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The role of plant–soil feedbacks in stabilizing a reindeer-induced vegetation shift in subarctic tundra

Egelkraut, Dagmar; Kardol, Paul; De Long, J.; Olofsson, Johan

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Plant-soil feedbacks contribute to stability of historical vegetation shifts induced by reindeer.

Dagmar Egelkraut, Paul Kardol, Jonathan R. De Long, Johan Olofsson

Herbivores can have large impacts on the composition and functioning of plant communities, and may even drive the vegetation towards a different state.



*Photo
provided by
authors*

For example, we know that grazing by reindeer can result in a shift from relatively unproductive dwarf shrub vegetation to a more nutrient rich vegetation type dominated by herbaceous plants.

However, how stable such changes are over longer timescales is often difficult to determine. We studied so-called historical milking grounds (HMGs) in northern Sweden: these are old reindeer herding sites that were subject to high numbers of reindeer for many centuries, up to a century ago. The high reindeer concentrations in the past caused the vegetation to shift locally to small meadow-like patches which are still clearly discernible in the otherwise heath-and shrub dominated tundra, a century after their active use.

These sites provide an excellent place to ask *why* the vegetation remained so stable over time.

One possible mechanism is the interaction with the biotic and abiotic components of the soil. For example, sometimes the associated soil biota, such as mycorrhizal fungi, are most beneficial for the current plants growing in it. This would make it harder for other



Historical milking grounds (HMGs) show a strikingly different vegetation type, even a century after they were last used for reindeer herding.

plant species to invade, and thus help stabilize the current vegetation.

We tested this assumption by growing seedlings representative of both HMG vegetation and control vegetation in soils from HMGs and control sites, in a climate chamber. By sterilizing the soils, we could separate the biotic from abiotic drivers, to try and understand the different growth responses of plants in different soils.

We found that, although both the typical control- and HMG plant species grew well in HMG soils due to the increased nutrient availability, the microorganisms in the HMG soil provided an additional benefit for the typical HMG plant species. This was mostly the case when soils from nutrient poor habitats (heath) were considered.

In summary, we conclude that positive interactions between plants, soils and soil organisms can explain the long-term stability of vegetation shifts that were caused by reindeer many centuries ago.