

Project information

Project title

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

Year

2015

Project leader

Jane Uhd Jepsen

Participants

Jane U. Jepsen (Project leader, Senior researcher, NINA), Rolf A. Ims (Prof., UiT), Ole Petter L. Vindstad (postdoc, 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 Centre, NINA, UiT, Research Council of Norway

Summary of Results

2015 is the final year of NCoE-Tundra. However, all core activities at our field sites in Finnmark will be continued and we have therefore completed a full field survey also in 2015. A research paper based on data from the project was published (Vindstad et al. 2015). O.P.L. Vindstad, who has been associated with the project since 2011, defended his PhD thesis on January 9th 2015. The other PhD student in the project (M. Ek), funded by the University of Tromsø, is progressing according to plan. A new project, which will continue and expand upon the research conducted in NCoE Tundra, was secured from the Research Council of Norway under the ECOSYSTEMS call. This new project (*After-the-pest*, 244454/E10) will run for 3 years from May 2015.

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 in 2011, 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 completed the 5th annual survey of the plots in 2015 documenting changes in forest health and regeneration, vegetation abundance and composition, herbivore use, snow accumulation/melt and temperature. Four 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. There is, however, a striking difference in the pattern of regeneration between the two grazing regimes. In the mainly summer grazed Finnish areas, regeneration after the moth outbreak is virtually absent, and the 2015 density of live trees and saplings was reduced to approx. 5% of the pre-outbreak density. On the winter grazed Norwegian side current density is approx. 75% of pre-outbreak density. These results were presented for stakeholders from the Nordic countries at a stakeholder symposium arranged by the NCoE management in October 2015, and will feed into the NCoE-Tundra synthesis report.

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

In collaboration with The Finnmark Estate (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 2015 we completed the 5th survey of the plots supported partly by the flagship and partly by After-the-pest. For the years 2016-17 this activity will be continued as part of After-the-pest.

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. In 2011-12 we examined the response, in terms of abundance and community composition, of saproxylic beetles to changes in forest damage along two 20 km transects running from healthy forest to severely moth damaged forest. At that time (three-five years after the outbreak) saproxylic beetles still showed a limited numeric response (Vindstad et al. 2014). In 2015 we have repeated the trapping and will do so in 2016 as well, in order to evaluate the change from the early successional stage documented in 2011-12. We also surveyed the community composition of forest dwelling birds along the same transects in 2011-13. Similarly to the beetle community, the response of forest dwelling birds to the outbreak was limited (Vindstad et al 2015). 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 an 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. A new survey of the bird community was completed in 2015 and is scheduled for 2016 as well.

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:

Vindstad, O.P.L., Jepsen, J.U. & Ims, R.A. (2015). Resistance of a sub-arctic bird community to severe forest damage caused by geometrid moth outbreaks. *European Journal of Forest Research* 134 (4): 725-736.

Ammunet, T. Bylund, H. & Jepsen, J.U. (2015) Northern Geometrids and Climate Change: From Abiotic Factors to Trophic Interactions. In: Björkman, C. & Niemela, P. (Eds) *Climate change and insect pests*. CABI Climate Change Series 292 p.

Posters and conference presentations:

Jepsen, J.U., Biuw, M., Vindstad, O.P.L., Ims, R.A., Markkola, A.M., Wäli, P., Cohen, J., Ahonen, S.H., Tejesvi, M., Aikio, S. & Niemelä, P. (2015). Ecosystem impacts of a long-standing contrast in reindeer herding regime at the forest-tundra ecotone. Poster at the NCoE Tundra stakeholder symposium. Rovaniemi, Oct 15th-16th 2015.

Jepsen, J.U., Vindstad, O.P.L., Ek, M., Markkola, A.M., Suominen, O., Biuw, M. & Ims, R.A. (2015). Successional trajectories in a birch forest ecosystem following severe outbreaks by geometrid moths: the role of mammalian herbivores. Poster at the NCoE Tundra stakeholder symposium. Rovaniemi, Oct 15th-16th 2015.

Scheduled conference presentations:

Käyhkö, J., Horstkotte, T., Kivinen, S., Vehmas, J., Oksanen, L., Forbes, B.C., Johansen, B., Jepsen, J.U., Markkola, A., Pulliainen, J., Olofsson, J., Oksanen, T., Utsi, T.A., Korpimäki, E. and Nordic Centre of Excellence 'Tundra' (2015). Warming Climate and Changing Societies – a Challenge or an Opportunity for Reindeer Herding? AGU Fall meeting, San Francisco Dec. 14th-18th 2015. Final Paper#: GC31B-1184

Communicated Results

Workshops: NCoE Tundra stakeholder symposium. Rovaniemi, Oct 15th-16th 2015.

Web: In 2015 we have launched a new website www.birchmoth.no, which presents activities and results from our work on the moth-birch forest system, including NCoE Tundra and After-the-pest.

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. In the course of NCoE Tundra we initiated a collaboration with a

climatologist involved in NCoE-Tundra WP7 to develop estimates of surface reflectance (albedo) in our field experimental areas (Biuw et al. 2014). We have further developed a collaboration with a hydrologist (Cecile Menard) which has resulted in a joint conference contribution (CAFF, Dec 2014, Cecile Menard et al.). Cecile Menard also joined the WP4 field work in 2014, to get a better understanding of the ecological questions addressed within our WP, and are scheduled to spend 3 months in Tromsø as a visiting scientist as part of the new project After-the-pest.

During the last year of NCoE Tundra, we have initiated an interdisciplinary collaboration with a remote sensing physicist from UiT (Stian Anfinssen, Dept Physics and Technology) in order to evaluate the use of synoptic aperture rader (SAR) in quantifying vegetation structure. We will continue this collaboration ion After-the-pest.

Disciplines involved: ecology, climatology, hydrology, physics/remote sensing

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 2015. 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. Throughout the project period 2011-2015 additional support from the Terrestrial Flagship has been critical in order to maintain the required high level of field activity in the project. It has allowed us to build up research infrastructure which will now be continued in After-the-pest, and subsequently into the long-term as an integral part of COAT infrastructure.

The Fram Centre funding in 2015 has covered student salaries, field costs, small field equipment, and researcher salary (NINA, project leader). The allocated funding will be used according to budget before Dec 31st 2015, and the expected allocation will be:

Indirect costs (Student salaries and field costs): 120K (UiT) + 114K (NINA)

Project leader salary: 366K (NINA)

Could results from the project be subject for any commercial utilization

No

Conclusions

The preliminary analysis of the first data generated by the project (Biuw et al. 2014) 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 as part of After-the-pest, and will involve continued collaboration with key NCoE-Tundra partners. 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.

In the short run all the experimental infrastructure established in NCoE-Tundra WP4 during 2011-15 will be continued in After-the-pest. In the long run, the most important sections of the NCoE infrastructure will be continued into the long-term as part of the Forest-Tundra module of COAT.