



Activity patterns in reindeer with domestic vs. wild ancestry



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ABSTRACT

We analyzed GPS-based activity patterns for two wild reindeer (*Rangifer tarandus tarandus*) herds: Norefjell-Reinsjøfjell with domestic ancestry and larger average body size and Rondane with wild ancestry and smaller body sizes. We compared activity patterns and tested whether these could translate into different energy budgets that in turn contribute to population differences in body weights between the two ancestries. We defined activities and calculated movement rates based on distance moved every 40 min from GPS-fixes during 2005–2007 for 10 females from reindeer with domestic ancestry and 12 females from reindeer with wild ancestry. During May (i.e. calving season), summer and hunting seasons, reindeer with wild ancestry travelled 2.2, 1.8 and 2.1 times further than those with domestic ancestry. Female reindeer of wild ancestry sustained higher movement rates and bigger home range during the seasons from May to the hunting season. While the total daily cost of locomotion in relation to standard metabolic rate (SMR) during bare-ground seasons amounts to 32–37% and 33–48% among reindeer with domestic and wild ancestry, respectively, the daily energy expenditure (DEE) was higher for the females with domestic ancestry because of their higher body weights. Shorter distances travelled in May, summer and during hunt give reindeer with domestic ancestry a compensatory advantage during the growth season translating into bigger body size, compared to reindeer with wild ancestry. Reindeer with both domestic and wild ancestry exhibited nychthemeral activity in all seasons, optimizing activity regardless of daylight. We conclude that the underlying genetic component associated with ancestry is an important driving force for the significant differences in movement patterns, activity and possibly also body weights.

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1. Introduction

The central concept of bioenergetics is that of energy budgets. Herbivores gain energy from the ingestion, digestion, and assimilation of forage. They use energy for physiological maintenance, thermoregulation, and activity. The surplus is allocated to growth and reproduction. Energy budgets themselves are used for comparing evolutionary aspects of life history strategies, behaviour, and productivity of animal species (Hudson, 1985). Most of the increase in energy expenditure of activity results from locomotion

costs, which can be very high for animals walking long distances, breaking trail in deep snow, or climbing slopes (Fancy and White, 1985b). Likewise, increased movement rates over time will reduce optimal time spent feeding and ruminating, thus simultaneously exerting a direct and indirect negative effect on the herbivore's energy budget (Colman et al., 2003).

In Norway, wild reindeer are managed through hunting in several separate herds with different ancestries, from assumed pure wild herds to herds of domestic origin. The herds, numbering from a few hundred to more than 10,000 animals, are distributed in 23 areas (Fig. 1) varying in size from a few hundred km² to more than 8000 km² (Bevanger and Jordhøy, 2004). Reindeer in herds with a domestic ancestry have consistently higher body weights compared

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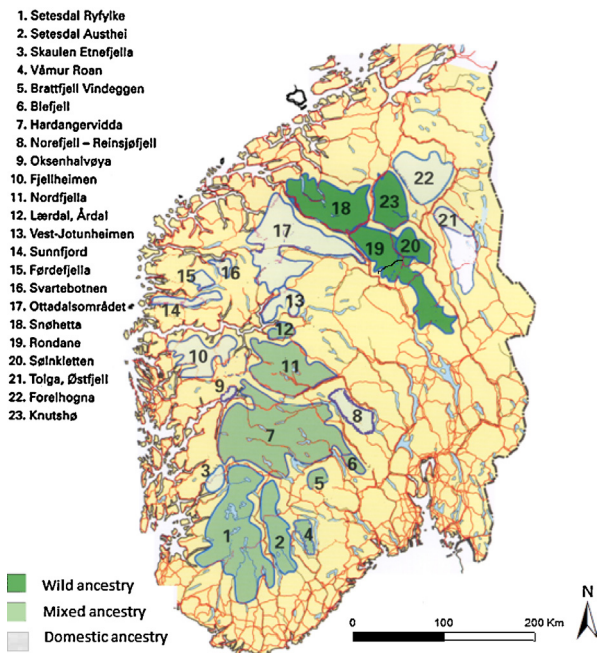


Fig. 1. Distribution of wild reindeer areas in southern Norway; Modified from Andersen and Hustad (2004). The two study areas are Rondane (19) and Norefjell-Reinsjøfjell (8).

to those with a wild ancestry (Reimers, 1997). As the higher body weights also have a cascade effect on life history traits like age at maturity and reproductive rates (Reimers, 1983) and calving dates (Reimers, 1997), it seems relevant to investigate the connections between ancestry, activity and energy budgets within this large herbivore.

