Proceedings and Abstracts

International meeting on “Mires and Wetlands of the North Calotte”

Special focus on palsa mires and climate change and knowledge exchange between authorities and researchers

NORDKALOTTRÅDET
POHJOISKALOTIN NEUVOSTO

October 2019

Contents

Front page photo collage:

Palsa mire in Karlebotn, Nesseby Norway. Photo: Tiia Kalske
Downloading of temperature data. Photo: Paul E. Aspholm
Group picture. Photo: Paul E. Aspholm

Introduction

Aim and background for the meeting

Wetlands are highly productive ecosystems. They take many forms including mires, bogs, swamps, deltas etc. There are many ways of categorising wetlands and numerous different types. Most large wetland areas are unique mosaic of different wetland types. Wetlands cover 3% of the earth but they accumulate more carbon than tropical rainforests. Mires are areas that are inundated or saturated by water, water logged peatlands in old lake basins or depressions in the landscape. Almost all water in bogs comes from rainfall. Bogs have a specialised and unique flora that have evolved in their nutrient-poor and acidic conditions. Mostly bogs are unsuited for agriculture and forestry or other development. Finally: wetlands and mires provide nesting and resting sites to migratory birds, purify water and trapping floodwaters. Mires are valuable ecosystems which provide us with a lot of services and need protection and restoration if deteriorated.

The aim of this project was to exchange knowledge and to initiate cooperation between the three countries in the North Calotte region, on mires and wetlands, with special focus on palsa mires (monitoring and status) and climate change issues. Focus will be on the shared topics where the countries share the same or similar environmental challenges – wetland protection issues, restoration status and measures, biodiversity and monitoring issues and ecosystem services.

Session 1 - Wetlands of the North Calotte

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1. Protection of mires and wetlands in Arctic Norway

Jan Petter Hubert Hansen
Threatened Biodiversity Section & Protected Areas Section, Norwegian Environment Agency
E-mail: jan.petter.hubert.hansen@miljodir.no

Wetlands covers over 10% of the Norwegian mainland. 1/3 of the mire areas are lost the last 100 years.

Protected areas of Svalbard: 29 (65,3%), protected marine areas within territorial border cover 86,6%.

Protected areas on mainland Norway, over 3300 (17,3%), marine protected areas cover 3,1%.

Norwegian Ramsar sites: 63 wetland systems. Ramsar Information Sheets (RIS) are updated for all areas in 2018.

Representativeness of protected areas: mires and including palsa mires are underrepresented in the protected area habitat types.

National Red list of nature types: 10 nature types of mires included. National plan for supplementary protection in 2019, over 1300 proposals, 275 proposals (cover 584 km2) sent to the Ministry of Environment for further follow up, May 2019.

Report: mires in northern Norway – knowledge base and the need for further studies (NTNU 2016). Knowledge base on mires in northern Norway is too poor, varying quality of information in national data bases (Naturbase).

Lack of aggregated overview. Give special attention to raised bogs and oceanic bogs (ombrotrophic mire types), palsa mires, rich fens and hay fens.

2. and 9. Wetland conservation in Sweden and Arctic wetland project

Michael Löfroth
Ministry of the Environment, Sweden
E-mail: michael.lofroth@regeringskansliet.se

Conservation includes protection, management and restoration. Conservation of wetlands must be based on retaining the hydrological and hydrochemical conditions that for thousands of years has formed the wetland. Each wetland is unique, and its ecosystem is formed based upon the water level, water movements, water fluctuation etc. Water chemistry, climate, species establishment history and in some cases management by man adds to forming the ecosystem. Many of these wetlands, especially mires, are long term stable ecosystems, maybe the most stable in the Nordic countries and even in the Northern hemisphere. Drillings in the peat of a mire can show the same Sphagnum individual growing in the same place for thousands of years!

Keeping the natural hydrological and hydrochemical conditions in the wetland are in many times the most important goal for wetland conservation. If these conditions are, protection of the wetland hydrology is the most important thing to do. But in many cases, a majority of the wetlands in Sweden are more or less affected or destroyed by drainage or other changes in hydrology. In these cases, restoration of hydrology is needed as a first step. In other, more rare cases wetlands needs management like grazing or mowing to keep the ecosystem in place, like wet meadows, some rich fens etc.

Many mires are forming hydrologically connected wetland areas consisting of many different mire types. These areas are called mire complexes. The mire types can be bogs, string mires, inundation fens, flat fens, sloping fens, palsa-mires and swamps. Each mire type has its own hydrological and climatological demands for its long-term existence.

