

Project information

Project title

NCoE-Tundra: Moth-reindeer-birch dynamics in northernmost Fennoscandia

Year

2012/2013

Project leader

Jane Uhd Jepsen, NINA

Participants

- Jane U. Jepsen (Researcher, NINA)
- Rolf A. Ims (Prof., UiT)
- Martin Biuw (postdoc, NCoE/NINA)
- Ole Petter L. Vindstad (PhD-student, UiT)
- Sabrina Schultze (MSc-student, UiT)
- Moritz Klinghardt (MSc-student, NINA/UiT)

Flagship

Terrestrial, Theme: Vegetation state change and herbivore management

Funding Source

Fram Centre, Nordforsk, NFR, internal Terrestrial Flagship research project support: 610.000 NOK for salaries for field staff (students and research technician) and researcher salary for project leader (Jepsen, NINA) Internal institutional: NINA: Research salary (Jepsen): 465.000 NOK UiT: Phd salary (Vindstad): 425.000 NOK External: NCoE-Tundra/Nordforsk: Postdoc salary (Biuw, NINA): 851.000 NOK NCoE-Tundra/Nordforsk: meetings: 25.000 NOK NFR (project CLIMOTH to UiT): field costs: 150.000 NOK

Summary of Results

During the summer field season in 2011, **two new activities and installations** were established at field sites in Finnmark to capitalize on the opportunity presented by the establishment of the NCoE and the Fram Centre funding.

The first activity focuses on the effects of grazing by herbivores on the regeneration and successional pathways in birch forest systems heavily affected by the recent outbreak of geometrid moth in the region. The field sites established during the 2011 field season were revisited during the 2012 summer field campaign. In addition to repeating all the measurements taken during 2011, we also initiated **two new data series**. Firstly, we deployed twelve automatic wildlife cameras, each overlooking one of our exclosures to monitor snow accumulation and melt throughout the season, and twelve additional cameras were deployed overlooking the control plots to document the usage of these plots by reindeer and other herbivores. Secondly, we used Kite Aerial Photography (KAP) to obtain aerial photographs of each plot (Figure 1 in appendix). These have been used to estimate the percent birch crown cover and distance between trees. Both of these data sets will allow us to draw the links more explicitly between grazing pressure, forest structure and the potential climate feedback in terms of the differential reflectivity of solar energy (i.e. snow vs. vegetation/ground). After field activities were completed Sept 2012, our work has focused on initial analyses of the 2011 data to describe the ecosystem-wide baseline conditions in the plots prior to any changes occurring as a result of the experimental setup. More importantly, these data have allowed us to assess the long-term effects on multi-level ecosystem structure of the different grazing regimes on the Finnish and Norwegian sides. For these analyses, we collaborate with international partners within our own WP4, but also WP7 (climatologists) of the NCoE-Tundra, thereby obtaining a dataset covering a range of levels, including soil condition (nutrients, bacteria and fungi), vegetation community composition, forest structure and regeneration and herbivore abundance. By combining these datasets with remote sensing data on vegetation index (NDVI) and albedo, we were also able to show that differences in long-term grazing regimes, and the resulting differences in ecosystem structure, has the potential to translate into differences in the climate feedback signals (please see Figure 2 in appendix). These results are currently being prepared as a joint manuscript of the WP4/WP7 partners, with the post-doctoral researcher (M. Biuw, NINA) being the lead author. This manuscript will be submitted to "Ecosystems" in January 2013.

The second activity aims to examine the effectiveness of logging as a management approach for stimulating rejuvenation and re-establishment of birch forests following moth outbreaks. Study plots established and inventoried in 2011 season were re-visited during the 2012 field campaign. Half of these plots had been clear-cut following the 2011 field season by our collaborators at Finnmarkseiendommen and Fylkesmannen in Finnmark. We re-examined vegetation community structure, herbivore abundance and were also able to obtain some initial estimates of short-term effects of clear-cutting in terms of early recruitment and rejuvenation of the forest. Already at this stage, the short-term effects are striking. There is a clear increase in the number of basal shoots on clear-cut plots compared to control plots. Interestingly, this effect appears to occur mainly on plots situated in poor soils, where trees are already multi-stemmed and basal shoots most likely constitute the main regeneration on the tree level. In contrast very few basal shoots were observed on logged trees in the rich clear-cut plots, where trees are predominantly mono-stemmed and where basal shoots are less important as a regeneration mechanism. This may have important implications in terms of which recommendations to give about the use of clear-cutting to stimulate rejuvenation and re-establishment following moth outbreaks. While it may work well in some (poor) regions, it may be less efficient in other (richer) regions.

