

Project information

Keywords

Ecology; Anthropology; Environmental science; Resource management

Project title

Socio-ecologic modelling of reindeer population dynamics at multiple spatial scales using a Structural Equation Modelling approach

Year

2017

Project leader

Bård-Jørgen Bårdsen

Geographical localization of the research project in decimal degrees (max 5 per project, ex. 70,662°N and 23,707°E)

Approx. extent of the Norwegian Reindeer Husbandry (in °N, °E): North (71.18552, 25.67560); South (61.87132, 12.17962); East (69.57264, 30.95326); and West (63.87732, 9.83851).

Participants

- **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.
- **Matthew Gwynfryn Thomas** (matthew.thomas@nina.no), NINA, Tromsø & NIKU, Tromsø (postdoc who terminated his contract in the autumn and moved back to England).
- **Øystein Holand** (oystein.holand@nmbu.no), Norwegian University of Life Sciences (NMBU; www.nmbu.no), Ås, Norway.

Flagship

Terrestrial

Funding Source

The Terrestrial Flagship's WP3 ('Tilpasningskapasitet i lokalsamfunn og urfolk').

Summary of Results

Spatiotemporal fluctuations of biological populations are caused by a multitude of factors—making it challenging to single out the impacts of a single factor. We proposed to use Structural Equation Models (SEMs), or path analysis, 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. One of the advantages of applying SEMs is that this opens up the possibility to quantify indirect and direct effects of various factors in shaping important characteristics of population and herd dynamics (focusing on growth rates and density/abundance). To our knowledge, this has never been attempted in the Norwegian reindeer husbandry, and there is much to gain from applying this approach—and to compare our results with previous studies. This is pertinent as the reindeer husbandry consists of large contrasts, and consists of several levels of organization where we *a priori* expect the relative importance of various factors to vary. Previous ecological studies have focused on the district-level, revealing the interesting result that the effect of direct regulation and climate depended on harvest and access to poor vs. good winter pastures. We propose to expand this by assessing herd dynamics at the level of the siida share (licensed owners) and siida, which is a level of social organization that has received legal recognition since the previous studies were performed, in addition to perform new analyses at the district-level.

In line with the stipulated progress (this report cover the first year of a two-year project), the project is *en route* as we have: 1) sent applications to get access to official statistics on the reindeer husbandry; 2) extracted and ran pre-analyses of satellite-derived data on vegetation biomass and gridded/interpolated meteorological data on temperature and precipitation across all reindeer districts in Norway (Fig. 1). We are still awaiting an answer on access to the official data on: the reindeer husbandry (now under consideration at the *Ministry of Agriculture and Food*; MAF); and predator presence/numbers. As soon as all these data sources are in place, we are ready to run the analyses. In the original proposal, this was planned to take place in the end of 2017 and early 2018.

