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Tamrein i Hammerfest (Semi-domesticated reindeer in Hammerfest)
By Per Harald Olsen
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Climate change and Saami reindeer herding in Norway and Sweden – impact of climate change on slaughter profits

Introduction

The impact of climate change is already evident in many natural resource-dependent Arctic societies, and perhaps especially for indigenous communities (Furberg et al. 2011). Saami reindeer herders in Norway and Sweden live close to nature and are directly exposed to the effects of climate change. Reindeer graze on natural pastures throughout the year following a migratory pattern between winter and summer grazing areas (Johannesen and Skonhoft 2009). This implies that climate change affects reindeer herding conditions both in the summer and winter grazing seasons. The main changes to the Arctic climate include rapidly shifting warm and cold periods during the winter coupled with a year-round increase in precipitation intensity, which is expected to increase the frequency of wet weather, deep snow, and ice crust formation (Kelman and Næss, 2019). Winter grazing conditions are limiting factors for the survival and productivity of reindeer (Tveraa et al. 2003). Difficult winter

conditions, such as ice layers, are found to lower animal weights, the number of calves born and surviving to the following spring, and adult survival (Helle and Kojola 2008; Tveraa et al. 2003).

On the other hand, increased temperatures may also lead to earlier snowmelt and the onset of spring and improved plant productivity (ACIA 2005). The spring, summer and autumn grazing season is when reindeer gain weight, and the earlier onset of spring can provide additional forage and increase reindeer weights (Aikio and Kojala 2003; Albon et al. 2017) and reproductive success (Aikio and Kojala 2003).

Moreover, climate change is just one of several external factors causing challenges and concerns in Saami reindeer herding. The herders describe that the ability to adapt to climate change is restricted by loss of pastures through various forms of land use change, such as forestry, settlement, and industrial development (Fohringer, et al. 2021; Tyler et al., 2021; Uboni et al. 2020). A recent survey we conducted among Saami reindeer herders in Norway and Sweden (unpublished material) reveals that wind farm expansion is the main factor causing worry among reindeer herders in Norway and is also a factor causing worry in Sweden. Wind farms are usually established in remote areas and may lead to fragmentation and disturbances in reindeer grazing areas (Eftestøl et al. 2023). Since the 1990s, there has been an increase in the number and size of wind farms motivated by governmental policies and subsidies to increase the production of renewable energy to meet national targets for reduced carbon emissions (Eftestøl et al. 2023). Thus, while such measures may reduce national carbon emissions, they may lead to further reductions of reindeer grazing areas.

This brief presents some predictions on how projected future climate scenarios may affect the economic returns in Saami reindeer herding in Norway and Sweden, considering different geographical areas and focusing on the relative importance of future changes in winter and summer climate conditions. The brief also gives insights into the possible impacts of wind farm expansions on the economic returns of reindeer herding. The four study areas are illustrated in Figure 1.

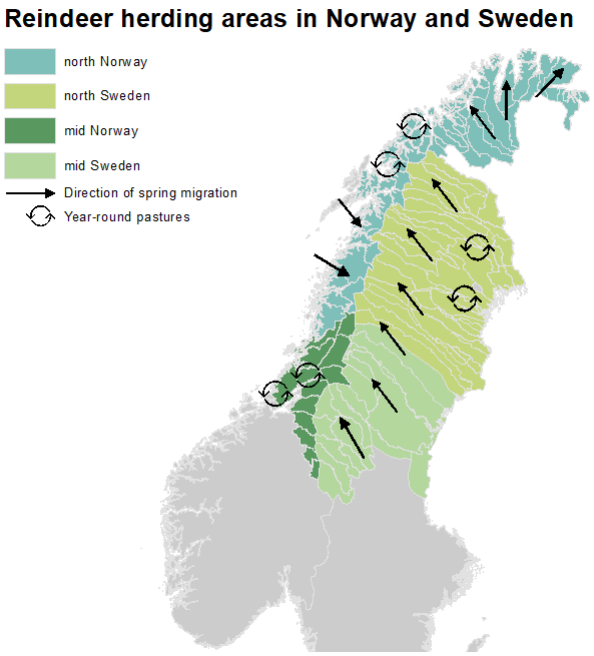

Figure 1 Reindeer herding regions and reindeer herding communities in Norway and Sweden, respectively. The colors indicate the four simulation areas. Arrows indicate spring migration and year-round pastures (Source: Pape and Löffler, 2012)

Materials and Methods

We use a bioeconomic model that includes a climate-reindeer weight relationship and differentiate between winter and summer climate conditions. We estimate the climate-

weight relationships using historical data on reindeer weights and various climate factors. We then insert future climate estimates into the bioeconomic model and apply the model to simulate possible future economic effects on reindeer herding using climate projections from the CMIP6 multi-model dataset (Eyring et al. 2016). In addition, we considers the case of establishing wind farms in reindeer herding areas to fulfill national goals on reduced CO2 emissions. We do so by allowing for wind farms to reduce the carrying capacity of reindeer pastures and then measure the tradeoff between dampened climate change and reduced pasture areas.