Reimers et al. (2012) concluded that reindeer with a predominantly wild ancestry in Norway had a vigilance level two and three times higher than reindeer with a domestic ancestry, indicating a higher level of alertness among reindeer in the former areas. As shown for roe deer (*Capreolus capreolus*) (Weiner, 1977) and moose (*Alces alces*) (Regelin et al., 1981), even a small change in a standing posture more than doubles the energy cost of standing over lying. To test for population level consequences, we needed to go beyond alertness and response levels and investigate the animals' overall activity pattern and energy budgets. Genetic differences could also apply to energy budgets, contributing to reindeer body weight differences recorded in these herds, supplementing an otherwise general pasture quality/density dependent explanation for body weight differences amongst Norwegian wild reindeer herds. Thus, based on previous findings of both genetic and behavioural differences between reindeer with domestic versus wild ancestry (Reimers et al., 2012), we used movement rates to measure activity patterns and then estimated energy budgets for two herds with different ancestries.

Earlier studies show caribou (Maier and White, 1998) and reindeer (Colman et al., 2001b, 2003) to be grazing maximizers, optimizing feeding time regardless of daylight, resulting in polycyclic, nycthemeral feeding rhythms in the absence of disturbances. As reindeer with domestic ancestry maintain a genetically distinct

tameness towards humans as a consequence of domestication (Reimers et al., 2012), we anticipate a different diurnal activity pattern in the two herds. Therefore, we also investigated diurnal and seasonal activity patterns, testing whether reindeer with domestic and wild ancestries exhibited similar activity patterns according to season and daylight.

2. Materials and methods

Reindeer from Rondane and Norefjell-Reinsjøfjell in southern Norway were selected to represent reindeer with a wild and domestic ancestry and behavioural traits, respectively (Reimers et al., 2012). Fifteen female reindeer from Rondane and ten female reindeer from Norefjell-Reinsjøfjell were equipped with GPS collars to measure distance moved every 40 min. Movement patterns were then used to investigate area and seasonal differences in activity patterns (defined below) and energy expenditure/budgets.

2.1. Study areas

The two areas, Rondane (61°53'N; 9°45'E) and Norefjell-Reinsjøfjell (60°25'N; 9°15'E), cover approximately 1441 and 308 km² alpine terrain above 1000 m.a.s.l. respectively and are located in southern Norway (Fig. 1). Large sections of Rondane are national parks under strict management regarding human infrastructure such as cabins, tourist resorts, hydroelectric development, power lines and roads. Recreational activities are extensive in Norefjell-Reinsjøfjell, but moderate in Rondane, both within and outside the national park due to the more remote location, the topography and the less developed hiking facilities and other human infrastructure. Proportion of area with no infrastructure (areas more than 5 km from power lines, roads, cabin areas, etc.) is estimated at 21% in Rondane and 0% in Norefjell-Reinsjøfjell (Granum, 2008). Based on overnight visitors in 2004 to Grimsdalen tourist cabin, central areas were visited by less than 3000 persons in Rondane (Den norske turistforening, unpublished data). Norefjell-Reinsjøfjell has no centrally located tourist cabins and number of annual visitors to the area is estimated by the lead author on basis of cabin areas, trail systems and other human infrastructures to more than 100,000.

Hunting is allowed in both areas (also within the national park) and is the major mortality factor, as wolves (*Canis lupus* L.) are essentially absent from the areas and wolverine (*Gulo gulo* L.), golden eagle (*Aquila chrysaetos* L.) and lynx (*Lynx lynx* L.), although present permanently or as stragglers, exert minor predatory influence.

2.2. Reindeer herds

The Rondane herd has fluctuated between 1200 and 2400 animals during the last 30 years (Wegge, 1997) and numbered 1500–1600 animals during the winter seasons in 2005–2007 (T. Toldnes, personal communication). The herd has always been hunted, except during 1902–1906, when wild reindeer were protected in Norway due to low herd numbers.

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