

Population Increase of Muskoxen on Banks Island and Implications for Competition with Peary Caribou

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ABSTRACT. Surveys were flown in March 1979 and 1980 north and south of 73°N on Banks Island to estimate numbers of muskoxen. Observed total was 11 809 animals and estimated population was 18 328 muskoxen, suggesting that the population has continued to expand since previous surveys in the early 1970s. A comparison with previous surveys of densities between the north and the south of the island indicates muskoxen have spread from the Thomsen River valley to the northeast and the south. Comparisons with muskox and caribou populations in Alaska and with reindeer in Greenland suggest that co-existence between these species is normal and does not involve competition.

RÉSUMÉ. En mars 1979 et 1980, nous avons étudié, les aires situées respectivement au nord et au sud du 73°N à l'île Banks pour évaluer le nombre de boeuf-musqués. Au total, 11,809 boeuf-musqués furent aperçus et nous avons estimé une population de 19,328 individus. Nos résultats suggèrent que la population a continué de s'accroître depuis les reconnaissances antérieures effectuées durant la première partie des années 70. Une comparaison des densités entre les parties nord et sud de l'île avec celles des reconnaissances antérieures indique que les boeuf-musqués se sont étendus de la vallée de la rivière Thomsen vers le nord-est et le sud. Une comparaison avec les populations de boeuf-musqués et de caribous en Alaska et au Groënland suggère que la co-existence des deux espèces est normale et la compétition n'a pas été signalée en-dessous des densités observées.

INTRODUCTION

Muskoxen (*Ovibos moschatus*) have been increasing their numbers on Banks Island since the turn of the century (Urquhart, 1973). Information supplied by the hunters of Sachs Harbour suggested that the muskox population was continuing to expand and increase its ranges in the mid- and late 1970s. Concern is growing among the hunters that the expanding muskox population might be detrimental to Peary caribou (*Rangifer tarandus pearyi*).

In response to the community concerns and a request for an increased muskox quota, the Wildlife Service undertook to carry out aerial surveys to estimate the size of the muskox population. Unfortunately, fiscal constraints dictated that the survey take place in two years. Latitude 73°N divided the island into two survey areas: the southern half was flown in March 1979 and the north half in March 1980.

Banks Island is the westernmost arctic island, lying about 130 km north of the arctic mainland and separated from Victoria Island by the narrow stretch of Prince of Wales Strait (Fig. 1). Southwest and central Banks are gently rolling lowlands with dissected regions to the north and south. Along the east coast the hills are more steep-sided and reach 500 m above sea level. The vegetation is mainly polar desert and semi-desert with localized areas of richer vegetation such as the Thomsen River valley which has well-developed sedge meadows.

METHODS

Aerial counts were done from 180 m above ground level within 1.6 km wide north-south transects spaced at 6.4 km intervals. A Cessna 337 flying at 190-215 km/h was used in 1979 and a Twin Otter at 190-260 km/h was used in

