

Project information

Project title

NCoE-Tundra WP4: Moth-reindeer-birch dynamics in northernmost Fennoscandia

Year

2014

Project leader

Jane Uhd Jepsen

Participants

Jane U. Jepsen (Project leader, Senior researcher, NINA), Rolf A. Ims (Prof., UiT), Ole Petter L. Vindstad (PhD-student, UiT), Malin Ek (PhD-student, UiT)

In addition international collaborators within the Nordic Centre of Excellence – Tundra program at the University of Turku (Finland), the University of Oulu (Finland) and the Finnish Meteorological Institute

Flagship

Terrestrial

Funding Source

FRAM, NINA, UiT

Summary of Results

In 2014, all ongoing activities at our field sites in Finnmark were continued, and a research paper based on initial results was published (Biuw et al. 2014). The PhD student who has been associated with the project since 2011 (O.P.L. Vindstad) published one paper (Vindstad et al. 2014), and submitted his PhD thesis for evaluation (Nov. 1st 2014). His defense is scheduled for January 9th 2015. One new PhD student (M. Ek), funded by the University of Tromsø, joined the project in May.

Main activities

The effects of grazing by herbivores on the regeneration and successional pathways in birch forest

The birch forest in northern Fennoscandia was heavily affected by outbreak of geometrid moth during the 2000's and large tracts of forest were damaged or killed. In order to track how the regeneration of the forest is influenced by grazing and browsing by mammalian herbivores we established 12 large exclosures in Polmak, 6 on each side of the fenced Finnish-Norwegian border. They are paralleled by 12 open control plots to which all herbivores have free access. Using automatic camera traps, we have previously shown that the Finnish plots are grazed by reindeer primarily in spring-summer, and the Norwegian plots primarily in winter (see 2013 report). In 2014, the

research paper documenting the state of the system just prior to establishment of the experimental exclosures was published in *Ecosystems* (Biuw et al. 2014). With funding from the flagship, we have in 2014 completed the 4th survey of the plots documenting changes in forest health and regeneration, vegetation abundance and composition, herbivore use, snow accumulation/melt and temperature. Three years into the experiment, the effects of the exclosure treatment are still fairly subtle. However, a contrast in the effect of the exclosure treatment between the Finnish and the Norwegian grazing regime is emerging in terms of the number and growth of basal shoots. In the winter grazed Norwegian plots excluding reindeer has so far not influenced the growth (height and diameter) of basal shoots at all, while in the spring/summer grazed Finnish plots the growth of basal shoots is significantly higher in the absence of reindeer. Preliminary results will be presented at the CAFF congress in Trondheim in December, and will feed into the NCoE-Tundra synthesis during the last project year in 2015.

The effectiveness of salvage logging as a management approach for stimulating rejuvenation and re-establishment of birch forests following moth outbreaks.

In collaboration with Finnmarkseiendommen (Fefo) and Fylkesmannen i Finnmark (FmFi) we established and inventoried 40 study plots in 2011. Following the 2011 inventory half the plots were subject to salvage logging in order to examine the effects of this management action on forest regeneration in moth damaged birch forests. These experimental plots have been surveyed annually since establishment. The short-term results formed the basis of a MSc thesis in 2013 (M. Klinghardt), and showed a significantly greater increase in regeneration of the forest through basal shoots in the logged plots compared to control plots. In 2014 we completed the 4th survey of the plots supported partly by the flagship and partly by our collaborators in Fefo and FmFi. We now plan to transfer this activity to a long-term protocol with reanalysis every 5 years, in order to monitor the longer-term effects of logging on forest regeneration

The influence of moth outbreak induced forest mortality on abundance and community composition of saproxylic beetles and forest dwelling small birds.

Moth outbreaks can dramatically alter the living conditions for a number of forest dwelling organisms by killing off trees and hence causing rapid changes in resource availability and habitat characteristics. Two prime examples are dead-wood associated (saproxylic) insects which complete all or parts of their life cycle in dead and dying trees, and forest dwelling bird species. Since 2011 we have examined the response, in terms of abundance and community composition, of saproxylic beetles and forest dwelling birds to changes in forest damage along two 20 km transects running from

healthy forest to severely moth damaged forest. Three-five years after the outbreak saproxylic beetles still showed a limited numeric response with total abundance being approx. 10% higher in the damaged sections of the transects than in the non-damaged sections (Vindstad et al. 2014). This suggests that saproxylic beetles so far play a minor role in decomposing the vast amounts of dead wood made available by the outbreak. Similarly, the response of forest dwelling birds to the outbreak is so far limited (Vindstad et al submitted). One of the two transects showed a 25% decrease in abundance in the damaged section, while in the other transect no effect on abundance was evident. This suggests that at this early successional stage the bird community appears fairly resistant to the loss of crown cover in the forest perhaps because the vertical structure of the forest habitat is still maintained by standing dead and damaged trees.

