

## Caribou recovery and coexistence with introduced feral reindeer on the Nuussuaq Peninsula (70–71°N), West Greenland

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**Abstract:** The small native caribou population (*Rangifer tarandus groenlandicus*) of Nuussuaq Peninsula was supplemented in 1968 with 10 semi-domestic reindeer (*Rangifer tarandus tarandus*). Hunting was prohibited in the early 1990s, but resumed with a quota of 100 animals in 1996 after the population was estimated to be around 400. Despite local criticism that herd size had increased, managers kept the estimate unchanged and permitted similar quotas for the next 5 years. To ascertain current status of the population, a late winter ground survey for minimum count, recruitment and distribution was done in April 2002 employing local hunters. Data collected included group size, location and animal sex/age. Only two age classes were used; calf (<1 year) and "adult" (>1 year). The 2002 ground survey observed 1164 individuals and a calf percentage of approximately 30%. The bull to cow ratio was 0.32. This data did not allow a calculation of population size, because areas where maximum animal numbers were expected were preferentially sampled. Spatial segregation of these two subspecies is suggested, given the observed and unexpected dissimilar behavior, phenotype and spatial distribution. If true, then by 2002 feral reindeer had established a successful population, while native caribou had recovered to number several hundred. Genetic sampling is necessary to examine this hypothesis. At current late winter recruitment rates animal density could increase rapidly making both range expansion and genetic mixing likely in future. Since the total non-ice covered area available is about 6000 km<sup>2</sup>, greater caribou/reindeer densities may not be compatible with sustainable range use. Harvest quotas were increased in 2002 and 2003, and may reduce densities and preserve caribou range for the future.

**Key words:** density, distribution, phenotype, population, *Rangifer tarandus groenlandicus*, *Rangifer tarandus tarandus*, recruitment, sex ratio, status, survey.

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### Introduction

The Nuussuaq Peninsula (70–71°N; 49–55°W) in West Greenland is isolated by topography and distance from other *Rangifer tarandus* populations in Greenland. Prior to 1968 only native wild caribou (*Rangifer t. groenlandicus*) were present and just 15–25 individuals were presumed remaining (Meldgaard, 1986). Therefore 10 semi-domestic reindeer (*Rangifer t. tarandus*) were introduced in 1968. These animals originated from the Greenland Godthåbsfjord's Itivnera/Kapisillit reindeer herding district (64.2°N; 50.5°W), which was established in 1952 with a shipment of reindeer from northern Norway, (Cuyler, 1999). The 10 semi-domestic reindeer were released

into the eastern portion of the Nuussuaq Peninsula in the vicinity of the lake, Boyes Sø (Fig. 1).

These semi-domestic reindeer were never intended for animal husbandry, but were to become feral, possibly mix with the native caribou, and ultimately provide the region's hunters with a meat resource for future harvests. Semi-domestic reindeer typically rut and calve about two or three weeks earlier than their caribou counterparts. Because the latitude of the Nuussuaq Peninsula matches the extreme northern limit for semi-domestic reindeer in Scandinavia, the success of this introduction was uncertain. Still, neither wolves (*Canis lupus*) nor any other potential

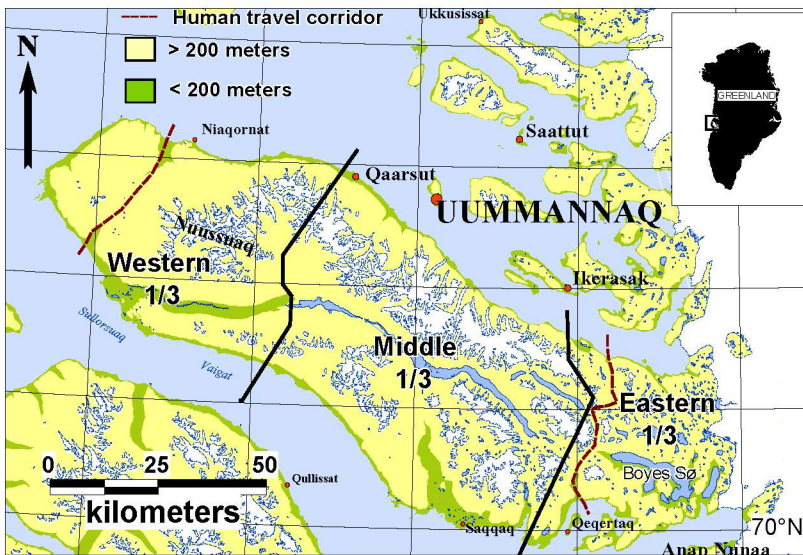


Fig. 1. West Greenland's Nuussuaq Peninsula (70–71°N) divided into rough thirds: Western, Middle, and Eastern. Approximately 6000 km<sup>2</sup> non-ice covered. Shading indicates elevation.

predator have existed in West Greenland for several hundred years (Dawes *et al.*, 1986). Harvesting by local hunters, however, was unregulated by quotas until 1987 (Fig. 2).

