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Co-feeding between Svalbard Rock Ptarmigan (*Lagopus muta hyperborea*) and Svalbard Reindeer (*Rangifer tarandus platyrhynchus*)

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ABSTRACT. Co-feeding between Svalbard rock ptarmigan (*Lagopus muta hyperborea*) and Svalbard reindeer (*Rangifer tarandus platyrhynchus*) on Svalbard, Norway, was observed during our annual point transect survey of territorial Svalbard ptarmigan cocks in two side valleys of Adventdalen and Sassendalen. Both pairs and single hens or cocks used the feeding craters excavated by reindeer in search of food. We suggest that the use of reindeer feeding craters may be important to the Svalbard rock ptarmigan during snow-rich events in winter or after terrestrial ice-crust formation resulting from mild spells and rain-on-snow events. We expect that such co-feeding may be particularly important for saving energy in periods when territorial defence and preparation for the breeding season make high energy demands on ptarmigan of both sexes.

Key words: rock ptarmigan, reindeer, co-feeding, feeding crater, climate, meteorological data

RÉSUMÉ. La co-alimentation entre le lagopède alpin de Svalbard (*Lagopus mutus hyperboreus*) et le renne de Svalbard (*Rangifer tarandus platyrhynchus*) à Svalbard, en Norvège, a été observée dans le cadre de notre enquête transect annuelle des coqs lagopèdes territoriaux de Svalbard dans deux vallées latérales d'Adventdalen et de Sassendalen. Les poules et les coqs en couples ou célibataires se servaient des fosses de broutage creusées par les rennes à la recherche de nourriture. On suggère que l'utilisation des fosses de broutage des rennes peut revêtir de l'importance pour le lagopède alpin de Svalbard pendant les périodes hivernales riches en neige ou après la formation de glace sur la couche terrestre résultant du temps doux ou de pluie sur la neige. On s'attend à ce que la co-alimentation de ce genre soit particulièrement importante lorsque vient le temps de conserver l'énergie pendant les périodes où la défense du territoire et la préparation pour la saison de reproduction occasionnent de fortes demandes d'énergie chez les lagopèdes des deux sexes.

Mots clés : lagopède alpin, renne, co-alimentation, fosse de broutage, climat, données météorologiques

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INTRODUCTION

Snow is a significant barrier to foraging and greatly influences the availability of winter forage for herbivores (Formozov, 1946; Pruitt, 1959). Both quality and quantity of forage are at their lowest during late winter, when maximum amounts of snow or terrestrial ice-crust formation can prevent access to food. Such conditions may have a great impact on herbivore population dynamics (Collins and Smith, 1991; Aanes et al., 2000; Aars and Ims, 2002).

The Svalbard rock ptarmigan, *Lagopus muta hyperborea*, is the only herbivorous terrestrial bird resident on the Svalbard archipelago (Løvenskiold, 1964). Living at this High Arctic latitude with an extreme, periodically changing environment of light, temperature, precipitation and wind, the Svalbard rock ptarmigan has developed specific morphological, physiological, and behavioural adaptations to winter conditions (Stokkan, 1992). In the late winter months of March and April, *Salix polaris* makes up approximately 50% of the crop content, and *Dryas octopetala*, *Saxifraga oppositifolia*, and *Polygonum viviparum* are also important food resources (Unander et al., 1985). Another herbivorous species resident in the archipelago, the Svalbard reindeer, *Rangifer tarandus platyrhynchus*, is a generalist herbivore (Van der Wal et al., 2000). When snow starts to accumulate and becomes hard-packed in winter, wind-exposed ridges with sparse vegetation cover low in foraging quality become more and more important foraging grounds than open plains and wetlands (Lindner, 2003). When the amount of snow is at maximum in the landscape in April, heaths and ridges with vegetation dominated by graminoids (e.g., *Festuca* sp., *Poa* sp.), *Luzula* sp., *Salix* sp., and herbs (e.g., *Salix polaris*, *Dryas octopetala*, *Oxyria digyna*, *Saxifraga*