The distribution of mire-types and mire complex types follows a regionality that can be divided in different regions. At the moment, we are in the palsa mire region. Palsa mires are unique ecosystems in the northern hemisphere depending on permafrost. The peat mounds formed like giant chocolate puddings are getting destroyed. Many of them are dying and melting due to climate change, in this area having the double accelerating speed compared to the globe-average. Besides the giant task to halt climate change, we should also examine the possibilities to carry out rescue missions on dying palsas. This could seem like an impossible task, but we should at least try to find out if there is anything that could be done to preserve, at least some examples of them until we have reversed climate change.

Generally, wetland conservation is a good thing. They have a unique biodiversity and are beautiful natural components in the landscape and besides of this the give us numerous ecosystem services. They help to maintain water in the landscape, supporting ground water, serving water for wildlife and forest/agriculture production. They store carbon, act as water -cleaners, reduce eutrophication-substances and gives us possibilities to pick cloudberry's, hunt and fish.

Restauration of wetlands, where possible, is important to get back ecosystem services lost by drainage and other changes. The Swedish government initiated a special action program for wetland restoration and establishment in 2018 with a financing of several hundred million SEK. Hundreds of restoration project started and hopefully this campaign together with the work on the Swedish mire protection plan will lead to a better situation for the wetlands.

An important base for all wetland work is to have a sound knowledge base of the functions, distributions and variability. The most important work in this area carried out in Sweden is the Swedish Wetland Inventory (VMI) that started 1981 and ended 2005. All larger wetlands were surveyed (at least the size of 10 ha in the south and 50 ha in the north) with aerial photos and about 10% of them surveyed in the field. This covered the whole county except the alpine region. Data on size, drainage, status, ecosystem type and distribution were collected and stored in a database where county administrations, municipalities, government agency's etc can use wetland data for conservation work and avoiding damage of valuable wetlands. This inventory been the most important base for wetland conservation in the country.

A special EU-Life project was carried out in Sweden 2010-2015, restoring about 2500 ha of drained mires has been a very successful pioneer project from which we can learn a lot of the best methods in different regions. Another project worth mentioning is the Arctic Wetland project, initiated by the Swedish government. This project works within the Arctic Council /CAFF and will identify knowledge-base: inventories, land-use, damage, indigenous peoples use etc. In the ongoing face there are a production of case-studies – good examples of different restauration/management measures in different regions, with different stakeholders. Maps of wetland distribution, status, threats, land use in the Arctic will be produced and the goal is that in produce policy recommendations for different regions within the Arctic.

3. Protection of wetlands in Finland

Eira Luokkanen
Centre for Economic Development, Transport and the Environment of Lapland, Finland
E-mail: eira.luokkanen@ely-keskus.fi

In Finland human impact has affected wetlands very strongly. From the original 10,3 million ha of peatlands (for example Vasander 1998), there were 9,7 million ha left in 1950's, of which 8,8 million ha were still undrained mires (Ilvessalo 1956). In 2010 the total area was 8,8 million ha, of which only 4,1 million ha were considered undrained (Korhonen 6 al 2017).

The IUCN Red list of Ecosystems, that Finland participated in developing and testing, was taken into use in 2014. According this system, 57 % of the 69 mire types identified in Finland are threatened, and appr 35 – 40 % of the undrained area belong to the threatened habitats.

The Government and the environmental administration have launched extensive nature conservation programmes based on the Nature Conservation Act and various action plans in order to safeguard biodiversity. The most important action programme is Forest Biodiversity Programme for Southern Finland (METSO). In total there are six national nature conservation programmes covering mires, waterfowl habitats, eskers, herb-rich forests, shore areas and old-growth forests, most areas belonging also to the Natura 2000 network.

The state must negotiate with landowners for the implementation of private lands belonging to the conservation programme areas. Implementation can take place by selling the land area to the state, land swap or establishing a private nature conservation area (compensation payments). 99 % of the programme areas have been implemented voluntarily. Approximately 13 % of Finnish mires area protected.

Metsähallitus administrates State owned land and Metsähallitus Natural Heritage Services is responsible for the ecological management of protected areas. Natural Heritage Services also carries out habitat restoration and ecological management work in many privately-owned protected areas.

There are further steps planned to include for example developing infosystems (Finnish Ecosystem Observatory FEO -project), developing nature reporting and certification system, Reporting of Nature directive (in April 2019); The report for Finland biodiversity strategy and action plan 2019 and EU Prioritized Action Framework (PAF) –programme for the financing period 2021-2027. The strategic project of the Ministry of the Environment 2019-2020 includes pilot projects and reports and the goal is to have a new widening action plan starting from 2021 (comparable to METSO).