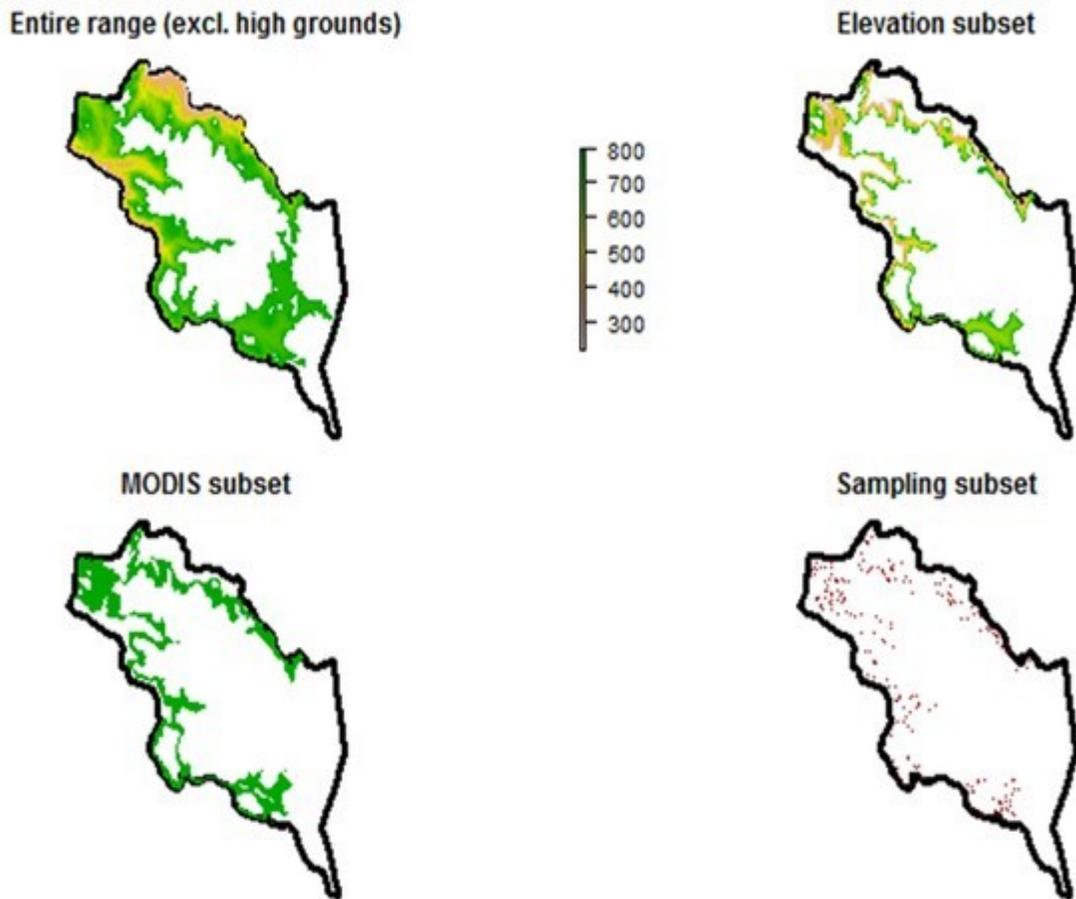


Fig. 1. Example district used to show the study design for how satellite-derived information of plant biomass and gridded meteorological data was extracted across the entire Norwegian reindeer husbandry. The first plot show the elevation gradient for the district (excluding areas > 800 m). Based on this subset, we calculated the average elevation and extracted all pixels within ± 75 m in elevation. Data on 16 days composites of the *Enhanced Vegetation Index* (EVI) and the *Normalized Difference Vegetation Index* (NDVI), based on the *Moderate Resolution Imaging Spectroradiometer* (MODIS), was then extracted from this subset of pixels (selection only pixels consisting of vegetation using based criteria used previous studies). Finally, we selected 1000 randomly selected pixels in which we extracted MODIS time series and data on gridded meteorological data. From these pixels, we extracted annual means from for monthly EVI/NDVI and estimate parameters from plant phenology model (the double logistic model).

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 socioecological factors affects the reindeer husbandry at different levels of social organization (siidashare, siida and district).

Published Results/Planned Publications

In line with the proposal, we plan to write up 1-2 publications during 2018 when we have finalized the statistical analyses. During 2017, however, three papers relevant for the ongoing project have been published or are subject for minor revisions:

- Bårdsen, B.-J. (2017). Evolutionary responses to a changing climate: implications for reindeer population viability. *Ecology and Evolution* 7(15):5833-5844.
- Bårdsen, B.-J., Næss, M. W., Singh, N. J., and Åhman, B. (2017). The pursuit of population collapses: long-term dynamics of semi-domestic reindeer in Sweden. *Human Ecology*:1-15.
- Thomas, M.G., Bårdsen, B.-J., and Næss, M. W. (in revision). The narrow gap between norms and cooperative behaviour in a reindeer herding community. *Royal Society Open Science*.

Communicated Results

As we have spent this year on getting access to data from the Norwegian reindeer husbandry and preparing data on vegetation greenness and meteorological measures we have not communicated any results yet.

Interdisciplinary Cooperation

The project consisted of three biologists and two anthropologist (including the postdoc who terminated his contract with NINA and NIKU and moved back to England in the autumn).

Budget in accordance to results

The budget is spent in accordance with the proposal.

Could results from the project be subject for any commercial utilization

No

Conclusions

This was the year of a two-year project where we have focused on preparing data prior to performing statistical analyses, but the project is on schedule as three out of five tasks have been done:

Task 1: <i>Data access</i> (April 2017).	Awaiting answer to our request to MAF for access to official statistics on reindeer husbandry ('Melding om reindrift', predation
---	--

	etc.).
Task 2: Data organization (Aug-Oct 2017).	Data downloading, processed and pre-analyzing (extracting parameters from the double-logistic models and May-Aug averages; for both NDVI and EVI) and gridded meteorological data (precipitation and temperature) for each reindeer district
Task 3: Competence enhancement (Oct-Nov 2017).	Learning theory and practical application of SEMs by participation on the workshop “Disentangling complex causal relationships in spatial and temporal ecological data”.

Task 4: Statistical analyses (May-Aug 2018)	Running SEMs (and spatiotemporal analyses of the underlying variables) on data from the reindeer husbandry.
Task 5: Dissemination & outreach (Aug-Dec 2018)	Producing scientific and popular scientific articles (see Dissemination below for details).