In 1991, following an aerial survey, which observed only 44 animals, the decision was made to prohibit hunting for 10 years (Greenland Institute of Natural Resources [GN] file 28.63.02/15 Nuussuaq). Another survey in 1995 observed 161 animals, which included 11% calves (age <1 year), and population size was estimated to be 400 (Ydemann & Pedersen, 1999). Thus, despite the decision to prohibit hunting until 2001, a quota of 100 animals was permitted in 1996. Harvesting continued with little variation in

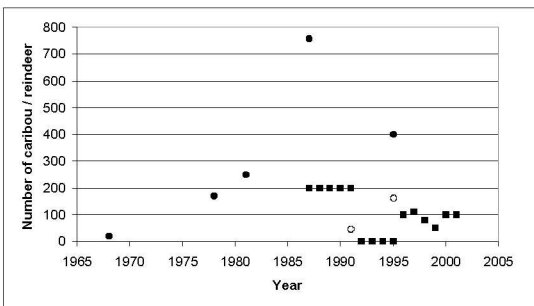


Fig. 2. Population estimates (●), numbers observed (○) and harvest quotas (■) for *Rangifer tarandus* on the Nuussuaq Peninsula, West Greenland, between 1968 and 2001. (Unpubl. data from the Greenland Institute of Natural Resources and Greenland Ministry of Fisheries, Hunting and Agriculture.)

quota into 2001. Managers assumed population size remained unchanged since the 1995 estimate of 400 animals, however by 2001, locals insisted that caribou numbers had risen and wanted the harvest quota increased. As a result, this study was initiated to ascertain a current minimum count, calf recruitment and the distribution of *R. tarandus* on the Nuussuaq Peninsula in 2002.

## Methods

### Study area

The Nuussuaq Peninsula (70–71°N; 49–55°W) roughly follows an east–west orientation, with the Greenland Ice Cap forming its eastern border. It encompasses an area of about 7150 km<sup>2</sup>. If the numerous alpine ice caps and glaciers are deleted, however, the remaining area is about 6000 km<sup>2</sup> and most is above 200 meters elevation.

### Minimum count ground survey

This ground survey sought a minimum count of *R. tarandus* and the percentage of calves from the previous spring 2001. The minimum count is the number of animals observed and was not intended to be a population size estimate. This data did not allow a calculation of population size, because areas where maximum numbers were expected were preferentially sampled. Minimum counts, if repeated, could

Table 1. Late winter *R. tarandus* herd structure observations on the Nuussuaq Peninsula, West Greenland, April 2002.

Caribou/Reindeer	Observations	Percentage
Adult female	443	38.1%
Adult male	143	12.3%
Adult sex unknown	167	14.3%
Calves (both sexes)	324	27.8% (30.1% <sup>a</sup> )
Unknown age	87	7.5%
Total	1164	100%

<sup>a</sup> True calf percentage, 30.1%, calculated using animals of known age; adult (753), calf (324).

be expected to provide indices of abundance and recruitment, and indicate population changes.

The Nuussuaq Peninsula was surveyed by snowmobile for minimum count and calf recruitment in late winter 2002 (21–29 Apr). Local knowledge on where animals were likely to be concentrated was obtained through several meetings with the Uummannaq community, which also chose survey routes and local participants. The survey included seven participants: four local commercial hunters and one hunting officer from the Uummannaq Municipality, and two staff from the Greenland Institute of Natural Resources. Six snowmobiles were used, and the total distance of survey routes was about 1000 kilometers.

The observers drove together as a group and counted all animals seen using 10×30 Leica binoculars or 60× Leica telescopes, which made it possible to observe animals even from several kilometers distance. Since caribou/reindeer can be expected to move in the terrain, to prevent the possibility of “double-counting” animals, routes taken were surveyed once only and as quickly as weather and snow conditions permitted. Animals were sexed and aged. Sex was determined by presence or absence of a vulva and/or urine patch on the rump. This reliably indicated a female on both adults and calves. No other method was 100% certain, e.g., antler size, shape, presence/absence were not used. There were two age categories, calf (<1 year) and adult (>1 year). Age was determined by body size. Calves of both sexes were smaller than all others.