A further activity, towards which the additional funding from the terrestrial flagship contributed, is the submission of a research proposal to the NFR NORKLIMA program which relates thematically closely to the NCoE-Tundra. This is a modified version of the proposal that was submitted in the last round, and which was not awarded funding despite receiving an excellent evaluation. This year's NORKLIMA call is even more appropriate for the types of study we are conducting, and we hope to receive positive feedback on this proposal by mid-December.

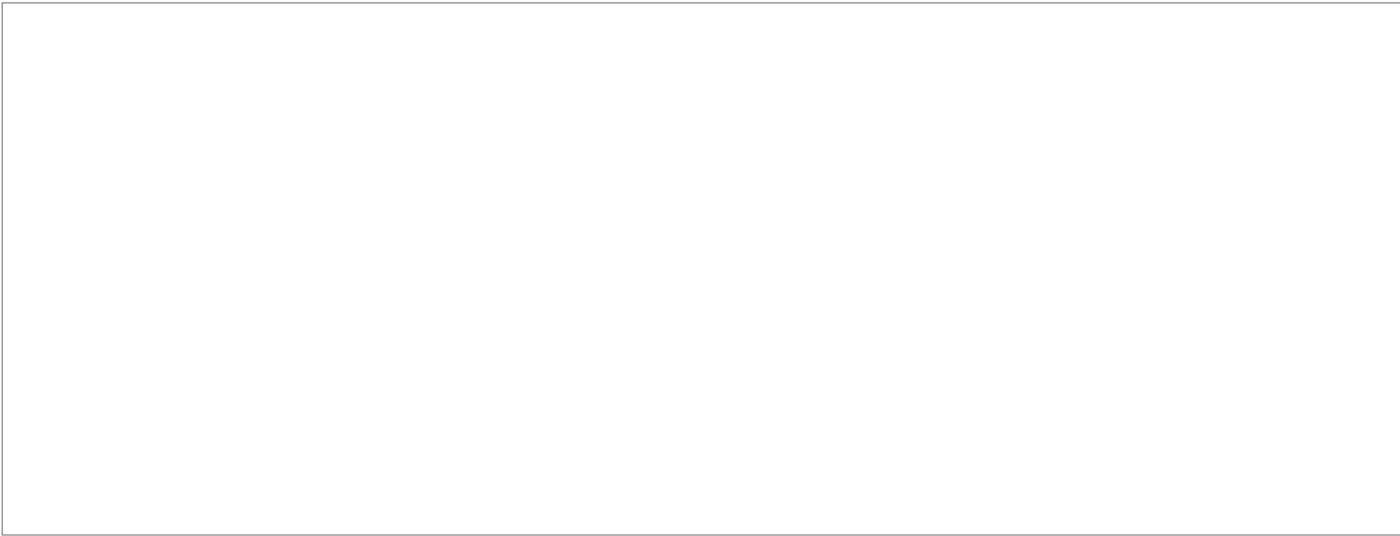


Figure 1. Kite Aerial Photography (KAP). Left: Postdoc Martin Biuw navigates the kite over the experimental plots. Right: MSc student Moritz Klinghardt is mounting the down-facing camera under the kite.

