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Social-ecological feedbacks between climate, reindeer and people - contributions to climate change adaptation?

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The circumpolar tundra is experiencing significant transformations as a consequence of climate change. The anticipated changes include greening of the tundra due to a latitudinal and altitudinal progression of the tree line and range expansion of shrubs. In Northern Fennoscandia, reindeer husbandry by the indigenous Sámi people depends on large, seasonally variable grazing grounds, including the tundra. We demonstrate relationships between different vegetation types and climate conditions in Northern Fennoscandia. A generalized, seamless vegetation type map with 100 m grid, based on Landsat TM/ETM+ satellite images and various ancillary data, allows examination of vegetation types in relation to current climate conditions (1950-2000). Downscaled GCMs with different RCPs for 2050 and 2070 allow estimating future vegetation changes. Recently, the potential of herbivores has been recognized in slowing down this regime shift of vegetation composition with its feedbacks e.g. on the atmospheric energy balance, biodiversity and local livelihoods that depend on the tundra ecosystem. However, ecology alone is not the answer. We need comprehensive scenarios for adaptive ecosystem management for this social-ecological system to slow down the unfavourable impacts of climate change and excessive grazing pressure by reindeer in space and time, as well as across country borders. Possible adaptations could encourage the design of new institutional structures, and thus contest the legal background governing reindeer husbandry in the Nordic countries today. Designing such policy options for socially desirable and ecologically reasonable decision making, as well as navigating trade-offs inherent in flexible grazing patterns, require careful scenario analysis and acceptance by a variety of land users. A clear understanding of which values should be prioritized in relation to what ecosystem dynamics over what time scales is essential.