6

Notes:

1. Muskox groups 1-11 were sampled in order of observation in area 30 km west of Perry River and 20 km SW.

2. Afterwards, we did encounter some large (40^{+}) groups that appeared to have higher proportions of calves and yearlings in comparison to the smaller groups. No segregation of sexes and ages was possible because the animals moved out of view quickly.

3. Muskox group 12 was the only group seen in the vicinity of where we found caribou between Armark Lake and Simpson River.