4. Monitoring of palsa mires in Norway

Annika Hofgaard
Norwegian Institute for Nature Research, P.O. Box 5685 Torgarden, NO-7485 Trondheim, Norway
E-mail: annika.hofgaard@nina.no

The Norwegian monitoring program for palsa areas was initiated in 2004 by the Norwegian Environment Agency. The program is designed to reveal changes in climate-sensitive ecosystems and includes six selected permafrost areas from Finnmark County in northern Norway to the Dovre region in south-central Norway. The areas represent the western fringe of the North-Eurasian permafrost region. The proximity to the Atlantic and Barents Sea regions makes Norwegian permafrost areas sensitive climate change indicators both regarding ecosystem components, such as edaphic structures and biotic communities, and regarding change rates.

Selected areas are characterized by a mosaic of palsas, peat areas without permafrost, wet sedge areas, and thermokarst ponds, and are highly dynamic through time due to growth and decay of palsas. Monitoring areas are reanalysed each fifth year and the results are presented in annual reports. The monitoring program is based on line-analyses complemented by air photos. The line-analyses include distribution of land cover types, bottom-, field- and shrub layer components, permafrost distribution, thaw depth, frequency of peat cracks, and height above surrounding mire.

All studied areas have experienced a reduction in palsa frequency and distribution during last decades, but formation of new palsas has occurred in some areas. However, these are mostly of ephemeral character. The main climatic background for recorded changes is a pronounced change in precipitation regime (close to a doubling since the beginning of the 20th century in some areas) combined with warmer temperatures.

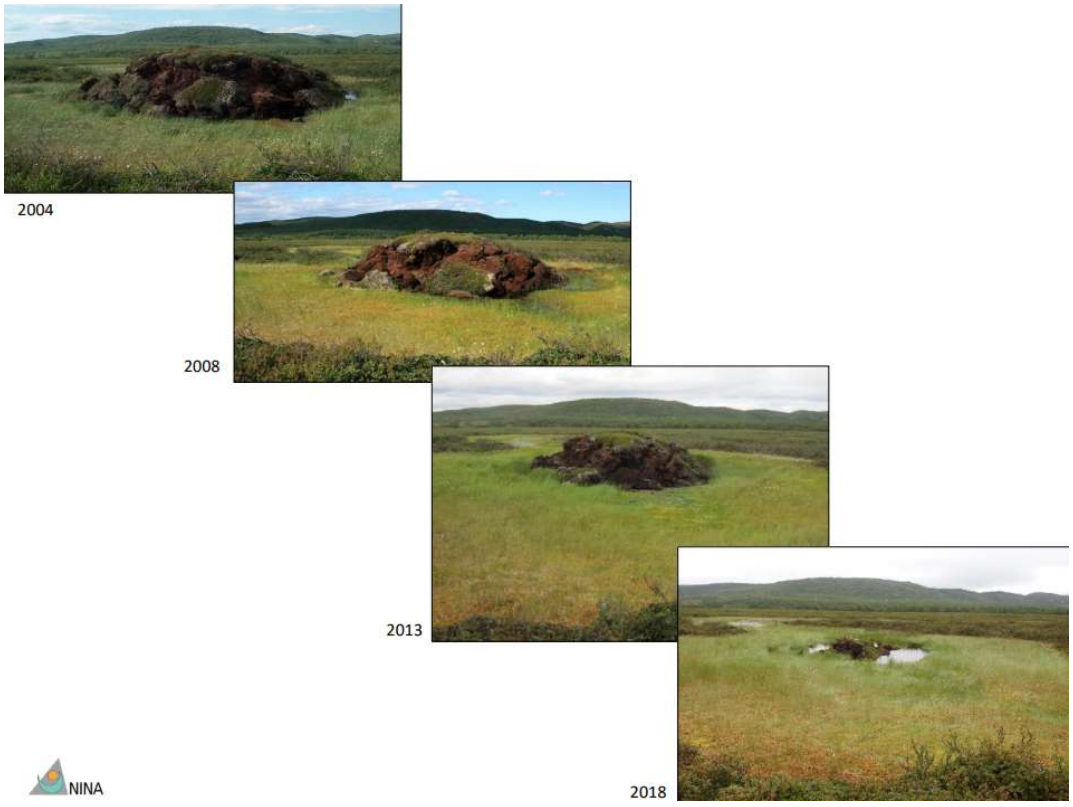

Photo 1. Palsa mire degradation. Source: NINA Trondheim

5. Monitoring of palsa mires in Sweden

Susanne Backe
County Administrative Board of Norrbotten, Sweden
E-mail: susanne.backe@lansstyrelsen.se

