

## Project information

### Project title

Limnosystem Pasvik (LIPA) observation system – a limnic observation system for adaptive monitoring and management of climate impacts

### Year

2012/2013

### Project leader

Karl Øystein Gjelland, NINA

### Participants

- Principal investigator (PI): Karl Øystein Gjelland, Norwegian Institute for Nature Research (NINA)
- Co-PI: Per-Arne Amundsen, University of Tromsø (UiT).
- Guttorm Christensen, Akvaplan-niva (APN)
- Paul-Eric Aspholm, Bioforsk
- Hallvard Jensen, Bioforsk
- Morten Falkegård, NINA
- Anders G. Finstad, NINA
- Martin Svenning, NINA
- Heleen de Wit, Norwegian Institute for Water Research (NIVA)
- Markus Lindholm, NIVA
- Brita Lisa Skjelkvåle, NIVA
- Rune Knudsen, UiT
- Roar Kristoffersen, UiT
- Raul Primicerio, UiT

### Flagship

Terrestrial, Theme: Observation systems for climate changes

### Funding Source

Fram Centre

### Summary of Results

The pilot project for the establishment of Limnosystem Pasvik (LIPA) observation system have worked along two main axes; a research axis were the relationships linking environmental/climate and biological variables as well as biological interaction effects are sought, and a monitoring axis aiming at extending long term data series providing new data to the research objectives as well as monitoring effects of management responses/actions. The aim is to integrate these into an adaptive monitoring framework, but there is a lack of research programs that finance such integrated approaches. The NORKLIMA program call from the Norwegian Research Council was highly relevant to the research part of our project, hence we have focused on developing a strong application for this program. This resulted in the project application “Anthropogenic forcing of responses to climate change across ecosystems (ACROSS)” with a time frame of three years and total budget of NOK 13.9 million. ACROSS has taken a wider perspective than initially planned for LIPA. ACROSS will take advantage of the extensive monitoring data sets from Pasvik and Finmarksvidda held by the LIPA partners, as well as from monitoring programs in Southern Norway. With this wider approach, we are better able to address important aspects of climate effects, invasive species and anthropogenic influence, which are all central to the LIPA project.

Terrestrial vegetation has a strong influence on water quality (Fig. 1), which in turn has a strong influence on aquatic production and community composition (Fig. 2). In ACROSS we will study how interactions across terrestrial and aquatic ecosystems respond to climate change, and thereby provide fundamental knowledge needed to successfully manage and mitigate anthropogenic stressors in a changing climate. Climate sets important functional premises from the level of organisms to the level of ecosystems, and shapes the flow of nutrients and organic matter between adjacent ecosystems. Together, climate and cross-ecosystem effects influence species composition and population abundance through ecological interactions between the organisms. Anthropogenic stressors such as land use changes and invasive species influence the outcome of the complex ecological responses to climate change, and may create unexpected tipping points. Presently, policymakers' ability to initiate informed climate mitigation and adaptation strategies is limited by the lack of knowledge on how multiple stressors interact across ecosystems. In ACROSS, we will address this issue by using terrestrial-aquatic links between boreal and sub-arctic lakes and their catchments as model systems. The project will build on methodological advancements and extensive empirical databases originating from recent NORKLIMA, IPY, FRIMEDBIO and MILJØ2015 projects coordinated by key consortium members. We will focus on i) how anthropogenically induced herbivore grazing pressure affects climate response of latitudinal and altitudinal forest advancement, ii) how forest advancement interacts with direct climate effects like water temperature and ice-cover, creating tipping-points in lake ecosystems, and iii) how such tipping-points shape the effects of anthropogenic fish translocations. Based upon this, we will develop scenarios to inform policymakers how to successfully mitigate climate change impacts across ecosystems.

Within this pilot project, we have also explored how the local Pasvik climate is expected to change according to forecast from global climate models and regional models from downscaled global models. Whereas predicted and observed changes have been modest in the period from 1951 to 2011, climate change in Pasvik are expected to be much stronger in the next decades, potentially extending the ice-free season by as much as two months within year 2099 (Figs. 3 and 4). This will have strong influences on lake metabolism, community composition and life history traits of fish species.

