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The introduction of reindeer to Brøggerhalvøya, Svalbard: grazing preference and effect on vegetation

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Abstract: In 1978 after about 100 years of absence, 15 Svalbard reindeer, *Rangifer tarandus platyrhynchus* were reintroduced to Brøggerhalvøya, a peninsula on the north-western coast of Svalbard. This stock had increased to about 200 animals in 1989. Studies of reindeer grazing behaviour were carried out in 1979–1980 and 1988–1989. Highly prefered lichen species such as *Cetraria nivalis* had almost completely disappeared by 1989, whereas a less prefered species, *Cetraria delisei*, was still abundant. Year round dietary intake of grasses, lichens and herbs e.g. *Oxyria digyna*, had decreased by 1989, whereas that of mosses had increased. Essentially reindeer showed a more opportunistic grazing behaviour with more balanced utilization of all types of plant associations in 1989. The grazing behaviour of the reindeer on Brøggerhalvøya is therefore similar to that observed for Svalbard reindeer in general.

Key words: Svalbard, reindeer, grazing effect, habitat preference, overgrazing

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Introduction

Reindeer had been extinct on Brøggerhalvøya, a peninsula on the north-western coast of Svalbard, for about 100 years when 15 reindeer were reintroduced in 1978. By 1989 the population had grown to about 200 animals utilizing approximately 60 km^2, of potential grazing land.

An initial study of grazing preference was carried out in 1979–1980 (Holand *et al.*, 1981; Persen *et al.*, 1983) followed by a comparative study using the same techniques in 1988–89 (Scheie and Grøndahl, 1990). The purpose of the present study was to describe possible changes in food and habitat preference of these reindeer after 10 years of increasing grazing pressure.

Methods

Habitat selection was studied by the pellet group technique (Rogers *et al.*, 1958; Punsvik *et al.*, 1980 and Persen *et al.*, 1983). Ten transects with a combined length of ca. 14 km were localized to cover the most important plant associations on Brøggerhalvøya. At every 20 m along the transects plant associations was described for a one m^2 plot using the categories earlier described by Brattbakk and Senstad (1975), Figs. 1-3. Plant coverage was estimated according to the Hult-Sernander scale (Rønning, 1976) and the one m^2 plot was then assumed to be representative of plant associations along the last 20 m of the transect.

In 1980 summer and winter fecal droppings were counted in a 10 m wide belt along the

transects, but because of increasing amounts of feces, this belt was narrowed to 5 m in 1989. The same transects were used both years. Samples of 10 summer and 10 winter pellet groups (*i.e.* one defecation) were collected and dried to constant weight. These values were used to calculate total amounts of feces per m^2 in different plant associations.

By directly observing reindeer it was possible to estimate time spent grazing in different plant associations. Based on the percent of total grazing time in each association (U), and the area percent of each association on Brøggerhalvøya (A) grazing preference (PR) was estimated according to Jacobs (1974) and Wright (1980):

$$\text{Eq.I.} \quad PR = \log_{10}(U/A)$$

Fresh fecal samples were collected for botanical composition analysis through the summers of 1980 and 1989. In 1980 single animals were observed until defecation and a single fresh fecal sample (n=24) collected while in 1989 droppings from 10 different animals were pooled (total of 13 pooled samples) for analysis. Winter samples were collected by pooling pellets from 10 different defecations as was samples from May and October 1989. Microhistological analysis were carried out at the Composition Analysis Laboratory, Range Science Department, Colorado State University, USA (Hansen and Lucich, 1980).

Results

Distribution of feces

In both 1980 and 1989 the large accumulation of winter and summer feces were found in moss-tundra and on moraine ridges dominated by lichens, but by the later date fecal distribution had changed (Winter $X^2=1337$, $p<0.001$; summer $X^2=1510$, $p<0.001$) and deposits had increased substantially in most other associations (Fig. 1).