Snow depth and type were noted. Area of survey coverage was calculated using MapInfo Professional Version 7.0 (Copyright©1985–2002 MapInfo Corporation) regions. Significance testing and predictability were tested using 2 tailed *t*-tests (2 sample assuming unequal variances).

## Results

### *Variations in snow and ice cover*

In the western third of the peninsula a ground ice layer occurred, and this was overlain by 70 cm of hard packed snow. The thick ground layer of ice was

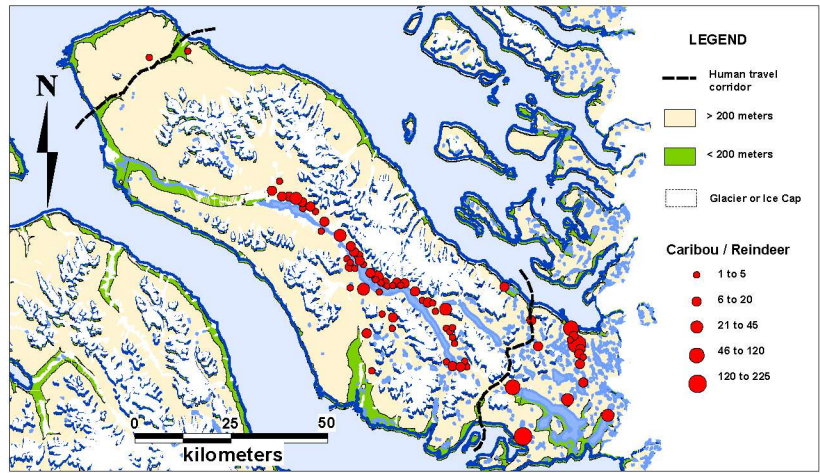


Fig. 3. Locations of *Rangifer tarandus* observations on the Nuussuaq Peninsula, West Greenland, April 2002.

caused by an unusual and heavy December 2001 rainstorm, which was followed by below freezing temperatures for the rest of the winter. The ground ice ended abruptly at the western most edge of the middle third. Snow in the middle third was often a deep (60–90 cm) loose powder, with no ground layer of ice. The situation was similar in the eastern third, except snow conditions also included extremely windblown areas of either stone-hard snow or rocky expanses blown bare of snow. South facing aspects had a thinner snow layer and relatively large patches of bare ground.

### *Status and distribution*

In late April 2002 animals were observed over the entire peninsula, however, the western third was scarcely used (Figs. 3 and 4). The greatest concentrations were in the middle third and specifically the eastern third of the peninsula. In both, valley bottoms were the primary habitat, followed by valley slopes or elevated plateaus. All animals in the middle third were observed at elevations above 200 meters and reaching to about 500–600 meters. Most in the eastern third occurred below 200 meters. Few animals were observed at elevations over 600 meters. Most of the animals and feeding craters were on south facing slopes and plains, where snow was thin and large patches of bare ground were available. Macro-lichens preferred by caribou/reindeer (*Cladina* spp., *Cetraria* spp.) were present on the south-facing slopes and being grazed.

The ground survey area coverage was ca. 25% of the 6000 km<sup>2</sup> of non-ice covered terrain and observed a minimum count of 1164 individuals, which included 324 calves (age <1 year; born in 2001), for an overall calf percentage of 27.8% (Table 1). However, 87

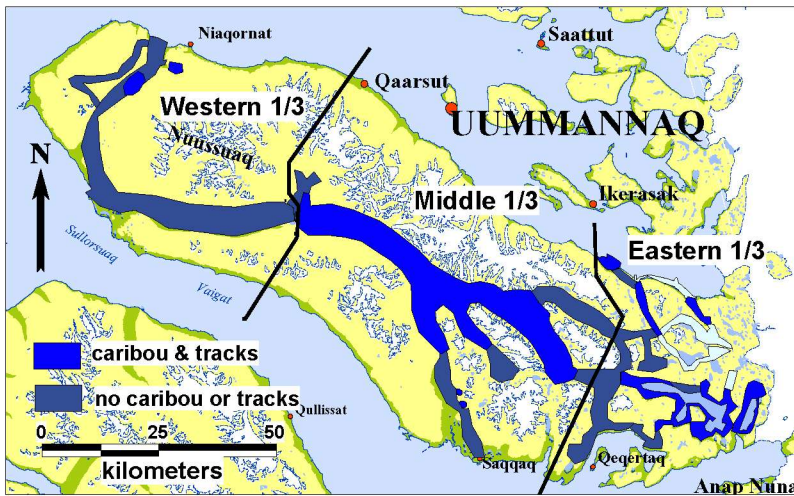


Fig. 4. Survey area coverage and the presence or absence of *Rangifer tarandus* in the areas surveyed on the Nuussuaq Peninsula in April 2002, West Greenland.