Pilot study for monitoring of palsa mires in Sweden 2009-2013

A pilot study was started in 2009 for a monitoring program of palsa mires in Sweden. The overall purpose was to develop an operational method based on very high-resolution satellite data in combination with detailed laser scanning data for monitoring. Ten palsa mires were subjectively selected depending on spread in region, different palsa types and stages and available historical data. Detailed documentation was done for four of the sites for example transects for vegetation, palsa height and palsa mapping. The most useful parameters were the palsa area and palsa volume. The result from the ten sites was detailed but not enough for describe the whole palsa population in Sweden. For that reason, Swedish Environmental Protection Agency (SEPA) decided 2013 to revise the monitoring program from the pilot study.

Mapping of all palsa mires in Sweden 2013

Commissioned by the Swedish Environmental Protection Agency, a mapping of palsa mires in Sweden was made by County Administration of Norrbotten in 2013. The mapping was performed by aerial photo interpretation in a grid of squares (100 m x 100 m). In each square, the percentage of palsas and water related to palsas was specified. A total of about 250 000 squares were mapped. 12 960 of these squares contain palsas. The total palsa area was 1977,30 hectares. 99,9 % of the Swedish palsa area is situated in the County of Norrbotten and the remaining 0,1 % in the County of Västerbotten. 47 % of the palsa area is situated within protected areas, e.g. national parks, nature reserves and Natura 2000 sites. Vissátvuopmi, the largest contiguous palsa mire complex in Sweden, containing 13,8 % of its palsa area, is not protected. The reporting to the EU 2013 for palsa mires complex, according to Article 17 of the Habitats Directive, was based on results of the mapping.

Program for Monitoring of palsa mires in Sweden 2018

The monitoring program was revise on basis of the mapping of all palsa mires in Sweden who describe the whole population (12 960 hectare or 100x100 meters squares). 260 squares (100x100 meters) was random sampled, stratified from 20 groups (depending om how much palsas there was 2013). For the EU´s Article 17 reporting 2019 SEPA needed new data for the palsa mires. In 2019 all the 260 squares were mapped based on new aerial photos from 2016-2018 compared with the Total mapping aerial photos from 2008-2010. 35 % of squares with palsas was intact. 65% had declined palsa area between 1 and 21 % (mean 2,4 % lesser area).

The 260 randomly selected squares are now even the basis for the SEPA´s National monitoring program – Climate related monitoring. Detailed palsa area and palsa volume will be mapped in 3D terrain model based on aerial photos and The National elevation model of Sweden. From this “National total palsa area 2016” and “National total palsa volume 2016” will be calculated. Plans for updating of these national parameters are 2024 depending on new aerial photos and elevation models.

6. Palsa mire research in Sweden

A. Britta K. Sannel
britta.sannel@natgeo.su.se, phone +46 8164795
Stockholm University, Department of Physical Geography, 106 91 Stockholm, Sweden

Permafrost peatlands are widespread in the sporadic and discontinuous permafrost zones around the circum-Arctic and store ~300 Pg carbon (C), which is nearly 25% of the total soil organic carbon (SOC) in the northern circumpolar permafrost region (Hugelius et al. 2014). Palsa mires and peat plateaus in Sweden are located in the southern part of the permafrost region and are therefore very sensitive to future warmer conditions. Time-series analyses of aerial photographs have shown extensive reduction in palsa area, and changes in lake distribution in these landscapes since the 1960s (Zuidhoff and Kolstrup 2000, Sannel and Kuhry 2011). Thawing and warming permafrost has also been reported by monitoring studies, showing that the active layer has been getting deeper and mean annual ground temperatures have increased by ~0.6 °C/decade since the 1990s (Åkerman and Johansson 2008, Johansson et al. 2013, Sannel et al. 2016). As the permafrost thaws, palsa mires will contribute with emissions of greenhouse gases (both carbon dioxide and methane) temporarily turning these ecosystems into carbon sources, but on longer time scales these wetlands can return to being carbon sinks as fen vegetation develops in drained collapse features and new peat is accumulating.

References

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Zuidhoff FS, Kolstrup E, 2000: Changes in palsa distribution in relation to climate change in Laivadalen, northern Sweden, especially 1960–1997. Permafrost and Periglacial Processes 11, 55–69.