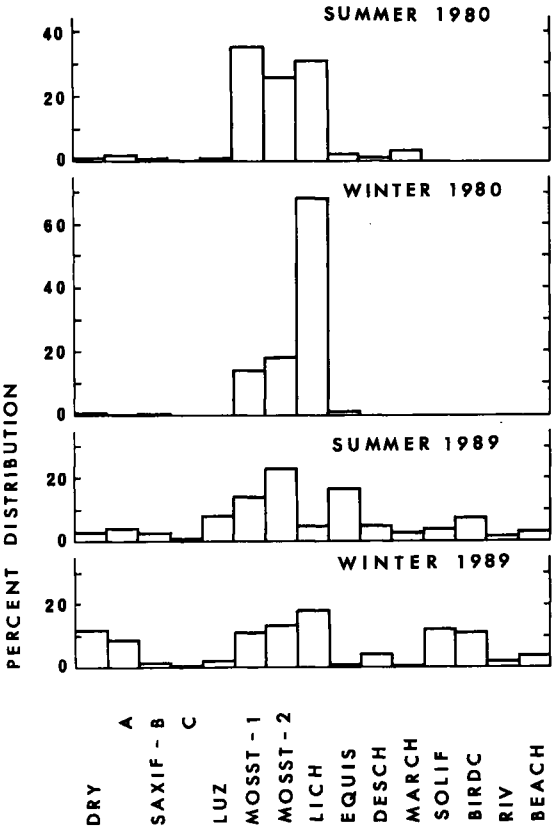

Fig. 1. Comparison of fecal distribution in different plant associations in 1980 and 1989 g/1000m^2 ±S.D. DRY = Community dominated by *Dryas octopelata* and *Cassiope tetragona* (Dryadion); SAXIF-A-B-C Community of *Saxifraga oppositifolium* and *Cetraria delisei* with plant coverage of > 50 %, 10–50 % and < 10 %; LUZ = Luzula field; MOSST-1 = Moss-tundra; MOSST-2 = Moss-tundra dominated by *Tomenthypnum nitens;* LICH= Moraines dominated by lichens; EQUIS= Fields dominated by *Salix polaris* and *Equisetum arvense;* DESCH = Fields dominated by *Deschampsia alpina;* MARCH = March fields, usually wet all summer; SOLIF = Solifluction areas and unstable soils; BIRDC = Thallus below bird-cliffs; RIV = River beds and flooded areas; BEACH = Fields at sea level.

Grazing preference

Calculations of a grazing preference index (Eq. 1) indicates several shifts in grazing preference from 1980 to 1989 (Fig. 2): *Dryadetum* associations changing from negative preference to neutral, mosstundra dominated by *Tomenthypnum nitens* from negative to positive, reduced positive preference for *Equisetum* fields, *Deschampsia* fields changed from slightly positive to negative, and also reduced preference for marches.

Microhistological analyses

The percentage of moss in the diet increased from 1980 to 1989, both in winter and summer. *Salix polaris* was heavily used in the summer of both years, but the number of fragments of this plant in feces decreased through the 1980 summer while it remained high in 1989. Its winter percentage was lower in 1989 than in 1980. In

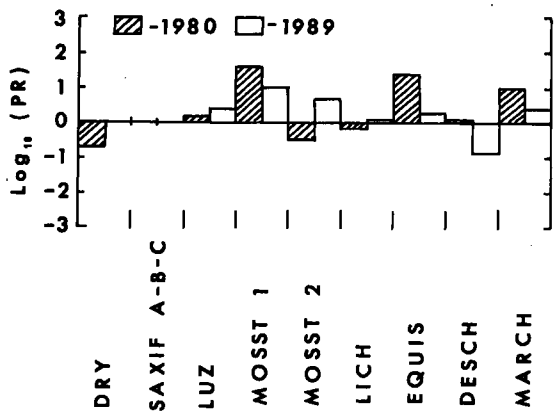

Fig. 2. Comparison of grazing preference (Jacobs, 1974) of reindeer on Brøggerhalvøya in 1980 and 1989. Negative values show negative preference and positive values positive preference. For further explanation see Fig. 1.

1980 *Oxyria digyna*, was an important food plant, but not nearly so in 1989. Also, the utilization of grasses decreased from 1980 to 1989 as did the utilization of lichens (Fig. 3).

Table 1. Observed decrease in percentage plant coverage between 1980 and 1989 on Brøggerhalvøya. The data were obtained by subtracting plant coverage measured in 1989 from that of 1980 in 11 plantassociations (±S.D).

Vascular plants	14.3± 7.2
Mosses	5.6±20.7
Lichens	5.4±11.5
Total plant coverage	13.8±19.5

Plant coverage

Based on measurements according to the Hult-Sernader scale total plant coverage was reduced from 1980 to 1989 (Table 1). This reduction was apparently largest for vascular plants, and less for mosses and lichens.

Discussion

There was an apparent decrease in coverage of vascular plants and lichens on Brøggerhalvøya between 1980 and 1989 (Table 1). In particular, prefered species of lichen like *Cetraria nivalis* and *Cladonia mitis* had almost disappeared, whereas the less prefered species *Cetraria delisei* was still abundant. It is also apparent from Fig. 3 that quantities of lichens and grasses have diminished in fecal droppings. No comparative analyses of the abundance of single species of vascular plants were carried out. However, the reduction in *Oxyria digyna* in fecal droppings from 1980 to 1989 appears to indicate a major reduction in the quantities of importance of this food plant. *Salix polaris* on the other hand remained a highly important forage plant and was apparently even more important in 1989 than in 1980. By 1989 the percetage mosses in the diet had also increased.

