

Project information

Project title

Svalbard's terrestrial ecosystem – climate impacts and trophic interactions II

Year

2012/2013

Project leader

Åshild Ønvik Pedersen, NPI

Participants

Project leader:

- Åshild Ønvik Pedersen (NPI)

Participants:

- Audun Stien, Ingunn Tombre and Jane Uhd Jepsen (NINA)
- Pernille Bronken Eidesen (UNIS)
- Eva Fuglei (NPI)

Flagship

Terrestrial, Theme: Ecosystem effects of extreme climate events and changing seasons

Funding Source

Fram Centre, internal

Summary of Results

1. NORKLIMA application for the Norwegian Research Council

As planned we submitted a research project application with the title: "Tundra ecosystem responses to climate change in Svalbard" to NFR, NORKLIMA 5 September 2012.

The project consists of three integrated work packages (WP) with the following main questions:

1. Which past and present climate parameters are important for the dynamics of the terrestrial vertebrate community in Svalbard?
2. What are the climate change impacts on the ecological interactions within the simple terrestrial vertebrate community?
3. What are the projected terrestrial ecosystem responses to climate change in Svalbard?
4. Is it possible to mitigate the effect of climate change on the ecosystem through sustainable management strategies?

In addition to the active partners from the FRAM Centre the project consortium for the proposed project consist of:

- Leif-Egil Loe (Norwegian University of Life Sciences)
- Jesper Madsen (National Environmental Research Institute, Denmark)
- Rene van der Wal (University of Aberdeen, United Kingdom)
- Niels Martin Schmidt (Zackenberg Ecological Research Operations, Denmark)
- Arne Moksnes and Brage B. Hansen (Norwegian University of Science and Technology)
- Glen Liston (Colorado State University)
- Jack Kohler (NPI)

The application decision will be taken during December 2012.

2. Pilot project - testing field methods for ecosystem studies on Svalbard

In this project we continued testing the suitability of selected ecosystem study methods, currently used in an ecosystem study on Varangerhalvøya (EcoFin) and tested out in the pilot studies in Svalbard 2011 funded by FRAM.

In 2012 the main goals for the study were as follow:

1. To determine spatial distribution of herbivores and relative use of habitats by faeces counts. *Summer accumulation of faeces in 2011*

was low suggesting that the spatial and temporal scale of data collection, given the low abundance of most herbivore species, must be re-evaluated. The goal in 2012 is to evaluate winter accumulation as a possible alternative measure of herbivore space use and distribution and extend surveys into lowland habitats.

2. To quantify amount of goose grubbing related to herbivore space use and habitats. The 2011 pilot showed that we have chosen a suitable methodology for mapping goose grubbing activity. In 2012 we will extend the transect lines to cover also the important lowland habitats at the valley floors (as above for goal 1) and sample data on a finer scale within the sampling unit.

3. To investigate development of individual *B. vivipara* plants and evaluate if the altitudinal gradient give sufficient variation in onset of spring as compared to seasonal variation. The 2011 pilot confirmed the suitability of our survey protocol for plant development in *B. vivipara*. This year we will expand on these results and test automatic cameras for monitoring snow-melt to be able to relate field estimates of plant development to on-site snow melt and onset of spring.

4. To test and validate methodologies for estimating relative predation rates on ground breeding bird (new).

Methods

We conducted studies related to goal 1-3 in Adventdalen and Hanaskogdalen along the 19 established transects from 2011. Data were sampled in 80 sub-plots of which 4 of them were new in 2012 (i.e. lowland habitats). Three sub-plots (15x15 m) were placed in areas with > 50 % vegetation cover whereas the last sub-plot in areas with < 25 % cover vegetation. We conducted the artificial nest predation study (goal 4) in Sassendalen and Adventdalen where we established 24 study transects along an altitudinal gradient contrasted by goose nest density. The field work was carried out by 6 people in July 2012.

Data collected to answer goal 1-3: (1) Removal of faeces in 8 sampling quadrates of 50x50 cm in each sub-plot; (2) presence/absence of goose grubbing in the same sampling quadrates within 25 small squares; (3) collection of faeces to test DNA-techniques to estimate diet of the herbivore community; and (4) phenological development of 15 individual *Bistorta vivipara* in each of the 16 sub-plots along 4 transect lines combined with temperature loggers collecting data on soil temperatures in each sub-plot.

Data collected to answer goal 4: We placed out 5 artificial nests, consisting of 2 quail eggs, in each of the 24 altitudinal transects in the study areas. At each nest we collected information about habitat type, slope and exposure of the nest. The eggs were exposed to predators in two consecutive periods of 10 days.

Summary of preliminary results

Limited number of faeces had accumulated over the winter in the 608 sampling frames. We think the spatial scale of data collection, considering the low abundance of most herbivore species, is likely not suitable for sampling data to evaluate habitat use and the potential for competition among the herbivores. Thus, to continue investigating space use, we need to find alternative methods that could be camera traps, overlaying habitat models etc.

The goose grubbing survey sampling method (i.e. sampling of grubbing in 25 small squares within the sampling quadrat of 50x50 cm) in the sub-plots in 2012 captured sufficiently the spatial variation of grubbing levels and is likely a good method to monitor changes in grubbing levels across space and time. The data are already being used in a manuscript (in preparation) comparing goose grubbing levels in 2012 with published results from 2006 (Speed et al. 2009). Pre-liminary results from 2012 corresponds to the finding of the 2011 survey in that grubbing was documented along the entire altitudinal gradient in several transects, though to lesser extent at the highest altitude (see point 6 for a summary of submitted article).

