ARCTIC
VOL. 39, NO. 1 (MARCH 1986) P. 78-81

Survey of Vegetated Areas and Muskox Populations in East-Central Ellesmere Island

G. HENRY,[1] B. FREEDMAN[2] and J. SVOBODA[1]

(Received 5 June 1984; accepted in revised form 11 April 1985)

ABSTRACT. The results of 1981-84 summer helicopter surveys and ground reconnaissance of east-central Ellesmere Island are presented. This was the first systematic ecological survey to be conducted in this region of the Canadian High Arctic. Central Ellesmere Island is dominated by two large ice fields separated by the deglaciated Sverdrup Pass (79°N). Muskox migrate freely through the 70 km long corridor between the Fosheim Peninsula and some lowlands on the east coast, but large areas of suitable habitat were found unused on the central east coast. Muskox densities in Sverdrup Pass were comparable with those at other arctic sites, as were their reproduction rates (proportion of calves). Vegetated areas (> 5% cover) constituted only 5% of the total surveyed land area and were largely restricted to coastal lowlands and the Sverdrup Pass valley.

Key words: Ellesmere Island, Sverdrup Pass, high arctic vegetation, polar oases, muskox, muskox habitat

RÉSUMÉ. Le présent article présente les résultats de levés sur terre et par hélicoptère effectués durant les étés de 1981 à 1984 dans la partie centrale de l'est de l'île d'Ellesmere. Il s'agissait du premier levé écologique systématique exécuté dans cette région du Grand Nord canadien. Le centre de l'île d'Ellesmere est dominé par deux champs de glace importants séparés par le col Sverdrup déglacé (79°N). Le boeuf musqué passe librement en migration à travers le corridor d'une longueur de 70 km entre la presqu'île Fosheim et des terres basses sur la côte est, mais de grandes régions pouvant servir d'habitat convenable furent trouvées sur la côte est centrale sans aucune présence de boeuf musqué. Les densités de boeuf musqué dans le col Sverdrup furent comparables à celles d'autres sites arctiques tout comme l'étaient les taux de reproduction quant à la proportion de jeunes animaux. Les régions couvertes de végétation (>5% végétation) ne constituaient que 5% de l'aire où eu lieu le levé et se trouvaient surtout dans les terres basses côtières et dans la vallée du col Sverdrup.

Mots clés: île d'Ellesmere, Col Sverdrup, végétation dans le Grand Nord, oasis polaires, boeuf musqué, habitat du boeuf musqué

Traduit pour le journal par Maurice Guibord.

INTRODUCTION

The east-central portion of Ellesmere Island is covered by two extensive ice fields separated by a narrow unglaciated corridor, Sverdrup Pass. The western side of the island (Fosheim Peninsula) is characterized by a low rolling landscape, which in many places supports relatively extensive complexes of vegetation and significant wildlife populations (Tener, 1958; Thomas *et al.*, 1981). In contrast, the east coast is rugged, with mountains (1000-2000 m), deep and steep-sided fiords, and numerous glaciers, some of which terminate in the sea. The central part of the east coast of the island (*ca.* 79°N) is less glaciated, has a relatively long coastline (due to numerous fiords and inlets), and contains many discrete lowlands previously undescribed. The physiography, maritime climate (Maxwell, 1980), and Sverdrup Pass migration corridor all suggest the ecological importance of this region.

This note reports on observations made during an exploratory ecological survey of the terrain along the coastlines, lowlands, and passes between Bache and Fosheim peninsulas on central Ellesmere Island. The primary objectives were to briefly describe the sites with extensive complexes of vegetation and to estimate the associated populations of muskox (*Ovibos moschatus*). A secondary aim of the survey was to place an intensively studied lowland oasis at Alexandra Fiord (Svoboda and Freedman, 1981) into a regional perspective.

METHODS

Observations were made during a series of aerial reconnaissance flights on 18 and 19 July 1981, 21 June 1982, 21 June and 23 July 1983, and 25 July 1984. Twenty-two hours of Bell 206 helicopter flight time were used in the 1700 km survey. The flight paths were generally targeted to situations where vegetated habitat was likely to occur, e.g., coastlines and lowlands. Two or three researchers conducted each survey, and all observations were recorded directly onto topographic maps (1:500 000) during the flights. Besides the intensive ecological studies that were done at Alexandra Fiord (78°53′N, 75°55′W), a limited amount of ground reconnaissance was conducted in Sverdrup Pass (79°08′N, 79°30′W) and the Princess Marie Bay lowland (79°24′N, 75°40′W).