of the animals could not be aged due to within group animal movement, which confounded identification, combined with too great a distance between observer and animals. All 87 were in an area where observations included primarily females with calves. Given the known numbers of adults (753), the true late winter calf percentage was 30.1% and calf recruitment was 43 calves per 100 adults, or similarly, 73 calves per 100 cows (443). Given the known number of bulls (143) and cows (443), there were just over 3 females for every bull for a bull to cow ratio of 0.32. Average group size was small in the middle third of the peninsula (Table 2), but large in the eastern third, which included tightly cohesive groups of 63, 206 and 212 animals. Similarly, density was greatest in the eastern third. Body condition was subjectively ascertained as prime. All animals appeared well rounded and not a single animal showing ribs was observed.

#### Phenotypic variation

Average group size and density were not the only notable differences between the animals inhabiting the middle versus the eastern third of the peninsula. Adult females in the eastern third possessed antlers, and even many female calves were antlered (Table 3). Whether single or paired, antlers were well formed, with no raggedy remnants of velvet. Antlers among females in the middle third were not common. Further, the animals in the middle third were always a pale gray-white color. In contrast, the animals in the eastern third were typically dark, with some being a deep brown. Further, calves in the middle third were noticeably smaller than those observed in the eastern third. The latter were almost adult in size and often possessed paired antlers with several tines.

## Discussion

### Distribution

Caribou/reindeer were concentrated in the middle and eastern portions of the Nuussuaq Peninsula. This may be the typical late winter distribution, however, it is possible that 2002 was an exception. Given the ground ice layer and deep hard snow covering the western third of the peninsula in April 2002, it was not surprising to find so few animals present, since obtaining food would have required large energy expenditure.

Although most of the Nuussuaq Peninsula is above 200 meters elevations, most animals were observed in valley bottoms. South facing slopes and plateaus also received high utilization, likely due to the thinner snow layer and abundance of bare patches. Obtaining food from these locations would require a minimum of energy expenditure. Whether the vegetation at these locations differed from others, e.g., north-facing slopes, is currently unknown, but differences are suspected.

### Status

Body condition was subjectively ascertained as prime. Although late winter, animals appeared round and fat, when some individuals in other Greenland populations of *Rangifer tarandus* may clearly show backbone and ribs (C. Cuyler, pers. obs.).

During the ground survey in late April 2002, observers counted a minimum of 1164 animals. A population estimate was not possible. The late winter calf percentage was high at ca. 30%, and the recruitment was 73 calves per 100 cows. Since these calves were almost 1-year of age, at which time their mortality rate becomes similar to mature animals, this was a high rate for an ungulate population. Studies from North America and Scandinavia report late winter recruitments of 20, 22 and 41 calves per 100 cows (Dzus, 1999; Parker, 1972; Fancy *et al.*, 1994, respectively), but these populations have predators. The Southampton Island Herd, like Greenland, has no predators, and late winter recruitment varies between 22 and 77 calves per 100 cows and is likely dependent on climate (Heard & Ouellet, 1994).

The sex ratio of bulls to cows, 0.32, was low, and likely the result of selective hunting of bulls (estimated to be 90% of the harvest) (Loison *et*

al., 2000). Persistent male-skewed harvesting carries risks for the population dynamics and genetics of a population (Ryman *et al.*, 1981; Ginsberg & Milner-Gulland, 1994). On the Nuussuaq Peninsula, however, there is opportunity for crossbreeding between caribou and reindeer, which would likely tend to increase genetic variation in the population. Still, the Nuussuaq population would benefit if the preference for males were reduced and harvesting females encouraged. A female dominated population with good body condition and a high recruitment rate can rapidly become too large for the range to support, potentially resulting in long-term degradation of the range and ultimately a population crash.

