



## Critical tipping points of reindeer management in Finland

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Economic activities are intensifying in the Arctic, bringing along ecological and socio-economic impacts on traditional livelihoods. In recent decades Fennoscandian reindeer management has experienced land use conflicts due to the exploration of natural resources, forestry, tourism, hydropower and other land uses. This study introduces an approach to better understand the possibilities for co-existence of economic activities and traditional livelihoods sharing the same operational space and consider policies and practices to reduce potential conflicts. It is part of the Nordic Centre of Excellence called “Reindeer Husbandry in a Globalizing North (ReiGN)”. We are specifically interested in how climate change and land use change are affecting the preconditions for reindeer management in Finland. Research is lacking on the cumulative impacts of these changes, and on the tipping points that should be better understood in order to ensure that this traditional livelihood will remain viable.

Social-ecological systems (SESs) characterized by reindeer management in Finland lie at the nexus of regionally significant ecosystem services. Therefore, issues such as fragmentation of pastures due to industrial infrastructure projects or climate change, and related tundra shrubification affect the quality of pastures. The basis of successful reindeer management depends on the quantity, quality, and accessibility of forage. However, limited access to certain pasture resources in space and time often constrains the amount of available forage as such. These are some of the known factors that determine the tipping points of this livelihood. With this as our basis, we take a systems approach and analyze the cumulative impacts affecting the critical tipping points ranging from the perspective of environmental, social and economic transformations. We analyze land use over the entire reindeer management area in Finland, which covers 36% of the country’s total land area, within which herding management practices are exemplified by considerable regional differences. We further analyze climatic factors in recent decades over the same regions.

Our material consists of a combination of quantitative and qualitative data on: (i) climate; (ii) history of forestry; (iii) remote sensing of pastures; (iv) herders’ experiences and perceptions of risks and critical thresholds; (v) herders’ and other stakeholders’ perceptions of different land uses; (vi) map-based data on disruptive factors according to different land uses; (vii) a questionnaire survey data on climate change; and (viii) winter fodder demand. We use a mixed-methods approach to analyze the data.

We argue that because the distributions of land use and exposure to climate change exhibit large regional variations, one should examine these differences from the viewpoint of herding practices that vary geographically but also culturally together in order to understand critical tipping points. We hypothesize that the tipping points are dependent on the sum of cumulative impacts, and consisting of ecological, socio-economic and institutional interactions.