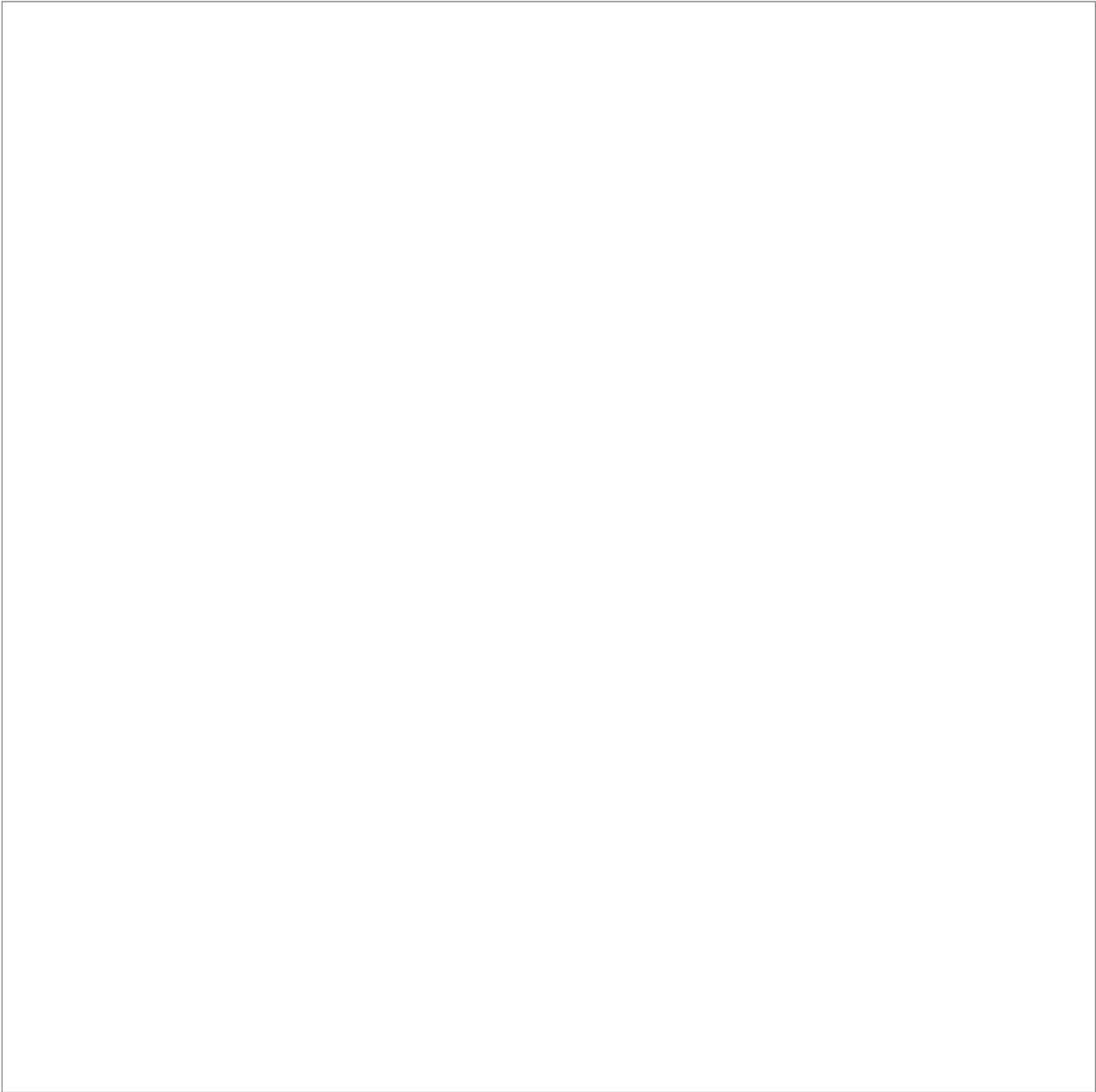


Figure 2. Differences in NDVI (black triangles) and albedo (grey circles) between Norway and Finland plotted against time of year. Positive values on the vertical axis indicate higher values in Finland while negative values indicate higher values in Norway. Each point and its associated error bar represent the average value \pm 1 standard error across years (2000-2011) for a particular 2-week (albedo) or 4-week (NDVI) period. The plot suggests that summer NDVI is slightly higher in Norway than in Finland, and that there is a transient spike during early May when this difference increases. This can be attributed either to slower snowmelt rate in Finland or greater amounts of greening foliage above the snow layer in Norway. For albedo, there is a striking difference in spring, with values being roughly 5% higher on the Finnish side.