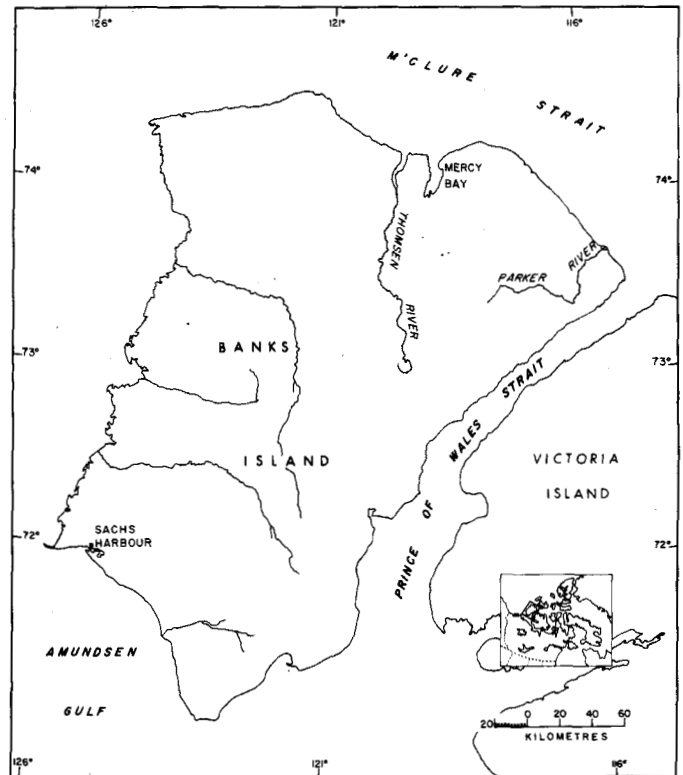


FIG. 1. Banks Island

1980. The pilots, aided by the aircraft's Global Navigation system, navigated and plotted observations on 1:250 000 maps. In the Cessna 337 both observers sat behind the pilot; in the Twin Otter, one observer sat in the co-pilot's (right hand) seat and the other in the left front cabin seat. Each observer recorded numbers of muskoxen within a 0.8 km strip, the outer edge of which was marked by tape on the plane's window. The observers also recorded

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muskoxen outside the transect and observations of other mammals.

The weather during both surveys was clear and cold, and the visibility of the muskoxen against the snow background was excellent. Locations and sizes of herds recorded as off-transect were carefully checked to discard any duplicated sightings between the transects.

Estimates of muskoxen numbers were extrapolated from the densities of muskoxen observed on the transects. We used Jolly's Method 2 (Jolly, 1969) for unequal sized sampling to calculate the estimates (Vincent and Gunn, 1981).

RESULTS

We flew 5211 km on transect between 26 February and 6 March 1979, surveying 26.1% of the southern half of the island (31 876 km²). On and off transect, a total of 2188 muskoxen in 153 groups was counted (Table 1). We estimated 4678 ± 1388 muskoxen on southern Banks with a density of 15 muskoxen/100 km².

During the period 10-14 March 1980, we flew 6010 km on transect and surveyed 25.4% of the northern half of the island (37 868 km²). On and off transect, a total of 9621 muskoxen in 648 groups was counted (Table 1). On northern Banks, the estimate was 14 650 ± 2744 muskoxen and the density was 39/100 km².

TABLE 1. Numbers of muskoxen and muskox groups counted during surveys of Banks Island, 1979 and 1980

Area surveyed (km ²)	Muskoxen observed		Groups observed	
	on transect	off transect	on transect	off transect
Southern Banks				
8338	1243	945	93	60
Northern Banks				
9616	3743	5878	249	399

After the survey, northern Banks was divided into three areas in order to calculate densities separately for the Thomsen and Parker river valleys, as the Thomsen valley had been previously identified as a high-density area for muskoxen (Urquhart, 1973). Within the Thomsen and Parker drainages, the density was 93/100 km² and 73/100 km², respectively and 12/100 km² elsewhere north of 73°.

We are aware of several shortcomings in our survey techniques that limit the reliability of the estimates. Three weaknesses were: a) the decision to fly the survey in two years; b) the relatively low altitude of the surveys which reduces coverage and c) the use of different aircraft types (Twin Otters are not the most suitable aircraft for aerial surveys). We also lack a tested technique to adequately survey muskoxen: linear transects at regularly spaced intervals may not be appropriate for a species which occurs in groups highly clumped according to topography. Our surveys were not stratified to proportion effort according to density. We felt distribution could have

changed since Urquhart's 1971 and 1972 surveys (1973) and funding was too limited to allow reconnaissance flights necessary to determine densities for stratification.

The separation of Banks Island into two survey areas flown a year apart may not completely confound the estimate of the island population's size. Reports from Sachs Harbour suggested that muskoxen had gradually extended their distribution southward over a period of several years. Muskoxen show some affinity to home ranges (Miller and Gunn, 1980; Jingfors, 1980) and normally only solitary bulls wander widely. We believe, then, that large-scale movements between northern and southern Banks Island were unlikely between the surveys of 1979 and 1980.

DISCUSSION

In the 1860s, the wood and the metal from H.M.S. *Investigator*, abandoned in Mercy Bay, northern Banks Island, attracted the Copper Eskimos from northwest Victoria Island. The Eskimos almost exterminated the muskox population by 1900 (Stefansson, 1921). Archaeological field studies in northern Banks in 1979-1980 have described 150 sites with 2700 muskox remains (C. Hickey, pers. comm. 1981).

There are no records of live muskoxen on Banks Island after the turn of the century until 1952 (Manning and Macpherson, 1958). Throughout the 1950s and 1960s, there were sporadic sightings of muskoxen (Harrington, 1963). Recordings of muskox sightings were also sporadic and confound any attempts to interpolate numbers and distribution of the muskox population. In the early 1970s, a series of systematic aerial surveys resulted in the first reliable estimates of muskox numbers (Urquhart, 1973).

