

INDICATOR
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Reindeer herding

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Reindeer, *Rangifer tarandus L.*, is an animal with a circumpolar distribution that has been a key component of Eurasian high latitude ecosystems for at least two million years. Interactions with humans date from the late Pleistocene onward, and both wild and semi-domestic animals continue to be highly valued by aboriginal and non-native peoples for a diversity of purposes [1–3]. The most productive semi-domestic herds occur in the Sápmi homeland of northern Fennoscandia and the Nenets regions of northwest Russia straddling the Ural Mountains.

As a widespread and dominant ungulate across many tundra and taiga regions, reindeer have a number of effects on ecosystem structure and function. Herded animals move seasonally between summer, winter, and transitional spring/autumn pastures. Their effects on vegetation and soils vary greatly in space and time depending on factors such as altitude/exposure, snow depth, substrate, moisture, prevailing vegetation type,

and most importantly, animal density. Given the diverse suite of factors involved, changes in vegetation associated with grazing and trampling can be remarkably varied spatially yet remain to a large extent predictable. Potential threats facing reindeer populations of Eurasia, and reindeer herding as a livelihood, include rapid land use change, excessive predation, climate change, and ongoing institutional conflicts.

Population/ecosystem status and trends

In Fennoscandia and Russia, carrying capacity models are generally used by the respective nations to manage semi-domestic animals in relation to state-sponsored scientific assessments of range conditions [2, 4–8]. Animal populations have generally increased in the Nenets and

Nordic regions since World War II and are at or near historic highs, although limits have been set in Fennoscandia. This trend has occurred in the Nordic countries in concert with the high-tech modernization of husbandry practices, such as motorized transport for herders and intensive

veterinary care. There are currently approximately 230,000 reindeer in Sweden, 165,000 in Norway, and 195,000 in Finland. In the Yamal-Nenets Autonomous Okrug of Russia, the number of reindeer has increased steadily since World War II from approximately 300,000 to around 610,000 animals today, despite the conspicuous absence of mechanized transport [9, 10]. In Finland, in particular, the negative effects of climate change, such as increasing frequency of rain-on-snow events which makes natural food sources less accessible, are offset via supplemental feeding of animals from January to April. In the Nenets Autonomous Okrug of Russia, there have been recent instances of extensive ice crusts on snow in which many animals died, yet herders have not expressed serious concern regarding weather or climate [11].

Strongly linked to carrying capacity is the concept of 'overgrazing' and that due to the high animal densities sustained over several decades, many rangelands across northern Eurasia are considered to be in poor condition [4, 12]. For herders, the concept of 'overgrazing' does not exist and, therefore, it is not recognized by them [13]. Lately some scientists have also asserted that it is extremely difficult to make a link between grazing impacts and animal performance [14, 15]. A recent study from Sweden also found no negative relationship between animal condition and either animal density or herd growth [16].

With regard to biodiversity, the evidence for the influence of reindeer is complicated and the results mixed. This is due to the fact that grazing may either increase or decrease vascular and/or non-vascular plant species richness, depending on factors such as grazing intensity and nutrient availability [15, 17–19]. There should be some caution against focusing too much on diversity indicators in the context of grazing and conservation goals since the various parties involved may be biased toward the protection of different species or plant groups [15, 18]. The standard indices of biodiversity are also equally influenced by rarities and trivial species [20]. One recent study in northernmost Fennoscandia concluded that reindeer are important for regional biodiversity as their presence seems to favor rare and threatened plants, at least on relatively rich dolomitic substrates [20]. As tundra/taiga vegetation has co-evolved to a large extent with important factors like reindeer (and fire), it is to be expected that biodiversity effects will be somewhat cyclical in response to the periodicity of these ecosystem drivers.

The trampling associated with grazing (Figure 18.1) is also an important driver for below ground impacts. Although changes in soils and surface waters are typically less apparent than those occurring in vegetation structure and cover, they may be critical for long-term ecosystem dynamics [21]. Trampling seems to be a key mechanism

