

## Project information

### Keywords

forest mortality, insect outbreaks, resilience, ecosystem dynamics

### Project title

What comes after the new pest? Ecosystem transitions following insect pest outbreaks induced by climate change in the European high North (After-the-Pest)

### Year

2017

### Project leader

Jane Uhd Jepsen

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

Geographical localization of the research project in decimal degrees (max 5 per project, ex. 70,662°N and 23,707°E) The Varanger fiord area including Tana and Polmak. Example coordinate Tana Bru 70.1994, 28.1852.

### Participants

The project leader is Jane U. Jepsen (senior researcher, NINA, jane.jepsen@nina.no). Administratively responsible at NINA is research director Cathrine Henaug (cathrine.henaug@nina.no).

#### Project participants:

From NINA: Audun Stien (audun.stien@uit.no) and Erling Solberg (erling.solberg@nina.no).

From UiT: Stian N. Anfinsen (stain.normann.anfinsen@uit.no), Rolf A. Ims (rolf.ims@uit.no), Nigel Yoccoz (nigel.yoccoz@uit.no), Ole Petter Vindstad (postdoc, ole.p.vindstad@uit.no) and Malin Ek (PhD student, malin.ek@uit.no). Administratively responsible at UiT is Faculty Director Terje Aspen.

### Flagship

Terrestrial

### Funding Source

Research Council of Norway

Fram Centre

UiT

NINA

### Summary of Results

The last field season of this 3-year project included repeating the snow tracking campaign done in 2016, to document the area use of ptarmigan and other herbivores. The survey gave similar results in 2016 and 2017; less tracks of ptarmigan and other herbivores were observed in the damaged forest relative to non-damaged forest (Jepsen et al in prep).

The large-scale network of camera traps established in 2015 has been retrieved, and analysis of this data, along with data from GPS-tagged individuals, is now in progress to document the area use of moose and reindeer in damaged forest stands.

A new full survey of the cross-border herbivore exclosures in Polmak was completed. Data from this monitoring will document the ability of the damaged forest to regenerate under winter (Norway) and summer (Finland) grazing. The results contribute to a Norwegian-Finnish collaboration, and project partners met for a 2-day workshop in October to discuss the joint results and prepare publication.

A field campaign was completed to sample ground truthing data for SAR-based mapping of vegetation structure. Ground truthing was in the form of vegetation structural variables measured on the ground as well as drone images taken at 2 elevations above ground.

In collaboration with forest management authorities and the primary land owner in Finnmark, we have performed a field experimental test of salvage logging as a management action to stimulate regrowth in the damaged birch forest. The results show that salvage logging is a promising action in the short term, but that the benefit depends to a significant degree on the local browsing pressure from moose and reindeer (Vindstad et al. 2017 Forest Ecol. Manage.).

Analysis of forest successional changes from 2010-16 reveal a gloomy future for the damaged forest. There has been substantial delayed mortality of damaged stems, and regeneration from basal sprouts has been very limited. Regeneration seems to depend mainly on saplings, which are vulnerable to herbivory and take decades to grow into new trees. Preliminary results (Vindstad et al. in prep) show that both forest mortality and regeneration is governed by strong non-linear thresholds which renders the system prone to abrupt state changes.

Master and PhD-students involved in the project

Malin Ek (PhD student, UiT)

Jørgen Agersborg (PhD student UiT Physics)

Ragnhild Bjørkås (MSc student, field assistant)

Adam Pepi (US Fulbright, ended March 2017)

For the Management

The results disseminated from *After-the-pest* are of both managerial and societal relevance, as they will contribute to a better understanding of how climate and herbivores drive vegetation state transitions in a sensitive region, and our options for intervention through forest- and ungulate management. In 2017 in particular, as we have reported on an experimental test of salvage logging effects on forest regeneration initiated in 2011 together with land owners (Finnmark Estate) and forest managers (FmFi).

Published Results/Planned Publications

Pepi, A., Vindstad, O.P.L., Ek, M. and Jepsen, J.U. (2017). Elevationally biased avian predation as a contributor to the spatial distribution of geometrid moth outbreaks in sub-arctic mountain birch forest. *Ecological Entomology Early View* DOI: 10.1111/een.12400

Vindstad, O.P.L., Jepsen, J.U., Klinghardt, M., Ek, M. & Ims, R.A. (2017) Salvage logging of mountain birch after geometrid outbreaks: ecological context determines management outcomes. *Forest Ecology and Management* 405: 81-91.

In preparation:

Jepsen, J.U. Vindstad, O.P.L., Ek, M., Yoccoz, N.G., Ims, R.A. Cascading effects of forest defoliator outbreaks on the distribution of a wildlife community in winter.

Vindstad, O.P.L., Jepsen, J.U., Ek, M., Ims. Can geometrid defoliators push the sub-arctic birch forest over catastrophic thresholds? (working title).

Communicated Results

NRK Dagsrevyen and NRK1: Norge stemmer - tema klima: Interview og debatt

NRK Ut i Naturen, filming June 2017, on air sometime winter 2017

Local newspapers: approx. 8 cases

Fram Forum winter 2017 in preparation

#### Interdisciplinary Cooperation

With support from the Fram Center we have through 2016 and 2017 developed an interdisciplinary collaboration with remote sensing specialists at UiT Physics (machine learning group). This has resulted in a joint PhD student, initiated Sept 2017 via the project COAT Tools. This student is trained in physics and remote sensing and in the use of radar data in particular. He participated in this years field work in East Finnmark and will over the next few years collaborate with After-the-pest and COAT personell on developing new methods for detecting vegetation structural changes based on radar (SAR).

#### Budget in accordance to results

Costs have been in accordance to budget. With the funding from the Fram Centre we have been able to strengthen two collaborations in the project. 1) the interdisciplinary collaboration with remote sensing and machine learning experts to develop SAR based mapping of vegetation structure (176K + project leader hours), and 2) the collacoration with ungulate ecologists on ungulate habitat use of moth damaged forests based on GPS tagged individuals and camera traps (137K + project leader hours).

Could results from the project be subject for any commercial utilization

No

#### Conclusions

Funding from the Fram Centre in 2017 has allowed us to strengthen two important collaborations in the project. The work on ungulate area use is well in progress and will be completed in the course of 2018. The work on SAR-based mapping of vegetation structure has resulted in a new PhD position (Sept 2017-2020) which will allow us to expand on this topic in the years to come.