Published Results/Planned Publications

Karlsen, S.R., **Jepsen, J.U.**, Odland, A., Ims, R.A., Elvebakk, A. State-dependent shifts in plant communities following an insect outbreak range expansion across the birch forest-tundra ecotone in northern Fennoscandia. In revision *Oecologia*

Jepsen, J.U., **Biuw, M.**, **Ims, R.A.**, **Kapari, L.**, Schott, T., **Vindstad, O.P.L.**, Hagen, S.B. Ecosystem impacts of a range expanding forest defoliator at the forest-tundra ecotone. In revision *Ecosystems*

Ims, R.A. and Henden, J.A. 2012. Collapse of an arctic bird community resulting from ungulate induced loss of erect shrubs. – *Biol. Cons.* 149: 2-5.

Ehrich, D., Henden, J.A. and **Ims, R.A.** 2012. The importance of willow thickets for ptarmigan and hares in shrub tundra: the more the better? – *Oecologia* 168: 141-151.

In preparation:

Biuw, M., et al. Evidence of long-term herbivory impacts on the structure of a birch forest ecosystem: management implications and climate feedback. In preparation for *Ecosystems*.

Communicated Results

Workshops:

NCoE-Tundra WP4-WP8 joint meeting in Kevo, Finland, Feb. 23-24 2012

NCoE-Tundra spring meeting in Puhätunturi, Finland March 19-21 2012

Others:

Jepsen, J.U., Biuw, M. Ims, R.A. NCoE-Tundra. Research Note in *Fram Forum* 2012, p. 46-49.

Framdagen 2012: Faglige fem-minutt (Jepsen)

NINA internal seminar: (Biuw, Nov. 2012)

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Interdisciplinary Cooperation

While the activities carried out under this specific project is purely ecological, the multidisciplinary nature of the NCoE provides a natural framework within which the results will be incorporated and made relevant in a broader societal and managerial perspective. During 2012 we have developed a direct collaboration with climatologists involved in NCoE-Tundra WP7 to develop estimates of surface reflectance (albedo) in our field experimental areas (see Publication section above).

Budget in accordance to results

The funding obtained from the Terrestrial Flagship has allowed us to complete a full scale field season in 2012, including the establishment of the automatic camera surveillance of herbivore area use and snow cover/snow melt. This data series will provide the basis necessary for interpreting the changes in vegetation composition, forest regeneration and vegetation reflectance in the years to come. The additional project funding obtained from the Terrestrial Flagship was hence a crucial contribution to the project in 2012.

Originally we intended the Fram Centre funding to cover student salaries, a field technician salary (UiT, 4 months) and a researcher salary (NINA, project leader, 2 months). The responsibility of the research technician would be to assist in planning the field season, participate in all field activities as well as assist in data typing and data quality assessments after the field season. During spring 2012 however, the person intended to participate as a research technician decided to take on a more long term position elsewhere. His responsibilities were taken over partly by the project leader and partly by students in the project. The funding originally allocated to the research technician (220K) was hence divided between additional project leader salary, some additional student salary, and field equipment (mainly the automatic cameras).

The original budget indicated the following allocation:

Indirect costs (Student salaries): 80K

Research technician salary: 220K

Project leader salary: 310K

The actual allocation will be closer to:

Indirect costs (Student salaries and field equipment): 170K

Research technician salary: 0K

Project leader salary: 440K

We refer to the final budget report for the exact figures.

Could results from the project be subject for any commercial utilization

No

Conclusions

Future research and perspectives

The preliminary analysis of the first data generated by the project have already led to the interesting finding that the long-standing (min. 50 years) difference in reindeer grazing regime across the Finnish-Norwegian border has led to systematic differences in forest structure and vegetation reflectance patterns, with Finnish plots having significantly elevated spring albedo. The implications of this will be followed up over the next few years in collaboration with climatologists from the NCoE-Tundra.

Further, the experimental setup established in NCoE-Tundra WP4 during 2011 and 2012 will become an integral component of the Forest-Tundra module of COAT-Climate Ecological Observatory for Arctic Tundra. COAT, which is currently progressing from planning to implementation, has recently (Nov. 2012) undergone a thorough review by an international review panel and received the highest grade possible ('Excellence').

New methods and techniques

In 2012 we have been active in implementing aerial documentation of all field plots based on Aerial Kite Photography (KAP). This provides us with a low-cost, low-tech solution for obtaining overview photographs, from which variables related to relative crown cover and tree density can be extracted. We intend to develop this further in 2013 to increase the quality and spatial resolution of the imagery.

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