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7. Palsa mires and monitoring in Enontekiö, Finland

Mariana Verdonen[1], Timo Kumpula[1], Pasi Korpelainen[1], Teemu Tahvanainen[2], Tiina Kolari[2]
[1]Department of Geographical and Historical studies, University of Eastern Finland, FI-80101 Joensuu, Finland
[2]Department of Environmental and Biological Sciences, University of Eastern Finland, FI-80101 Joensuu, Finland
Contact: mariana.verdonen@uef.fi

According to Finnish classification, palsa mire is a habitat complex that includes the whole mire area with palsas (417 km2). The area trend of these habitat complexes is considered ”stable”, while the trend of habitat quality is ”declining”, as palsa mounds and peat plateaus are degrading.

At UEF, various research methods on different scales are applied to detect and monitor changes in palsa mires in Enontekiö:

- Manual digitising of palsa mounds and peat plateaus from aerial image time series has shown a decrease of ca. 48–71 % in sample areas (Peera, Iitto and Nierivuoma) between 1959 and 2012.
- Around 400 annual (end of August) active-layer thickness measurements are taken since 2007 at Laassaniemi and Peera near Kilpisjärvi, using a 1 m metal probe and an RTK-GPS.
- 17 palsa mires along Käsivarrentie are monitored every August and every 2nd June by using Unmanned Aerial Systems (UAS) surveys since 2016/2017. Datasets include detailed digital elevation models (DEM) and multispectral orthomosaics. FLIR (temperature) data is also available from several locations.
- Three remote palsa mires located at different altitudes were visited in July 2018 as part of the SHIFTMIRE project (Academy of Finland, PI Teemu Tahvanainen). The data collected includes orthomosaics and DEMs from UASs, ca. 700 active-layer measurements, vegetation plots and gas and water samples. Some of the on-going applications are modelling of the the active-layer thickness based on remotely sensed data only, and extracting palsa mounds and peat plateaus from DEMs in a semi-automatic way.

Session 2 - Wetlands and ecosystem services in a changing climate

8. Ecosystem services connected to palsas and their climate change issues

Paul Eric Aspholm
Norwegian Institute of Bioeconomy Research, Svanhovd research station, 9925 Svanvik
E-mail: paul.eric.aspholm@nibio.no, mobile +47 93220452

The descriptions of goods and ecosystem services from palsas has very few references. The ecosystem functions of palsa are described. Among the provisioning ecosystem services, the palsas are mainly regarded as important for sustaining birdlife and some plants in the area. Some regulatory and maintenance ecosystem services are mentioned, i.e. carbon storage. The cultural ecosystem services have been given little attention, though several sources describe such services in historic and anthropological connections. Palsa systems differ from rounded heaps in Fennoscandia to flattened polygonal palsas in Siberia, as do their dimensions, from micro-palsas to giant sized palsas. This creates a variety of ecosystem functions and ecosystem services. The ecosystem services from palsa still need to be better investigated, and most likely, there are several more services to be revealed.

Observing the physical "life" of a palsa reveals connections to climate parameters of different scales: global to microclimate effects. The vulnerability of palsa to anthropogenic effects is also interesting and important to analyse, often small and unexpected incidents from the view of humans can make huge impact on the palsa.

Photo 2. Palsa in 2019 (Mire near Vesterelv in Karlebotn). Photo: Tiia Kalske (private)

10. Wetland monitoring and restoration in Sweden

Helena Öberg,
Swedish Environmental Protection Agency
E-mail: Helena.Oberg@Naturvardsverket.se

Environmental monitoring in Sweden

The current general aims of the environmental monitoring in Sweden are to describe the state of the environment and to follow up changes and trends. Monitoring is commissioned by the government and coordinated by the Swedish Environmental Protection Agency. The environmental monitoring is organized in ten program areas. The wetland program consists of two subprograms; “Satellite-based monitoring of wetlands” and “Climate-related monitoring” (of palsas).

Satellite based monitoring

The satellite-based wetland monitoring is developed for monitoring open mires and to detect changes in biomass related to land use. The method is based on a two-step approach using satellite images from two different points in time, with 10 years apart.

The first full rotation of the inventory started in 2007 and was completed in 2017. The surveyed area consists of open mire below the Alpine zone and covers in total 3 650 000 ha (ca. 8 % of Sweden's total land area). Changed areas are divided into two classes representing increased biomass/overgrowth; strong indication of change and potential indication of change. Ca 25 000 ha (0,77 %) of the analysed open mire resulted in strong indication of change and 21 000 ha (0,63 %) resulted in potential indication of change.