For the purpose of comparison, measurements of the aboveground standing crops (dry weight) were made for the sedge-dominated meadows using single peak-season harvests at Alexandra Fiord (20 × 50 cm quadrats, n = 5) and Sverdrup Pass (20 × 20 cm, n = 7) on 21 and 19 July 1981 respectively.

OBSERVATIONS AND DISCUSSION

Ice-free terrain comprises some 9500 km (56%) of the study area defined in Figure 1 and Table 1. This consists largely of

TABLE 1. Partitioning of glaciated, polar desert, and vegetated areas within the survey region defined by Johan Peninsula-Dobbin Bay-Cañon Fiord-Irene Bay, east-central Ellesmere Island (*cf.* Figure 1)

Habitat	Area (km^2)	% of total
glaciated	7500	44
polar desert	8700	51
vegetated	800	5
TOTAL	17 000	

[1]Department of Botany, Erindale Campus, University of Toronto, Mississauga, Ontario, Canada L5L 1C6
[2]Department of Biology and Institute for Resource and Environmental Studies, Dalhousie University, Halifax, Nova Scotia, Canada B3H 4J1

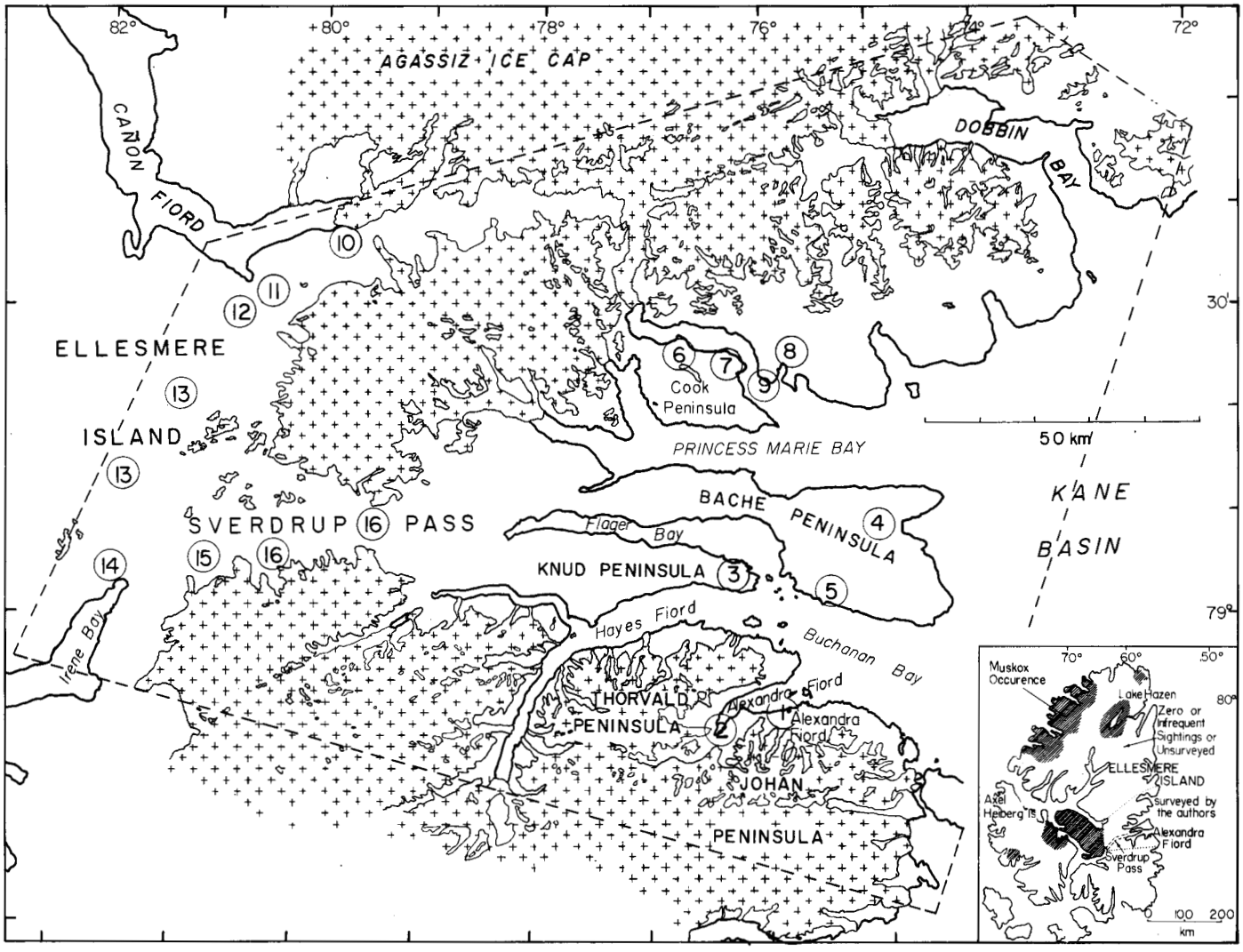

FIG. 1. The surveyed region on central Ellesmere Island. The numbers refer to the sites described in Table 2. The inset map shows the areas of known muskox occurrence on central and northern Ellesmere Island (after Urquhart, 1982).