The pilot studies of *Bistorta vivipara* individuals is new on Svalbard and the various way/experiences to collect data on this key forage plant of the Svalbard rock ptarmigan, is of high value in the continuation of developing studies to test the hypothesis regarding a potential mismatch between ptarmigan reproduction and quality/quantity of the *Bistorta vivipara* bulbils. The data from 2011 is currently used in a Master thesis, supervised by Pernille B. Eidesen at UNIS, to focus on the link between increased flower production versus bulbils under higher temperatures and increased nutrient availability, and we predict higher genetic diversity in the populations with overall higher flower production compared with bulbils. The data from 2012, including the snow-camera data, will be added to this work before publication of the thesis.

The artificial nest predation study yielded highest predation rates in the inner Adventdalen followed by the south-west side and the north-east side of Sassendalen. This gradient in predation pressure, ranging from 89.5 % depredated nests in Adventdalen (period 2) to 43.5 % in Sassendalen (period 2), likely reflects the relative predation pressure on ground breeding birds in environments contrasted by access to geese (eggs and goslings) as prey for predators. Pre-liminary analysis of the predation rates by a logistic regression model with predation rates as response variable and design variables as explanatory variables (study location, transect placement, plot placement along transect, study period and habitat) resulted in that predation rates were best explained by study location and plot placement. The data will further be explored and data on distance to occupied fox dens from the NPI arctic fox den database will be related to the analyses of relative predation rates. The success of these studies will be important in the continuation of studying predator-prey interactions within the proposed study submitted to NORKLIMA.

Published results:

We have submitted an article with the title "*Do geese grubbing affect dry habitats mainly during snow melt?*" based on the goose grubbing data from 2011 to Polar Research in September 2012. The article is currently under review.

Planned publications:

We plan 4 publications based on the field data sampling in 2011-2012:

1. Working title: "*Bistorta vivipara, phenological development, reproduction output, and genetic diversity along altitudinal gradients – the potential for a trophic mismatch with ptarmigan reproduction*" which will be based on the master thesis and similar data collected in 2012.
2. Working title: "*Increase in prevalence of grubbing following pink-footed goose population expansion*" which will be based on a comparison of data collected in 2012 and 2006 (Speed et al. 2009).
3. Working title: "*The effect of grubbing on the genetic diversity of Bistorta vivipara*" based on the field data sampling in 2011-2012, and new genetic analyses during spring 2013.
4. Working title: "*Relative predation rates on ground breeding birds in arctic tundra contrasted by prey availability*" which will be based on the artificial nest predation data from 2012, NPI monitoring data and preferably 1-2 additional field season to account for temporal variation.

Speed, J. D. M., S. J. Woodin, H. Tommervik, M. P. Tamstorf, and R. van der Wal. 2009. Predicting Habitat Utilization and Extent of Ecosystem Disturbance by an Increasing Herbivore Population. *Ecosystems* 12:349-359.

In the proposed NFR NORKLIMA project we plan to publish papers in high-quality scientific international peer-reviewed journals. Each of the 3 WP is planned to result in 1-3 key papers and additional spin-off papers from the project group.

See also the report from "Workshop Svalbard Terrestrial 2012" where additional publications related to both the pilot studies and the NFR proposal is listed.

Communicated Results

Results from the pilot studies in 2011-2012 were presented and discussed in an internal workshop for the project participants and invited experts related to "Svalbard terrestrial" in FRAM October 25-26, 2012. Additionally, two popular articles based on parts of the pilot studies will be published in FRAM forum in 2013.

Interdisciplinary Cooperation

The project is based on cooperation between different biological disciplines within FRAM and other Norwegian and foreign institutions.

Budget in accordance to results

The FRAM Centre funding has been essential for the project "Svalbards terrestrial ecosystem – climate impacts and trophic interactions II". By the incentive funding from the FRAM centre in 2010 we planned and conducted two workshop (March 2011, Final report submitted by J. U. Jepsen Oct 13. 2011; October 2012, Final report by A. Stien Nov. 15 2012) with invited researchers which became partners in the project consortium for a NORKLIMA project application submitted to NFR in August 2011 and in September 2012. The FRAM centre funding therefore helped to complete our NFR applications. Furthermore, the pilot project conducted in Svalbard 2011-2012 would not have been possible without this funding. This project has provided important datasets and experiences and validated field sampling methods which we intend to use in the NFR proposed project. Additionally and most important our project will give publications that will form a platform for future directions of studies focusing on climate impacts on terrestrial tundra ecosystems Svalbard.

Could results from the project be subject for any commercial utilization

No

If Yes

Conclusions

a) Indicate future research and/or perspectives which the project results have led to

If our NFR application will be funded, we will be able to conduct a 3-year study on climate impacts on Svalbard's terrestrial ecosystem involving funding for one doctoral position.

b) List and describe new methods or techniques that have been developed during the project or that the project has revealed a need for

We have developed/tested new methods (including genetic DNA studies) to collect data on the key forage plant of the Svalbard rock ptarmigan, the *Bistorta vivipara*. This is of importance for testing hypothesis regarding a potential mismatch between ptarmigan reproduction and quality/quantity of the *Bistorta vivipara* bulbils. This is new on Svalbard and will be of importance in future climate impact studies both in Svalbard and on the mainland of Norway.

We have also for the first time successfully tested the use of artificial nests to study relative predation rates of arctic fox and avian predators in Svalbard.