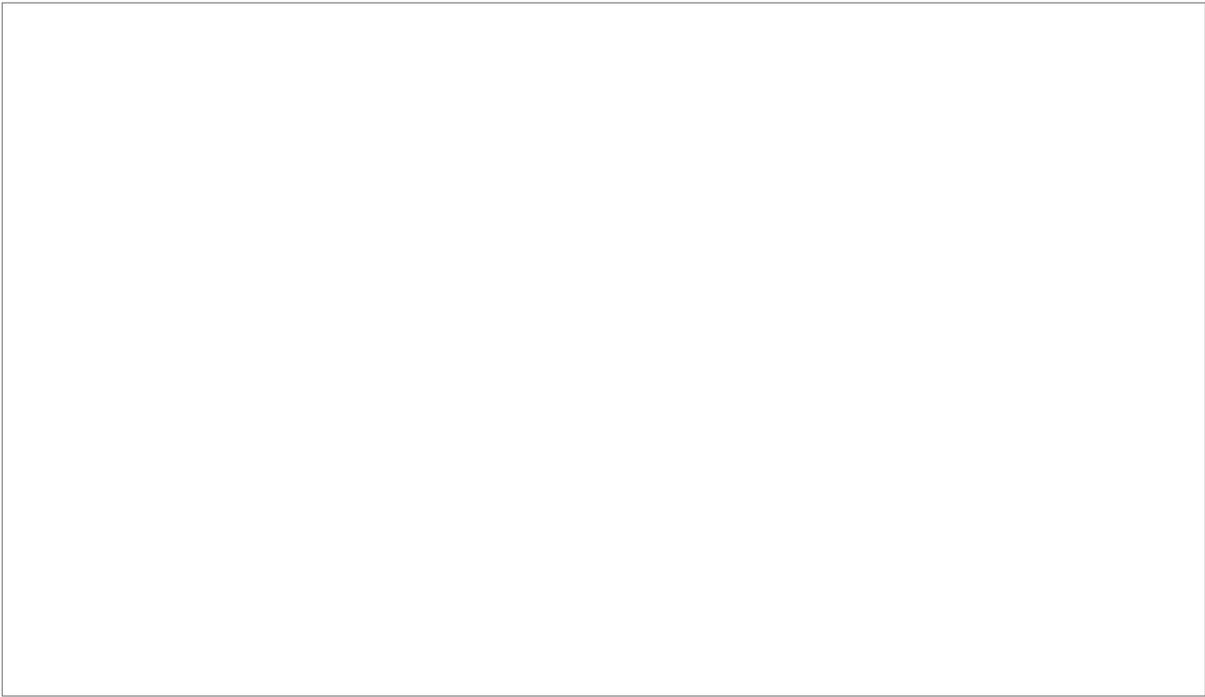


Fig. 2: Annual mean Normalized Difference Vegetation Index (NDVI) of catchment and Ice cover duration (days) for lakes in Eastern Finnmark. Lakes with whitefish, pike and European Minnow are indicated by red, green and blue dots, respectively. Ice cover duration is modelled values as described in Helland *et al.* (2011), and catchment NDVI extracted as described in Finstad *et al.* (2011, 2012).



Fig. 3: Daily mean air temperatures 2m above ground at Vaggatem from 1951 to 2100, averaged over 30 year periods as indicated by the figure key. The temperature predictions were extracted from the DMI-HIRHAM5 downscaling from the ECHAM5Global Climate Model using the A1B scenario.



Fig. 4: The number of summer days (mean temperature > 0 °C, dark grey), as compared to the number of winter days (mean temperature < 0 °C (light grey)). Winters used to be longer than summers in Pasvik, but the opposite is predicted for the future.

## Published Results/Planned Publications

The full pilot project report will be submitted to the Fram Centre by Jan 31 2013.

## Communicated Results

The “North Calotte limnic climate (ex)change workshop” financed by FRAM incentives, was arranged in conjunction with the LIPA project 25-27<sup>th</sup> April 2012 in Pasvik. At this workshop, international researcher and researchers from within LIPA gathered to share information and plan project cooperation and frameworks.

The workshop resulted in two radio interviews and a newspaper article in Sør-Varanger avis.

## Interdisciplinary Cooperation

Inter-disciplinary cooperation was sought by inviting archeologists (Bjørnar Olsen and Sven-Donald Hedman at the University of Tromsø, Maria Vretemark at Västergötlands museum) to the workshop in Pasvik. These researchers have a long experience with archeological excavations in Pasvik, and our aim was to include them in order to acquire more knowledge on the historical use and importance of the freshwater resources. Unfortunately, none of them had the opportunity to participate.

We did also consider the use of archeological fish bony structures (bones, scales, otoliths) for fish growth analyses, and discuss this with Maria Vretemark who is a paleo-zoologist. Unfortunately, the material from Pasvik excavations is of too poor quality for traditional growth analyses, although it may be possible that more advanced (and expensive) methods may be used.

## Budget in accordance to results

The funding from the Fram Centre has been essential to this pilot project, which would not have been undertaken without the Fram funding. The funding has furthermore furnished better collaboration between limnologists within the Fram Centre, and provided a framework and a good starting point for future projects. A primary goal of the Pilot project for the establishment of LIPA was to submit a research application for the Norwegian Research Council. This goal was fulfilled with the help of the Fram grant and internal fundings from the applicant institutions.

## Could results from the project be subject for any commercial utilization

No

## Conclusions

A primary goal of the Pilot project for the establishment of LIPA was to submit a research application for the Norwegian Research Council. This goal was fulfilled with the help of the Fram grant and internal fundings from the applicant institutions. The partner institutions have assessed metadata from a wide range of biological and environmental datasets from the Inari-Pasvik watercourse. Together with analyses of climate change perspectives and model work projected within the NORKLIMA application, we are better able to a) communicate to lay people consequences of climate changes in Pasvik, and b) plan for future adaptive monitoring in the watercourse. Another goal was to apply for funding for long-term monitoring in the Pasvik watercourse. This goal is still to be achieved, as appropriate funding announcement has been lacking. However, we will work through various canals to look for funding aside of announcements. Some monitoring in the Pasvik watercourse is undertaken in 2012 and 2013, and we will continue to work for long-term funding for adaptive monitoring within the watercourse.