unvegetated or very sparsely vegetated polar desert (<2% cover) or meagerly vegetated semi-desert (2-10% cover). In the High Arctic, relatively well-vegetated areas (>10% cover) tend to be small, discrete units that occur in moist coastal lowlands (Soper, 1940; Bliss, 1977; Svoboda and Freedman, 1981; Bliss and Svoboda, 1984). These lusher areas are of critical importance ecologically as they provide the resource base for resident and migratory land-based wildlife (Tener, 1963; Parker and Ross, 1976; Wilkinson *et al.*, 1976).

The sites that we estimated during our flights as being vegetated with at least 5% cover (Table 2) constituted only *ca.* 8% of the unglaciated terrain. Only about 10% of these vegetated sites was oasis habitat with >50% cover. The vegetation of these oases consisted mostly of mesic and/or dry mesic communities, dominated by willow (*Salix arctica*), cushion plants (mainly *Dryas integrifolia*), forbs, sedges, and grasses. Wetland and meadow communities were restricted to flood plains or poorly drained flatlands, or to snowbank seepages.

The most extensively vegetated areas include the Alexandra Fiord lowland, the Princess Marie Bay lowland, and the eastern part of Sverdrup Pass. Neither the Alexandra Fiord nor the Princess Marie Bay lowlands were observed to be grazed by muskox, either recently or for some time. The wet sedge meadows of these lowlands had relatively dense vegetation, with large accumulations of litter from previous growth, and there were no signs of muskox, such as dung or old bones. This contrasted markedly with the green, trampled, and well-grazed meadows of Sverdrup Pass. The wet meadows at Sverdrup Pass and Alexandra Fiord had similar above-ground standing crops of live graminoid biomass (dry weight, mean ± S.D.; 26 ± 17 $g \cdot m^{-2}$ and 24 ± 9 $g \cdot m^{-2}$ respectively). However, in the non-grazed meadows at Alexandra Fiord, litter constituted 87% of the total above-ground standing crop of 190 ± 70 $g \cdot m^{-2}$, and the ratio of litter to live biomass was 7:1. In comparison, the grazed Sverdrup Pass meadows had a total standing crop of 50 ± 27 $g \cdot m^{-2}$, of which 48% was litter, and the ratio of litter to live biomass was 0.9:1.

The lack of muskox on the Alexandra Fiord lowland seems to be related to its small size (8 km^2) and degree of isolation. It is probably too small to support a viable herd of muskox in the absence of other nearby habitat. The lowland is surrounded by icecaps and would be accessible only by a 35 km movement across sea ice from Knud Peninsula, the closest area where muskox occur. The absence of muskox at the much larger

TABLE 2. General characteristics of the most vegetated sites noted during the aerial reconnaissance of east-central Ellesmere Island; numbers correspond with those in Figure 1

Johan Peninsula

1. *Alexandra Fiord Lowland:* A largely vegetated but nongrazed 800 ha lowland oasis; *ca.* 49% mesic dwarf shrub-cushion plant communities, 20% wet to mesic sedge-dominated communities, 20% xeric rocky outcrops or talus slopes, 9% riverbeds or outwash plains. Plant cover ranges from <5-100%.
2. *Alexandra Fiord terminus lowland:* Mainly mesic patches of meadows with up to 40% cover.

Knud Peninsula

3. *Eastern coastal flats:* Mesic communities, cover 15-20%.

Bache Peninsula

4. *Bartlett Bay Lowland:* Large (*ca.* 50 km^2) lowland with 40-50% mesic communities and 15-20% wet meadows. Surrounding uplands up to 30% mesic communities. Muskox: 12 (1981), 2 (1983).
5. *Southeastern coastal flats:* Mesic communities, cover 2-10%. Muskox: 7 (1983).

Cook Peninsula

6,7. Two lowlands: Sporadic vegetation (5-15%). Muskox: 4 (1983).