The general trend seems to be that the reindeer have changed their grazing habits from selecting highly prefered plant-associations to a more opportunistic utilization. This information was evidenced by the neutral preference in 1989 for the widly distributed Dryadion association for which 1980 reindeer showed a nega-

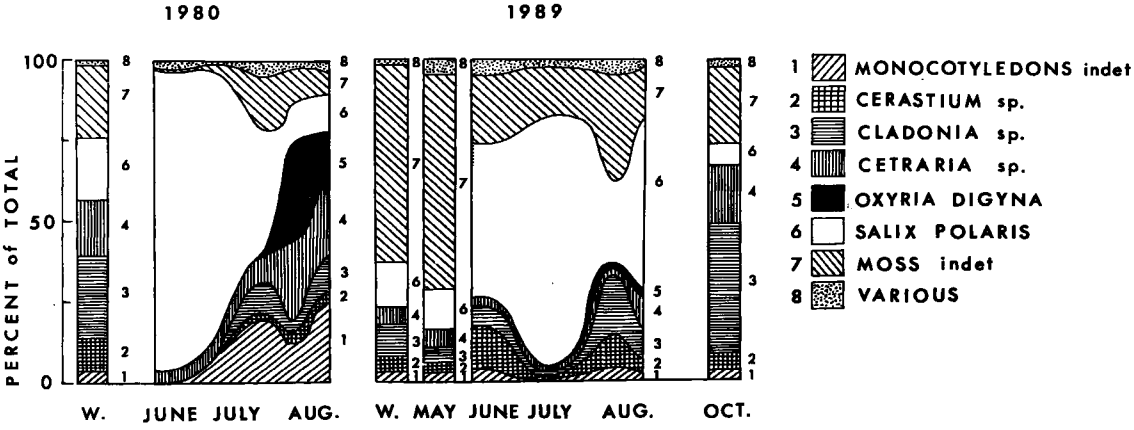

Fig. 3. Percent botanical composition of fecal pellets collected on Brøggerhalvøya in 1980 and 1989.

tive preference and by the reduced preferences for moss-tundra, *Equisetum* dominated associations and march vegetation (Fig. 2).

The findings here agree with conclusions drawn from grazing studies performed during the Man And Biosphere (MAB) program in various other geographical areas of Svalbard; namely that Svalbard reindeer prefer forage plants and grazing habitats of the highest quality, *i.e.* plant species high in digestive energy and nutrient content and areas with high plant biomass and relatively flat terrain (Scheie and Grøndahl, 1990; Staaland, 1986; Staaland *et al.*, 1988). When these qualities are not available the reindeer graze plant associations of lower quality (Staaland; 1986). A significant finding on Brøggerhalvøya was the increase in utilization of mosses. This could have resulted from over grazing of the more highly prefered lichens, grasses and herbs and in this context, utilization of mosses could be viewed as a sign of impoverished pastures. Observations elsewhere indicate that not only are mosses more resistent to mechanical destruction by trampling than many other forage plants. They are also reported to be an important food resource for high arctic reindeer and caribou (Parker, 1978). The persistent abundance of the lichen *Cetraria delisei* may have several explanations. Firstly this species has a low digestibility (Staaland *et al.*, 1988) and may not be prefered by reindeer, also it may be protected since it is tolerant to being frozen under ice (Hasselrot, 1953).

Any long term comparative study strive for methodological consistancy and in 1980 we did not foresee the importance of quantifying the occurrence of single vascular species like *Oxyria digyna* or single lichen species which apparently have measurably declined due to increased grazing pressure. It is now apparent that standard methods for describing plant associations may not be sensitive enough to properly assess the effects of grazing on vegetation.

An additional factor which may have confounded study findings is that the goose population on Brøggerhalvøya increased during the 1980–89 period. In the settlement of Ny Ålesund a colony of Barnacle Geese, (*Branta leucopsis*) became established and also the number of Pink-footed Geese, (*Anser fabalis brachyrhynchus*) has increased. These species may be competitors of the reindeer as analysis of goose droppings showed 53 % *Equisetum* fragments, 10 % monocots, 22 % mosses and 14 % forbs (Staaland unpublished).

Conclusion

So far, however, the reindeer on Brøggerhalvøya maintain both a high reproductive rate (63 calves: 69 females counted in July-August) and reproductive longetivity as tagged females 15 and 17 years old produced calves. In addition few animals have been found dead, and only a few young males are reported to have emigrated (Scheie and Grøndahl, 1990). Hence it appears that despite observed changes in vegetation, the reindeer grazing conditions on Brøggerhalvøya are still good.

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