Project information

Participants

Project leader(s)/institutions: **Bård-Jørgen Bårdsen** (bjb@nina.no), Norwegian Institute for Nature Research (NINA; www.nina.no), Tromsø, Norway.

Project participants/institutions (all are Fram Centre member institutions): **Marius Warg Næss** (marius.naess@niku.no), Norwegian Institute for Cultural Heritage Research (NIKU; www.niku.no). **Per Fauchald** (per.fauchald@nina.no), NINA, Tromsø, Norway. **Øystein Holand** (oystein.holand@nmbu.no), Norwegian University of Life Sciences (NMBU; www.nmbu.no), Ås, Norway. **André Frainer**[1] (andre.frainer@nina.no), NINA, Tromsø.

Administrative responsible: **Cathrine Henaug** (Cathrine.Henaug@nina.no), NINA, Tromsø.

Notes: [1]Frainer was not a partner on the application, but he has been included in the project due to his extensive expertise in the application of *Structural Equation Models* (SEMs). Moreover, Frainer was not employed by NINA at the time when we developed the project proposal.

Summary of Results

This report covers the last year of a three-year project, and due to unforeseen and uncontrollable factors, the project results have been constrained because we are still awaiting access to parts of the necessary official data administrated by the *Norwegian Agriculture Agency* (NAA). The timeline for the process of getting access covers >2.5 years: beginning on the 7th of April 2017 when we first requesting access to the official data on the reindeer husbandry (e.g. herd size and production measures like number of calves produced and slaughtered). As of the 17th of November 2019, we are still awaiting access to the economic parts of the data at the siida-share-level although a signed agreement between NINA and NAA granted us access the data in early November 2018. Moreover, NAA sent an e-mail to the flagship leader on January the 16th 2019 informing her that partners in the project would get the data no later than the February 8th. We did, however, get some of the data at the siida-share-level, and all the district-level data in the winter/spring and late summer 2019, respectively. For all the data we have been granted access we have:

-    Re-arranged and organized the data from numerous separate tables, i.e. the format the data was given to us from NAA, forming the databases we need in order to run statistical analyses.

-    Merged these data with satellite-derivate measures of vegetation growth and meteorological data (gridded data on temperature and precipitation) for all the reindeer herding districts in Norway (details provided in previous year's reports).

-    Manipulated the data in order to create the necessary variables needed in our analyses, such as e.g.: vegetation growth, extracting area size (km^2) in order to calculate density (animals km^{-2}), latitude and longitude for the centre of each district, as well as extracting information for our environmental variables at various time-lags.

We have recently managed to get the district-level data completed and ready for statistical analysis (Fig. 1a show our design for one example district). Based on this data set, we have ran some preliminary analyses using SEM, which allows the partitioning of direct and

indirect effects in complex data sets. As got we these data from NAA on August the 8th, we have not been capable of finalizing the analyses. Instead we have focused on the 'vegetation-climate-harvest-part' of the proposed SEM: i.e. we have explored the potential effect of precipitation and temperature on vegetation phenology (rate of spring greening, spring occurrence [day of the year], maximum plant biomass during summer, rate of autumn de-greening, autumn occurrence [day of the year], length of plant growing season [autumn÷spring occurrence]). The preliminary SEM-results shows that:

1)   Climate (a latent containing the variables precipitation and temperature in April and May) had direct negative effects on vegetation.

2)   Vegetation had a direct negative effect on population growth.

3)   Harvest did to our surprise not have any impact of population growth rates.

The implication of preliminary results is that climate has an indirect positive effect, which acts through vegetation, on the population growth of semi-domestic reindeer in Norway (Fig 1b,c; the reported values are level of statistical significance (p-values) and the correlation coefficients (r)]. We will continue to work on running the SEM, as outlined in the proposal and as soon as we get the final data from NAA we will run a SEMs at this siida-share-level as well.

Unfortunately, we have spent countless hours on following up our request to NAA this year as well. As soon as all these data sources are in place (we are in dialogue with NAA and they have promised to deliver the data to us as soon as possible), we are ready to run the analyses on the siida-share-level as well, and to produce the outlined publication (see below for details).

Master and PhD-students involved in the project

Not relevant

For the Management

The knowledge generated from this multidisciplinary project will be relevant for informing national/regional policy makers and reindeer herders, and for developing an ecologically/economically sustainable reindeer husbandry, which is important for the Norwegian Government. In this perspective, our goal of disentangling the relative importance of social and ecological factors (and potential interactions between such factors) is challenging yet important. Our analyses also include another important – yet easily forgotten – perspective as we want to assess how various socio-ecological factors affects the reindeer husbandry at different levels of social organization (siidas-hare, siida and district).

Published Results/Planned Publications

Bårdsen, B-J, MW Næss, A Frainer, P Fauchald & Ø Holand. In prep. Socio-ecologic modelling of reindeer population dynamics at multiple spatial scales using a Structural Equation Modelling approach.

Communicated Results

As we only have produced preliminary results so far, we have not communicated any results yet. Nonetheless, we have an agreement with the NAA to present our results to them as soon as we get the analyses done.

Interdisciplinary Cooperation

Project team consists of three ecologists and one anthropologist.

Budget in accordance to results

We were granted 450 000 NOK from Fram Centre. In addition we have spent 213 715 NOK in-kind from the partner institutions (25% of the man-hours for NINA- and NIKU-staff) as well as money from the Nordforsk funded project "Reindeer husbandry in a Globalizing North – resilience, adaptations and pathways for actions – A Nordic Centre of Excellence" (ReiGN; project number: 76915).

Could results from the project be subject for any commercial utilization
    No
Conclusions

The overall aim of the project to use SEMs to assess the relative influence of ecological and social factors in shaping population dynamics of Norwegian semi-domestic reindeer at several levels of social and administrative organization has merit. More importantly, this approach will produce new knowledge that is of importance for the management of this system.