For the Management

The results from the various work packages within the NCoE-Tundra are gradually becoming available and synthesized into a general multidisciplinary set of results. These aim to describe the potential of reindeer grazing as a climate change mitigation tool, and therefore have very direct and explicit management implication. While our work in WP 4 focuses on the effects of grazing on the regeneration of mountain birch stands after geometrid moth outbreaks, our initial analysis of the long-standing contrast in grazing regimes between Finland and Norway provides some very crucial pieces of data showing the links between grazing, forest structure and climate feedback (albedo).

In addition, our information on the short-term effects of clear-cutting as a method for stimulating the regeneration of birch forests after moth outbreaks provides immediate input into the management strategies adopted by Finnmarkseiendommen and Fylkesmannen i Finnmark.

Published Results/Planned Publications

Peer-reviewed papers:

Bjerke J.W., Karlsen S.R., Høgda K.A., Malnes E., Jepsen J.U., Lovibond S., Vikhamar-Schuler D. & Tømmervik H. (2014). Record-low primary productivity and high plant damage in the Nordic Arctic

Region in 2012 caused by multiple weather events and pest outbreaks. *Environmental Research Letters* 9: 084006 (14 pp.). Doi: 10.1088/1748-9326/9/8/084006

Biuw, M., et al. Long-term impacts of contrasting management of large ungulates in the arctic tundra-forest ecotone: Ecosystem structure and climate feedback. – *Ecosystems* 17: 890-905, DOI: 10.1007/s10021-014-9767-3

Vindstad, O.P.L. et al. Numerical responses of saproxylic beetles to rapid increases in dead-wood-availability following geometrid moth outbreaks. – *PLoS One* 01/2014 9(6):e99624.

Posters and conference presentations:

Huusko K, Ahonen SH, Aikio S, Andersson T, Biuw M, Jepsen JU, Karlsen SR, Kaukonen M, Klemola T, Koivuniemi H, Ruotsalainen AL, Saravesi K, Suominen O, Wäli P, Ims R, Niemelä P, UTomi J & Markkola AM (2014) **Herbivore-plant-fungal interactions in the subarctic**. Arctic Frontiers Meeting, Jan 19-24 2014, Tromsø, Norway (poster).

Jepsen, J.U., Biuw, M., Vindstad, O.P.L., Ims, R.A., Markkola, A.M., Wäli, P.³, Cohen, J., Ahonen, S.H., Tejesvi, M., Aikio, S. & Niemelä, P. (2014). Ecosystem impacts of a long-standing contrast in reindeer herding regime at the forest-tundra ecotone. Fourth Annual Meeting Top-level Research Initiative Effect studies and adaptation to climate change (ADAPT). Nov. 12-13. 2014. Turku University (Poster presentation).

Communicated Results

Workshops:

NCoE-Tundra summer meeting in Stockholm, June 2014

NCoE-Tundra SAB meeting in Turku, Nov. 2014 (poster)

NCoE-Tundra autumn/winter meeting in Trondheim, Dec 1st 2014 (organizers)

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 2013 we initiated a collaboration with climatologists and hydrologists involved in NCoE-Tundra WP7 to develop estimates of surface reflectance (albedo) in our field experimental areas (Biuw et al. 2014). This collaboration is being continued in 2014, through a joint contribution to a conference session (CAFF, Dec 2014, Cecile Menard et al.). A hydrologist from WP7 in NCoE-Tundra also joined the WP4 field work this summer, to get a better understanding of the ecological questions addressed within our WP. We are now in the process of collaboratively developing a set of vegetation scenarios describing different future states of forest succession following severe defoliation by moth for use in a hydrological model. The aim is to evaluate the hydrological consequences (in terms of snow cover distribution and snow

melt patterns) of different forest succession trajectories.

Budget in accordance to results

The funding obtained from the Terrestrial Flagship has allowed us to complete a full scale field season in NCoE-Tundra WP4 in 2014. Direct funding from NCoE only contribute to recruitment positions, while salaries for senior personnel and field costs are expected to be covered by other sources. During the period 2011-2014 additional support from the Terrestrial Flagship has hence been critical in order to maintain the required high level of field activity in the project.

The Fram Centre funding in 2014 has covered student salaries, field costs and researcher salary (NINA, project leader). The allocated funding will be used according to budget before Dec 31st 2014, and the expected allocation will be:

Indirect costs (Student salaries and field costs): 60K

Project leader salary: 170K

We refer to the budget report for the exact figures.

Could results from the project be subject for any commercial utilization

No

Conclusions

The preliminary analysis of the first data generated by the project (accepted in *Ecosystems*) 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 caused a 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, preliminary analysis of the short-term exclosure effect suggests that the consequences of severe moth outbreaks for the birch forest are likely to depend on the prevailing grazing regime, in that the summer grazed Finnish areas show much lower regeneration from basal shoots than the winter grazed Norwegian plots. That reindeer grazing is at least in part responsible for this effect is evident from the stronger exclosure effect under the Finnish grazing regime.

The experimental setup established in NCoE-Tundra WP4 during 2011-14 will become an integral component of the Forest-Tundra module of COAT-Climate Ecological Observatory for Arctic Tundra. We are currently seeking funds for the short term

continuation of the exclosure experiment from NRF through a proposal submitted to the OKOSYSTEM call.