Results

EMPIRICAL ESTIMATIONS

We find that onset of spring one day earlier than average (May 10th) is associated with 28.7 grams (0.09%) increase in the slaughter weights of adult females. Onset of spring before May is associated with slaughter weights that are 600 grams higher than the mean, whereas onset of spring after May is related to a decrease in slaughter weights by 800 grams. One more day with icing conditions is related to a decrease in slaughter weights of adult females by 67 grams (0.22%).

NUMERICAL SIMULATION OF THE FUTURE

The model is simulated for three potential future climate scenarios: the Paris agreement scenario (SSP 1-1.9), an intermediate scenario (SSP 2-4.5) and the business-as-usual (BAU) scenario (SSP 5-8.5). The scenarios are compared to a benchmark simulation without climate effects. Although the results vary across geographical areas, there is a general trend where earlier spring and slightly less icing lead to higher present value slaughter profits in the Paris scenario.

Figure 2 and 3 illustrate the 5-year moving average current value slaughter profits for the intermediate and BAU scenario, respectively. The figures indicate how the impact of climate change varies across areas. For most areas, the positive effect of earlier spring dominates the negative impact of increased icing in the Intermediate scenario. However, all but mid-Sweden have a clear downward trend over time. Finally, all areas are worse off due to increased icing in the BAU scenario.

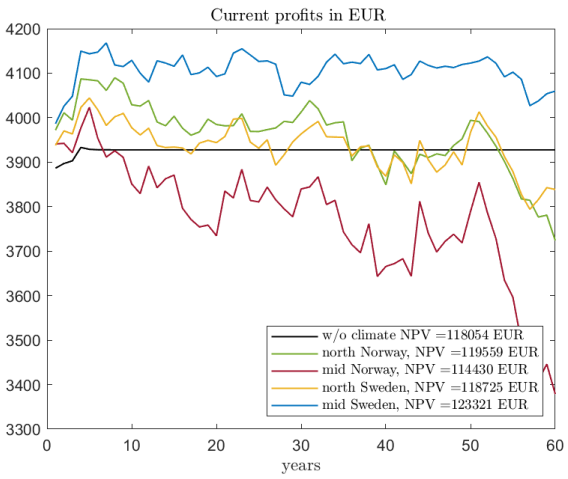

Figure 2 5-year moving average optimal current value profits for the intermediate scenario, all areas.

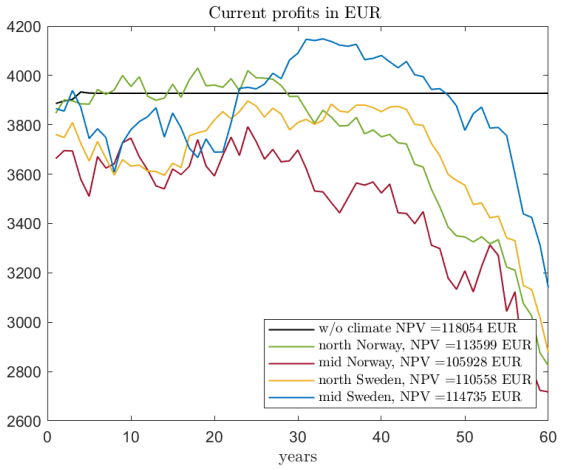

Figure 3 5-year moving average optimal current value profits for the BAU scenario, all areas.

When we reduce carrying capacity to imitate a loss of pastures due to wind farm expansion, it is optimal to reduce the herd size to maintain the same slaughter weights. However, as harvesting rates remain similar, this leads to a loss in profits. Nevertheless, ending up in the intermediate scenario at a 5 % reduction in carrying capacity (e.g., because the pasture area is used for green energy production) leads to a smaller reduction in profits than maintaining the carrying capacity level but ending up in the BAU scenario. That said, it is important to note that these results only consider slaughter profits. The value of cultural loss for the Saami herders would be much greater, especially if the cultural value is attached to the size of the herd, but also due to the cultural and historical values attached to the specific pasture area that is lost. If we consider a 25% reduction in carrying capacity, the loss of pasture area is more detrimental to slaughter profits than any of the climate change scenarios.

Policy Recommendations

Future policies to compensate for the impact of climate change must consider that mitigation efforts have collateral impacts that differs across areas and between people of different cultures.

The study provides new knowledge and insight to the ongoing conflict concerning wind turbines, climate, and reindeer husbandry. And when considering the placement of industrial development such as wind turbines it is important to keep in mind that reductions in carrying capacity related to pasture loss appears to be more detrimental to the economics of reindeer husbandry than climate change.

In future work, the project will include cultural values of reindeer husbandry to comprehend the full impact of climate change and climate change mitigation efforts on Saami reindeer herding.

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