The first quantitative information on the recovery of the muskoxen population was the estimate of 1200 to 1800 muskoxen north of 73°N in June 1971 (Kevan, 1971). Urquhart's (1973) surveys in 1971 and 1972 covered the entire island and confirmed the trend of Kevan's (1971) findings. The 1975 surveys of north Banks Island by Beak

TABLE 2. Densities of muskoxen on northern Banks Island during the 1970s

Source	Year	Month	Densities: muskoxen/100 km ²	
			Thomsen River	Parker River
Kevan	1970	June	29	23
Urquhart	1971	March	31	22
		June	29	18
Wilkinson and Shank ¹	1973	June-September	213	
Beak	1975	March 3	87	—
		March 28	105	
Russell	1977	March 13	89	26
Vincent and Gunn	1980	March	93	73

¹Average estimate based on ground counts in small areas averaging 7 km².

(in Russell, 1977) and Russell (1977) showed increases in the population, especially in the Thomsen River drainage (Table 2). The densities in the Parker River drainage remained similar until 1980 (Table 2). The comparisons of density between surveys can only be used to illustrate trends because the boundaries of the area to calculate the densities varied as did the survey methodology (Vincent and Gunn, 1981).

There was a dramatic change in numbers and densities of muskoxen between the early and late 1970s on the island south of the major northeast drainages. In March 1971, Urquhart (1973) estimated 584 muskoxen with a density of 0.9/100 km² outside the high density areas of Thomsen and Parker river drainages. In March 1979, we estimated a population of 7221 and the density was 13 muskoxen/100 km².

Our survey results confirm the recovery and expansion of the muskox population since the low at the turn of the century. The total number of muskoxen actually observed in 1979 and 1980 was 11 809. The combined estimates of 19 328 from both surveys (not adjusted for the 1979 calf crop) indicate population growth at an annual rate of 20-25% since Urquhart's (1973) estimate of 3800 muskoxen in May 1972. Leslie (in Tener, 1965) calculated a theoretical maximum rate of population growth at 23%. His assumptions were that cows did not breed until three years of age and then only bred in alternate years, and that calf survival was 50%. In reintroduced muskox populations in Alaska, those assumptions are violated in the Sadlerochit herd: cows were bred as yearlings and were bred in successive years, and calf mortality was less than 10% (Jingfors, 1980).

An underestimate in 1972 would inflate the apparent growth rate of the population. Urquhart (1973) used experienced observers in a satisfactory survey aircraft (Helio Courier); the estimates from the five surveys had coverages of 6-25% and were similar. While it cannot be quantified, Urquhart (1981) nevertheless believed that the estimate of 3000-3800 possibly was low (pers. comm. 1981). Even if his estimate is raised to an arbitrary 5000 muskoxen in May 1972, an annual growth rate of ~13% would have been required for the population to reach the minimum population of 11 800 in 1980 (11 800 is the number of muskoxen actually counted and is therefore the absolute minimum population). An annual rate of 13% would still be high for an arctic ungulate population.

Our survey results suggested that we should regard the muskoxen on Banks Island as having the demographic characteristics of an introduced population. The pattern of an introduced population is of apparently rapid growth after establishment (or nadir of a decline) often followed by a rapid decline of the population if the population damages the new range. In the initial period, the relatively slow growth after the decline in the 1900s may have been accentuated by wolf (*Canis lupus*) predation. If muskox numbers were extremely low, it would not require a large

wolf population to impede the expansion of the muskox population. The effect of wolf predation is speculative as we know so little about the relative numbers of muskoxen and wolves before the 1950s and 1970s, respectively. In the 1950s, however, wolves were causing sufficient damage to fox (*Alopex lagopus*) pelts on traplines to result in economic losses. A poisoning campaign in the 1950s and individual hunting of wolves reduced the wolf population and wolves are now rarely seen on the island.

Hunting of muskoxen was prohibited from 1917 until 1976 when limited quotas were issued to specified zones. The quota of 25 muskoxen for Banks Island was raised to 150 in 1978 but only 96 muskoxen were killed. In 1979, the Wildlife Ordinance was amended to allow commercial sale of muskox meat, and provision was made for sport-hunting of bulls under the quota.

