UMEÅ UNIVERSITET

Long-Lasting Ecological Legacies of Reindeer on Tundra Vegetation

Dagmar D. Egelkraut

Akademisk avhandling

som med vederbörligt tillstånd av Rektor vid Umeå universitet för avläggande av filosofie doktorsexamen framläggs till offentligt försvar i Carl Kempe salen, Kemiskt Biologiskt Centrum (KBC), December 15, kl. 09:30.
Avhandlingen kommer att försvaras på engelska.

Fakultetsopponent: Professor René van der Wal,
The Institute of Biological and Environmental Sciences,
University of Aberdeen, Aberdeen, Scotland.

Department of Ecology and Environmental Science

Organization
Umeå University

Document type
Doctoral thesis

Date of publication
24 November 2017

Department of Ecology and Environmental Science

Author
Dagmar D. Egelkraut

Title
Long-Lasting Ecological Legacies of Reindeer on Tundra Vegetation

Abstract
Reindeer can have strong effects on the plant species composition and functioning of tundra ecosystems, and often promote a transition towards a graminoid-dominated vegetation type. As a result, they influence many ecological processes, such as nutrient dynamics, soil biotic composition and functioning, and carbon storage. Several studies suggest that the effect of reindeer on vegetation may follow predictable patterns and could induce an alternative stable vegetation state. However, little empirical data on the long-term stability of reindeer effects on vegetation exist, as it is inherently challenging to study these ecological processes experimentally on a sufficiently long timescale. The main objective of this thesis was therefore to gain a better understanding of the long-term ecological processes following reindeer-induced vegetation shifts.
In order to gain a more mechanistic insight in what initially drives this transition, I used a field-based grazing simulation experiment which allowed me to test the relative contribution of reindeer-related activities to initiating the shift from moss and heath- dominated tundra, towards a graminoid-dominated vegetation state. Additionally, I studied the long-term ecological stability following such a vegetation shift. I did this by addressing historical milking grounds (HMGs): sites where high reindeer concentrations associated with historical traditional reindeer herding practices induced a vegetation transition from shrubs towards graminoids several centuries earlier, but which were abandoned a century ago. Studying HMGs allowed me to address: 1. The potential stability of reindeer-induced vegetation shifts; 2. The ecological mechanisms contributing to the long-term stability of these vegetation shifts; and 3. How such long-lasting vegetation changes influence soil carbon- and nutrient cycling.
I found that trampling by reindeer is an important mechanism by which reindeer cause vegetation change. Addressing HMGs further revealed that this vegetation change can be hightly persistent, as the studied HMGs showed only a low encroachment at the surrounding borders in the last 50 years. The vegetation in the core areas of all studied HMGs had remained strikingly stable, and were hardly invaded by surrounding shrubs. Interestingly, soil nutrient concentrations and microbial activities were still different from the surrounding area as well, and even comparable to actively grazed areas. Even after many centuries of changed vegetation composition and soil processes, there was no difference in total carbon sequestration. This suggests that the environmental conditions for microbial decomposition were more important than vegetation composition for the soil carbon stocks, in our study site.
After studying the contemporary habitat use of HMGs by reindeer and other herbivores, investigating the potential plant-soil feedbacks mechanisms and detailed soil analyses, I concluded that several ecological mechanisms contribute to the long-term stability of HMGs: first, the altered soil biotic and abiotic conditions appear to have a stronger advantage for HMG vegetation than for the surrounding tundra vegetation. Furthermore, I found a clear browsing preference of small rodents on single shrubs proliferating in HMGs, causing a strong limitation on shrub expansion. Moreover, the dense established sward of graminoids likely poses a strong direct competition for space and nutrients, hindering seedling establishment. Finally, I conclude that HMGs are highly stable on relevant ecological timescales, and propose how the concepts of historical contingency and ASS can be applied to understand stability of these reindeer-induced vegetation transitions.

Keywords
Alternative stable state, Herbivory, Historical contingency, Nutrient cycling, Plant-herbivore interactions, Plant-soil feedbacks, Rangifer tarandus*, Reindeer herding, Traditional land use, Tundra vegetation.*

Language
English

ISBN
978-91-7601-788-3

Number of pages
33 + 4 chapters