#### Possible spatial segregation

Observations of the morphology and behavior of the animals surveyed in April 2002 suggests that the two subspecies have remained relatively segregated since the reindeer were introduced in 1968. This was unexpected. Animals in the middle third of the peninsula were similar in appearance and behavior to native wild caribou in West Greenland. In contrast, among animals in the eastern third of the Nuussuaq Peninsula semi-domestic reindeer characteristics were common, e.g., group cohesion and large aggregations were prevalent, dark brown coloration, females with well developed antlers, antlered female calves, and large calf size. The latter suggests calves are born in May, which is typical of semi-domestic reindeer, rather than June, typical for the native caribou. The extra weeks allow for greater growth in reindeer calves during their first summer, range conditions permitting. Group cohesion and large aggregations are not typical for native West Greenland caribou, where average group sizes are 3–6 animals, regardless of density or population size (Cuyler & Linnell, 2001; Cuyler *et al.*, 2002, 2003). Further, female caribou with antlers are unusual,

Table 2. *Rangifer tarandus* group size and density on the Nuussuaq Peninsula, West Greenland, based on ground survey minimum counts of late April 2002.

Area	Survey area (km <sup>2</sup> )	Numbers observed	Known adult (calf) <sup>a</sup>	Calf %	Average group size	Density/km <sup>2</sup>
Western third	≈ 390	4	4 (0)	--	1–3	≈ 0.01
Middle third	≈ 726	449	449 (137)	30.51	8 ± 8 SD	≈ 0.6
Eastern third	≈ 420	711	624 (187)	29.97	40 ± 64 SD	≈ 1.8
Total	≈ 1506	1164	1077	30.08	15 ± 34 SD	≈ 0.8

<sup>a</sup> Number of calves among the total number observed is given in parentheses.

Table 3. Phenotypic and behavioral differences in *Rangifer tarandus* observed between the animals inhabiting the middle and eastern third's of the Nuussuaq Peninsula, West Greenland, April 2002.

	Middle third	Eastern third
Group size	Small	Large
Pelt coloration	Pale gray-white	Dark to deep brown
Antlers on females	Uncommon on adults; never on calves	Common adults and calves
Antler size on females	Few tines	Many tines
Antlers on calves <sup>a</sup>	Seldom	Common
Antlers size on calves <sup>a</sup>	Few or just a single peg	Many tines
Calf size	Smaller than animals >1 year	Similar to animals >1 year
Occurrence	Elevations >200 meters	Elevations <200 meters

<sup>a</sup> Calves male or female.

while polled females are common, and almost all female caribou calves lack antlers and are noticeably smaller than adults. In addition, the late winter pelt of caribou is always pale gray-white (C. Cuyler, pers. obs.). Possible contributing factors to the suggested segregation would include, low initial animal numbers and the hunting pressure and/or disturbance associated with the human travel corridor, which separates the middle and eastern areas. There is also the possibility of voluntary segregation, if reindeer and caribou are behaviorally incompatible.

#### Caribou recovery and successful establishment feral reindeer

It appears that today both wild native caribou and feral reindeer inhabit the Nuussuaq Peninsula in West Greenland. If the behavioral and morphological differences truly reflect subspecies segregation, then in April 2002 a minimum of 449 native wild caribou (*R. t. groenlandicus*) inhabited the middle portion of the Nuussuaq Peninsula, while a minimum of 711 feral reindeer (*R. t. tarandus*) lived in the eastern portion in close proximity to the Ice Cap. In future,

however, if both populations continue to increase in abundance, then genetic mixing may be expected.

Almost three times the number of animals was observed in 2002 than had been assumed present on the peninsula, and the late winter calf percentage was excellent. The few remaining native caribou from 1968 appear to have recovered. Also, the 1968 introduction of 10 semi-domestic reindeer has successfully established a feral population, which is currently providing a meat resource for locals. Greenland managers increased the harvest quota in 2002 to 350 animals and to 400 animals in 2003.

#### *Future surveys*

Random transects used elsewhere in Greenland are not recommended for the Nuussuaq Peninsula. The feral reindeer exhibit tight group cohesion. This results in an extremely clumped distribution of large numbers of animals. The native caribou, although more evenly spread throughout the terrain in small groups, were still more common in valley bottoms. Both distributions would likely make population estimates highly inaccurate if based on aerial surveys using random transects. An index of abundance is possible if the ground survey for minimum count is repeated, preferably annually, using the same routes and time period. Although vegetation maps, terrain models or NDVI maps are not yet available for this region, in future such maps could be used to stratify the census area. Then, an index of caribou density could be calculated for the various habitat types encountered on the survey route. Further, an objective documentation of snow and ice cover will better allow comparison of count data from different years.

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