Princess Marie Bay

8. *Lowland:* Extensive wet sedge meadows, larger than those at Alexandra Fiord. The meadows are "litter-dominated," overgrown, and obviously nongrazed. Other plant communities are dominated by *Salix* and *Dryas*. More detailed information on vegetation is in Meiklejohn (1980) and Torrens-Spence (1980).
9. *Coastal flats* west of the Princess Marie Bay lowland have extensive fields of *Dryas,* 20-25% cover.

Cañon Fiord

10. *Lower section* of the eastern terminal glacial lowland has 10-20% cover, mainly seepage communities and meadows.
11. *Hills* between the terminal lowland and the next lowland further west had *Dryas* hummocks on polygons (70%), sporadic meadows (5%). Muskox: 3 (1983).
12. *Western lowland* has its upper section well vegetated (30%), mostly submesic communities. Muskox: 4 (1983).

Irene Bay

13. *Valleys and mountain slopes* of the divide between Irene Bay and Cañon Fiord have numerous seepage communities, wet meadows, and *Salix* stands. Muskox: 10 (1983). Some animals may have been missed because of the expanse of irregular topography.
14. *Lowland* has lush wet meadow and mesic *Salix-Dryas* stands adjacent to slopes and elevated valleys. Muskox: 4 (1981).

Sverdrup Pass

15. *West of the divide* is a flat valley with very little vegetation. The northern valley slopes have sporadic *Salix* and herb stands. Muskox: 23 (1983).
16. East of the divide are frequent mesic and wet meadow communities, with up to 40% wet meadow along streams. Little vegetation in the lower section of the pass at Flagler Bay. Muskox: 19 (1981), 45 (1982), 47 (June 1983), 65 (July 1983), and 37 (1984). Calves represented the following percentages of the total animals observed: 16% (1981), 16% (1982), 23% (1983), and 14% (1984).

Princess Marie Bay lowland (*ca.* 20 × 5 km) cannot be explained on the basis of isolation, since this site is only *ca.* 15 km from the nearest muskox sighted on Cook Peninsula, a distance that these animals can easily travel over winter ice (Thomas *et al.*, 1981) or along the coast in summer. The likeliest explanation for the absence of muskox is the lack of population pressure that would force migrations to potential grazing areas peripheral to the main range at Fosheim Peninsula.

This is the only survey of muskox populations that has been carried out on east-central Ellesmere Island. The Fosheim Peninsula has been surveyed to a limited extent (Tener, 1958, 1963, 1965; Urquhart, 1982), and its northern part was identified as an International Biological Programme ecological site (Nettleship and Smith, 1975), mainly because of the relatively large numbers of muskox found there.

In the eastern Sverdrup Pass area 19 muskox were counted in July 1981, 47 in June 1982, 65 in July 1983, and 37 in July 1984. Over the first three years there was an apparent 340% increase. Reproduction alone could not account for such an increase (Jingfors and Klein, 1982); in addition, the proportion of calves in the populations showed little yearly variation (Table 2). Hence, the population changes are probably due to variations in the timing and numbers of animals migrating from wintering ranges on the Fosheim Peninsula to Sverdrup Pass (and further to the Bache, Cook, and Knud peninsulas, which are reached via Sverdrup Pass).

During our most extensive survey in 1983, a total of 115 muskox were observed. In the area bounded by Cook Peninsula, the eastern end of Bache Peninsula, and Knud Peninsula, we counted 80 animals, of which 65 were east of the divide in Sverdrup Pass. These 65 animals represent a density of 1.3 animals·km^{-2}, which is comparable with densities reported for sites on Axel Heiberg Island (1.1·km^{-2}) and Melville Island (1.4·km^{-2}) (Parker and Ross, 1976). It is also within the range reported for Banks Island (1.1-3.0·km^{-2}) by Wilkinson *et al.* (1976). In addition, the proportions of calves in the populations at Sverdrup Pass (Table 2) are similar to those reported by Parker and Ross (1976).

The result of this survey shows the importance of the spatially restricted lowland oases of the High Arctic as resource bases for muskox. It also reveals that habitat in east-central Ellesmere Island is available for colonization by muskox, should populations expand. These ecologically significant areas require protection to retain their unique character and to continue to play an important ecological role in the described region.

ACKNOWLEDGEMENTS

The surveys were made possible by helicopter support from the Polar Continental Shelf Project, Department of Energy, Mines and Resources. Special thanks go to our pilot during the 1983 season, J. Dionne, and to M. Muc of Camrose Lutheran College for his assistance in 1981. This work was funded by grants from the World Wildlife Fund (Canada) and the Natural Sciences and Engineering Research Council.

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