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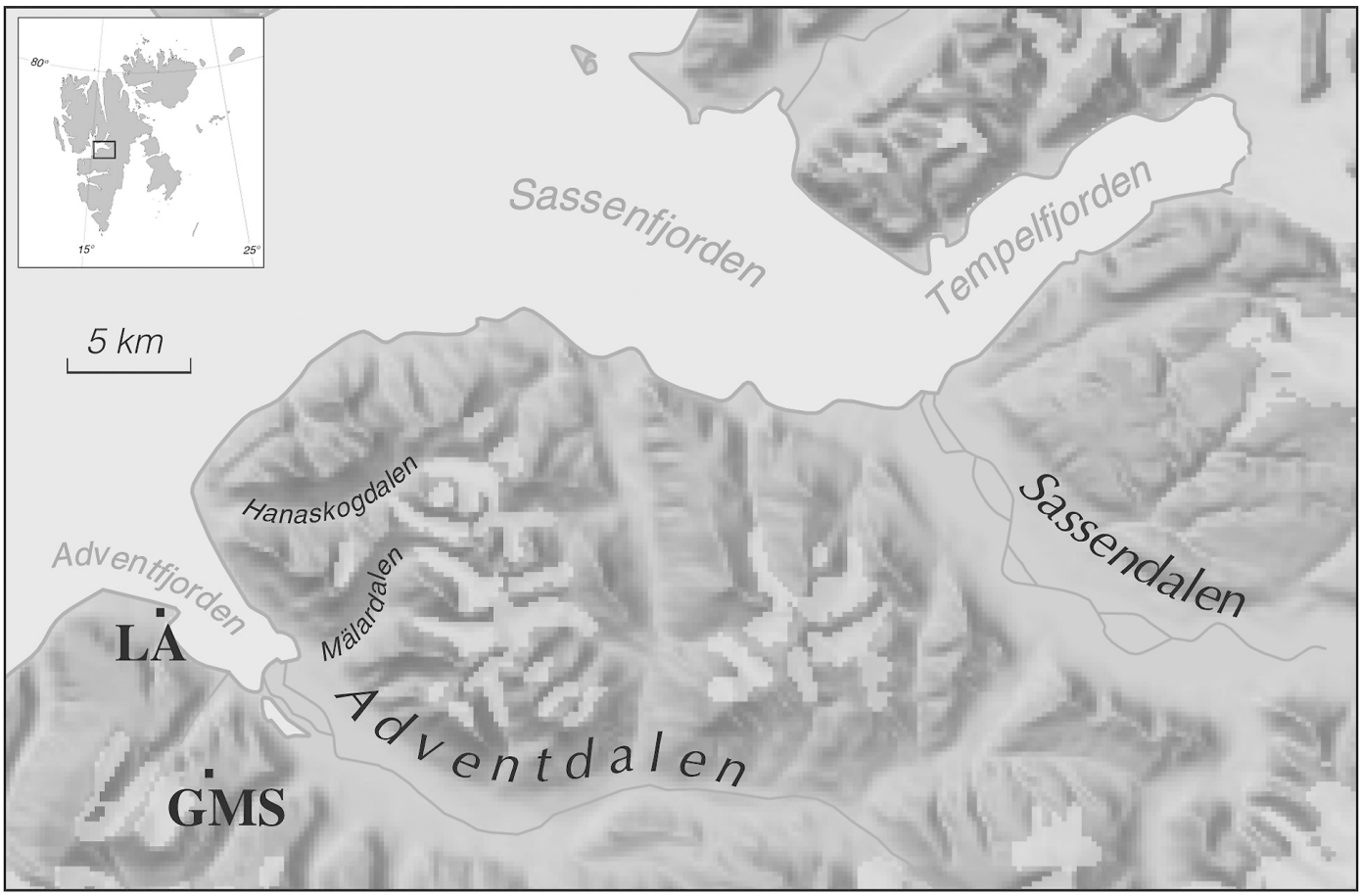

FIG. 1. Map showing the study area, located in the valleys of the Adventdalen and Sassendalen and their side valleys, and locations of the Gruvefjellet Meteorological Station (GMS) and Longyearbyen Airport (LA). Inset shows the location of the study area in the Svalbard Archipelago.

oppositifolia) are the most important foraging grounds (Van der Wal et al., 2000; Lindner, 2003). When snow accumulates, the reindeer are capable of cratering through the snow to forage.

Some anecdotal observations of ptarmigan using ungulate feeding craters exist in the literature (Formazov, 1946; Schaefer, 1995). In this study, we provide a more quantitative account of the extent of Svalbard rock ptarmigan co-feeding with Svalbard reindeer and how this behaviour relates to meteorological conditions.

METHODS

The Svalbard archipelago (62 700 km^2) is located in the Norwegian High Arctic (74–81° N, 10–30° E). Around 13% of the land area is covered by vegetation, 27% by barren rock, and approximately 60% by glaciers (Hisdal, 1985). The study area is in the northeastern part of Nordenskiöld Land and Sabine Land in the valleys of Adventdalen and Sassendalen (78°15′ N, 17°20′ E) and several side valleys (Fig. 1). Large braided rivers and open land with wetland, ridge, and heath vegetation dominate these two valleys, which are characterized as middle Arctic tundra zone (Elvebakk, 1989; Rønning, 1996). Peaks between 700 and 1200 m above sea level surround the valleys. The study area has a continental dry climate with low precipitation (190 mm/yr, with 21 mm in August, the wettest month). Temperatures are low in both summer and winter: means in 1912–96 were +5.8 °C for July and -15.8 °C for March (Førland et al., 1997).

Observations of co-feeding between Svalbard rock ptarmigan and the Svalbard reindeer were conducted during the annual point transect sampling survey of territorial cocks by the Norwegian Polar Institute and the Governor of Svalbard in April 2004. Data were collected between 0800 and 2200 on calm days, preferably days with sunshine or high cloud cover to maximize the possibility of detecting cocks by hearing or sighting. Three observers conducted the survey from approximately 100 permanent sampling sites located 1–2 km apart, depending on local topography. Typically a sampling site was placed at a predetermined GPS position 100–200 m above sea level, on a location with maximum visibility in all directions. The observer spent 20 minutes on each sampling site detecting territorial cocks. Ptarmigan feeding together with reindeer, or on sites where reindeer had recently fed (feeding craters), were detected by hearing or sighting, with or without binoculars.