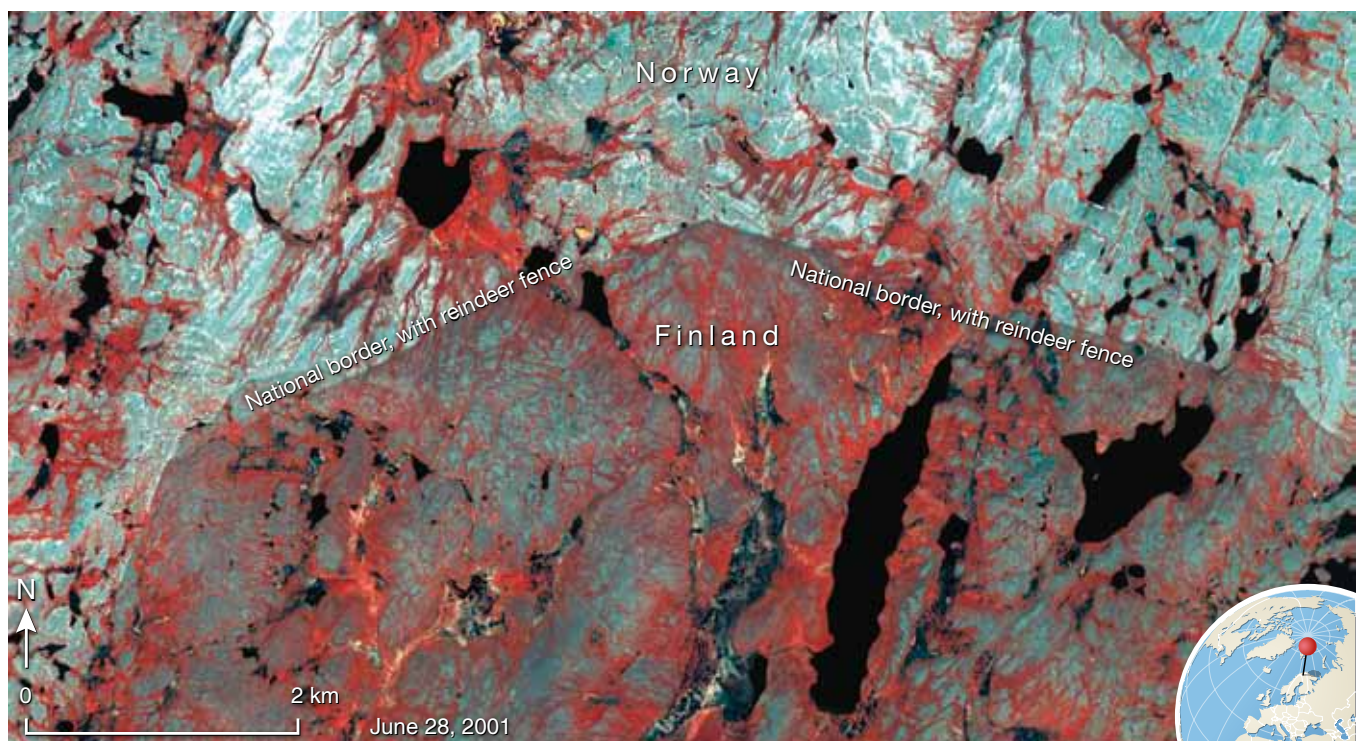


Figure 18.1: A very high-resolution false color Ikonos-2 satellite image of Jauristunturit in the border zone shared by Norway and Finland. Image acquired 28 June 2001. The main vegetation type is lichen dominated tundra heath with dwarf shrubs. The difference in whiteness is due to lichen coverage, and the national border with reindeer fence visibly divides the area. The northern portion is Norway, where fruticose lichen coverage is higher. This is a consequence of different pasture management. The Norwegian side is used only in late winter when there is snow cover and no grazing or trampling occurs in summer. The Finnish area is used in early summer, when vulnerable lichen mats have been progressively trampled over several decades [25].

for the deceleration of soil carbon cycling [22]. Studies in upland tundra heaths in Norway and Finland have documented degradation of the organic layer, followed by significant leaching away of essential plant nutrients, a reduction in plant available water, and consequently soil

fertility [22, 23]. An intact organic layer, similar to a thick lichen or bryophyte mat, serves to insulate the mineral soils beneath and their removal can result in significant and long-term increases in summer and decreases in winter soil temperatures [23, 24].

Concerns for the future

There is a great deal of geographic variation in the environmental and anthropogenic drivers that affect modern reindeer-based, socio-ecological systems across Eurasia [26]. In Fennoscandia, there is a danger that with animal populations so high, even supplemental feeding to buffer against losses may become prohibitively expensive. Other significant stakeholders include local residents, hydroelectric power facilities (including large artificial lakes), tourism/recreation, mining, and nature conservation/protected areas. On top of this, the annual losses to predators continue to increase [27–29]. Given the increasing costs, competition from other users for land, restrictions on controlling predators, and the overall risks involved, may be influencing the number of owners and families involved in reindeer management which continues to decline in Fennoscandia [1].

In Russia, the main threat for the most productive post-Soviet reindeer herding areas in the Nenets and Yamalo-Nenets Autonomous Okrugs is the rapidly accelerating oil and gas extraction (Figure 18.2). Herders remain in favor of development overall, since they receive tangible

benefits such as health care, assistance with transport, the ability to barter for goods on the tundra, and a few jobs [2, 30–32]. However, they fully recognize that the current pace of development will render the official objective of mutual coexistence impossible if their concerns are not properly addressed through meaningful consultation and accompanying action [31, 33]. As such, they continue to rank hydrocarbon development as a more serious ongoing and future problem than climate change [11]. In general, industrial impacts tend to decrease the biodiversity of tundra vegetation [34, 35].

The distribution of wild versus semi-domestic populations will remain fluid given the many places where their ranges directly overlap or at least come into close contact [1, 6]. The increasing ratio of private to state-owned animals in Russia, a trend which began in the waning days of the Soviet Union, may well accelerate [2, 36]. At the same time, pressure to reduce herd sizes will most likely remain in place within both Fennoscandia and Russia as long as state-funded management institutions continue to perceive high numbers of animals as ecologically unsustainable.



Figure 18.2: A false color Quickbird-2 satellite image of a portion of the Bovanenkovo Gas Field on the Yamal Peninsula in West Siberia. Image acquired 4 July 2004. The construction phase began in the late 1980s. From that period onward there remain visible signs of extensive off-road vehicle traffic across the terrain. Many of those tracks have naturally revegetated and now appear as bright red, indicating dense grass- and sedge-dominated vegetation. The road network was built in the mid-1990s, which has reduced off-road traffic significantly. However, infrastructure blocks segments of migration routes for Nenets and their reindeer herds, and pasture quality can be negatively affected by road dust, petrochemicals, trash left on the tundra, and even feral dogs abandoned by workers [25].