

Impacts of reindeer on arctic and alpine vegetation



Are reindeer harming the mountain vegetation of Northern Scandinavia? Or is their grazing, on the contrary, essential for maintaining the diversity of the montane flora? Mistra EviEM has attempted to achieve unequivocal answers by conducting a systematic review.

Small average effects

The impact of reindeer on vegetation in arctic and alpine areas is not fully known. This hampers both the management of wild and semi-domesticated reindeer populations and the preservation of biodiversity.

Public opinion on the impacts of reindeer grazing has shifted during the last few decades, not least in Sweden. In the 1990s, Scandinavian mountain regions were widely seen as being overexploited by reindeer, but a common view today is that reindeer grazing benefits the montane vegetation and enhances its species richness. However, there is still no scientific consensus on how important reindeer really are for the diversity of alpine or arctic vegetation. Some studies have found the impacts of reindeer grazing to be strong, but others suggest that they are relatively minor.

To synthesise the available evidence, we have undertaken a systematic review, assessing 41 studies of vegetation exposed to different levels of reindeer grazing. Almost two thirds of these studies had been conducted in Norway, Sweden or Finland. The others were undertaken in Svalbard, Greenland, Canada, Alaska or Russia.

Some of the studies compared herding districts with different numbers of reindeer, but most of them were designed as experiments where small areas had been fenced in to exclude reindeer entirely; comparisons were then made of vegetation inside and outside the fences.

Overall, the studies report highly varied responses of vegetation to reindeer. A certain group of plants may show a positive response at some sites, but a negative response elsewhere. The average effects are small, but when we combined data from different studies, some patterns nevertheless emerged:

- We could confirm the generally held view that **lichens** are vulnerable to grazing and trampling by reindeer.
- **Mosses** did not seem to be sensitive to such exposure.
- We saw no significant overall effect of reindeer on **grasses** and similar plants, indicating that these supposedly grazing-tolerant species are not always promoted by reindeer grazing.
- **Herbs (forbs)** are reduced by exposure to reindeer, although they usually do not occur very frequently in arctic and alpine areas. This indicates that herbs are highly selected by reindeer and also vulnerable to grazing.
- We did not find strong evidence that **shrubs** generally are reduced by reindeer.
- The **species richness** of vascular plants was found to decrease with increasing grazing pressure. This was particularly evident in cold climates, where the productivity of vegetation tends to be low.

Large variation from case to case

Many individual studies reported effects that were significantly more positive or negative than the overall average. There is not sufficient information to explain this variation, but there may be many reasons for it. One reason could be that the global distribution of reindeer covers large environmental gradients, ranging from low-productivity to high-productivity sites, from dry to wet soils, and from forests to high alpine tundra. All different vegetation types that occur here cannot be expected to respond in the same way to grazing and trampling. Variations in reindeer management systems may be another reason for the heterogeneity of our results.

Our review has gathered a large body of data on vegetation responses to reindeer grazing, but we still have to conclude that the evidence base is too weak and scattered to inform environmental policy or reindeer management in a detailed way. The available studies are not numerous, extensive and representative enough that they can be used as a basis for specific recommendations regarding reindeer ranges in Sweden, nor in the circumpolar region as a whole. It is unlikely that further studies can improve the evidence base much, unless they adopt standardised ways of quantifying reindeer impacts.

However, an important point that we can make is that vegetation responses to reindeer grazing are context-dependent – they do not only depend on grazing itself but also on many other factors. This suggests that no single conclusion or recommendation on reindeer and their impact on vegetation can be universally applicable.

What is a systematic review?

In this review, we used a systematic approach to synthesise available evidence on the impacts of reindeer grazing. A systematic review is characterised by meticulous planning, methodical procedures and a transparent, complete documentation of all assessments carried out in the course of the work.

How this review was conducted

Originally proposed by the Swedish Environmental Protection Agency, this systematic review has been initiated and financed by the Mistra Council for Evidence-Based Environmental Management (EviEM). The review was conducted as a project by a specially appointed team of researchers chaired by Jon Moen, professor of ecology at Umeå University. The project was managed by Claes Bernes, EviEM.

EviEM

The Mistra Council for Evidence-Based Environmental Management (EviEM) strives to ensure that environmental management in Sweden is informed by the best possible scientific evidence. Through systematic reviews of relevant research, we aim to improve the basis for decisions in environmental policy. EviEM is funded by the Swedish Foundation for Strategic Environmental Research (Mistra) and hosted by the Royal Swedish Academy of Sciences. It is financially and politically independent.

Free access to full report

A more detailed summary of this systematic review is available at the EviEM website (www.eviem.se/en/projects/Reindeer-grazing). The full report on the review can be downloaded there too. The report has also been published in the *Environmental Evidence* journal (www.environmentalevidencejournal.org/content/4/1/4).



Reindeer in Sarek National Park, northern Sweden. (Photo: Oskar Karlén)