RESULTS

During the ptarmigan survey, cocks or pairs were observed foraging in feeding craters made by Svalbard reindeer in the study area on 11 occasions (7.3% of the total 150 observations of cocks or pairs). These observations were made on 6 April 2004, in Mälardalen, where co-feeding of ptarmigan and reindeer was seen at 67% of the sampling points (4 of total 6), and Hanaskogdalen, where 38% of sampling points (3 of total 8) showed co-feeding. The remaining four observations were made between 11 and 23 April 2004 in Adventdalen, where only 15% of the sampling points (4 of 27) showed co-feeding.

Observations of wind speed and direction were made at the Gruvefjellet Meterological Station, located at 470 m a.s.l. on a plateau mountain 1 km south of Adventdalen (Fig. 1), from 1 October to 30 April in 2001–04. There was no significant difference in regional wind direction between these winters (Christiansen et al., 2005). Winds from the SE dominated in all years, but with more WSW winds during the 2002–03 winter. The total winter precipitation (1 October–30 April) was measured at the Longyearbyen Airport (Fig. 1) for the same years. Although total winter precipitation for 2003–2004 was less than in the two preceding winters, the largest amount (8 mm) fell on 14 March, not long before the annual ptarmigan survey. In the previous two winters, only small amounts of precipitation occurred just before the annual survey. Thus on 6 April 2004, large areas in the valleys of Mälardalen and Hanaskogdalen (Fig. 1) that are usually windswept with little snow had a snow cover 15–30 cm deep. This deep snow covered the entire valley, including areas that were windswept during observations in the other years.

Both hens and cocks were observed, either together with reindeer feeding from the same crater, or feeding at sites where reindeer had recently fed. While sitting in the craters foraging, the ptarmigan frequently raised their heads to watch the surrounding terrain, probably to minimize the risk of predation by arctic foxes (*Alopex lagopus*). The feeding craters were as described by Collins and Smith (1991).

DISCUSSION

Although the point transect sampling survey of rock ptarmigan has been conducted annually since 2000, 2004 was the first year in which we observed this foraging strategy. Both pairs and single hens or cocks used the feeding craters made by reindeer in search of food. Similar observations were made in the vicinity of Ny-Ålesund, Svalbard (78˚55′N, 11˚56′E), during research on Svalbard rock ptarmigan and reindeer in the early and mid 1980s (Sigmund Unander, pers. comm. 2004). Rock ptarmigan on the Norwegian mainland show the same feeding behaviour in snow-rich winters (Per Jordhøy, pers. comm. 2004). Schaefer (1995) frequently observed ptarmigan in association with muskox (*Ovibos moschatus*) herds in the Canadian High Arctic. Formozov (1946) reported observations of rock ptarmigan and other *Lagopus* species co-feeding with reindeer in the Russian Arctic. Studies of winter habitat use and inter-specific associations between herbivores in the Canadian High Arctic (e.g., Schaefer et al., 1996) have shown that at large scales (1 ha), caribou and ptarmigan use the habitat in different ways. However, this distinct use may not preclude co-feeding at a smaller scale during snow-rich periods of winter, when this strategy becomes important for survival.

During winter the Svalbard rock ptarmigan search for food at windswept areas with little snow accumulation (Løvenskiold, 1964). When the snow cover is deep and not too hard to dig through, they can burrow under the snow to find shelter and food (Løvenskiold, 1964). At the observation time in winter 2003–04, the entire landscape was snow-covered. On 6 April, an estimated 15–30 cm of snow covered the entire valleys of Mälardalen and Hanaskogdalen, but there was less snow in the much more exposed Adventdalen, which runs parallel to the dominating SE winter wind direction. In the previous years of the survey (2000–03), the transect observations were done at the same time in early April; however, the snow cover was much less continuous, as the snow had been significantly redistributed by wind. In early April 2004, the extensive snow cover on the ground made food less accessible for the ptarmigan. Thickness and density of snow alter the foraging conditions unpredictably, and may have negative effects during the course of winter (Andreev, 1991), and digging through ice or hard snow is highly demanding of energy (Fancy, 1985). At this time of the year the ptarmigan are at their leanest: they show decrease in body mass and increases in food intake, locomotor activity, and total daily energy consumption (Mortensen et al., 1985). It is important for hens to maximize energy intake before egg laying to enhance reproductive success, and cocks need energy for territorial defence and mate-guarding activities (Mortensen and Blix, 1989). Animals living in High Arctic areas in a changing climate need to develop opportunistic behaviour, using any possibility to save and gain energy. Thus the co-feeding we observed may be an important local behavioural strategy, used during extensive snow events or after terrestrial ice-crust formation, which the Svalbard rock ptarmigan have developed in response to climate variation.

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