The low predation by wolves and humans is not apparently curbing the population and the consequence of the rapid expansion of the muskox population is unknown. Parallels cannot be drawn with the known expansion of muskoxen on Nunivak Island, Alaska. The climate and range are dissimilar between the islands and the age and sex structure of the Nunivak population is manipulated by sport hunting and removals for transplants. Other reintroduced populations in Alaska were introduced within the last 10-15 years and their different range types and climates limit their potential as possible models for the Banks Island population.

The densities of muskoxen on Banks Island are not exceptionally high when compared to other muskox "hot spots". The Thomsen River valley has densities comparable with those of 60-100/100 km² on Bailey Point, Melville Island (D.C. Thomas, pers. comm.). Nevertheless, the densities over the northern half of the island are high when compared to other arctic islands. Jakimchuk and Caruthers (1980) estimated 12 160 ± 1757 muskoxen on Victoria Island with a density of 13/100 km² on the most dense stratum. On Prince of Wales Island, muskoxen densities were 2.4-6.2/100 km² in July 1980 (unpublished data, N.W.T. Wildlife Service). There is considerable variation among the ratios of range suitable for muskoxen to unsuitable area (polar desert, etc.) between and within the areas compared. Difference in range quality and seasonal influxes of muskoxen to productive areas will also affect the comparisons of muskox densities between islands.

The rapid expansion of the muskox population on Banks Island now means that 30-50% of the world's population of muskoxen occurs on Banks. Management-oriented studies of muskoxen have not proceeded except for limited monitoring of numbers and distributions. Our understanding of the rapid expansion of the muskox population is minimal especially with regard to the role of predation or weather fluctuations in the expansion.

The consequences of the expansion of the Banks Island muskox population to the muskoxen themselves, to the caribou and other animals and thereby to the people of

Sachs Harbour remain unknown. We do not have data to predict the shape of the muskox demographic curve. Continued monitoring of population size and, more importantly, of recruitment and productivity will be necessary to determine which growth phase the muskox population is currently in.

MUSKOX AND CARIBOU CO-EXISTENCE

The potential impact of the expanding muskox population on Peary caribou is a long standing matter of particular concern to the hunters of Sachs Harbour as caribou are a sought-after meat source. Concerns voiced in the early 1970s led to a range study which included a comparison of the feeding habits of both species (Wilkinson *et al.*, 1976). The study was inconclusive about the existence of competition but did describe differences in habitat selection that would reduce the likelihood of competition. The hunters have reiterated their concerns that muskoxen and caribou compete for food and that caribou are repelled by the musky odour of muskoxen. Although previous range studies and behavioral observations support neither contention, they were done under conditions of lower muskox densities.

Muskox and caribou (or reindeer) ranges overlap, at least seasonally, on nearly all muskox ranges. High densities of both species have occurred within the overlapping ranges. On Nunivak Island there have been no observations indicating competition between the muskox and reindeer populations (Lent and Knutson, 1971). Alendal (1976) asserted that competition between introduced muskoxen and reindeer occurred on Svalbard. While he had no evidence to support his contention that competition with reindeer led to the decline of the muskoxen, he did note that climatic conditions may have been detrimental to the growth of the muskox population.

The 27 muskoxen introduced in 1962 and 1965 to Søndy Strømfjord in Greenland expanded rapidly to a count of 220 in March 1980 (H. Thing in Jingfors, 1980). The rapid increase occurred at the same time that the caribou were declining primarily as a result of overgrazing (Roby, 1978). Where caribou and muskoxen wintered in the same valley (Safartaq Valley), there was some overlap in feeding habits but the muskoxen were apparently better adapted to survive on the available forage. The caribou in that valley starved during the winter. There is, however, no evidence that they starved because of competition — rather, they starved because they were forced, in a deep snow year, onto unsuitable ranges after over-grazing of other ranges. Similarly in the High Arctic, unfavourable winters could cause changes in use of normal winter ranges of Peary caribou and muskoxen and overlap of winter range could occur (Miller *et al.*, 1977).

The evidence from Nunivak Island and Greenland suggests that muskoxen at high densities can cause range damage (Lent and Knutson, 1971; Roby, 1978). There is,

however, no conclusive evidence for competition between caribou and muskoxen. Competition is a difficult concept to demonstrate under field conditions. If both the caribou and muskox populations are managed to prevent over-use of their ranges, such management would also prevent competition.

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