Analysis of the proportion of change adjacent to different types of land shows that open mires within 100 meters from agricultural land have the highest proportion of change. Comparative analyses between the satellite-based wetland monitoring and VMI-sites show that open mire with high degree of impact according to VMI also has high proportion of change according to the results from the wetland monitoring programme. Type of human impact registered in VMI and the Satellite based monitoring show strong similarities. Drainage is the most common impact, followed by logging and roads.

Restoration of wetlands

Sweden has lost about 25 % of its wetlands since early 19th century. Ditching on a large scale started in the late 19th century, to get more arable land and increase production in both forestry and agriculture, and was given large grants from the government.

The unusual droughts and low ground water tables in Sweden during 2016 and 2017 led to the government-initiated Wetland restoration project in 2018. The project had 200 million SEK in the budget that was used as grants to local projects through an existing program called LONA, local nature conservation projects. This program addresses local municipalities together with land owners and other stakeholders. Also, the County Administrative Boards got extra grants for wetland restauration in protected areas. During 2018 the project resulted in 160 local projects and 281 restoration measures in protected areas.

11. Restauration of Peatlands in Finland

Luokkanen Eira
Centre for Economic Development, Transport and the Environment of Lapland, Finland
E-mail: eira.luokkanen@ely-keskus.fi

The first steps in restoration of peatlands were taken as early as in 1970' and 1980's, when sites of very high ecological value were restored very soon after they had been drained. In practice the work started with manual blocking of ditches, and since 1992 machinery has been involved.

Since mid-1990's EU Life funding has been an important funding tool for the work leading to increased restored areas. Almost half of the Life nature projects have concerned peatlands to some degree, promoting the conservation of peatlands through additional protection or enhanced land use planning, by restoring peatlands earlier cleared for agriculture or drained for forestry purposes, and even by recreating areas of peatland habitat where such areas had been lost.

Peatland associated habitat types restored in Life projects (by 2012) were active and degraded raised bogs (1700ha), aapa mires (4000 ha), bog woodlands (2000 ha), alkaline fens (350 ha) and transition mires and quaking bogs (>100 ha).

In 2003 the first national Forest Biodiversity Programme METSO launched and findings of the habitat restoration working group (appointed by the Ministry of the Environment) were published.

In 2013 a new guidebook for the restoration (in Finnish) was published (Aapala et al. 2013). The work was coordinated by the Finnish Expert Group for Peatland Restoration (SuoELO*) in connection with the Boreal Peatland LIFE project and the Forest Biodiversity Programme METSO, with funding from the Ministry of the Environment https://julkaisut.metsa.fi/julkaisut/show/1601

The core results were published also in English under the title Ecological restoration in drained peatlands - Best practices from Finland (Similä, Aapala & Penttinen (Eds) 2014). The publication was financed through the Boreal Peatland LIFE project https://julkaisut.metsa.fi/julkaisut/show/1733

Restoration methods have been subsequently improved but restoring natural hydrological conditions to peatlands still cannot be considered as a straightforward process where success can be assured. The most serious water quality problem, that is not easy to predict, is the risk of a steep increase in phosphorus leaching, that occurred in more than half of the sites monitored.

NATNET Life+ -project (2012-2016) was presented http://en.natnet.fi/

12. Restoration of peat land and wetlands in Norway – background, status and challenges

Vibeke Husby and Jan Petter Hubert Hansen
Norwegian Environment Agency
E-mail: jan.petter.hubert.hansen@miljodir.no, vibeke.husby@miljodir.no

Wetlands are degraded and vanishing fast all over the world. International focus on wetlands role as food security, climate adaptation, carbon and other climate gas deposition and biodiversity. Work is going on to restore wetlands in accordance with numerous conventions.

National focus in Norway: Norway following international actions. National action plan for biodiversity (2015), is action to restore wetlands – following Aichi goal 15 (to restore at least 15% of degraded ecosystems).

National aims: reduce climate gas emissions, climate adaptation (flood prevention), improve ecological status. Premise: cost effectiveness, volunteering, not in conflict with agricultural/ forestry interests (or other important community interests).

Knowledge base for mires and wetlands is greatly improved under the planning process. Plan in implementation. Own budget post (c. 23,5 mill NOK/ year). Restorations started in protected areas. Raised bogs are prioritised. So far c. 50 mires have been restored (most in southern Norway).

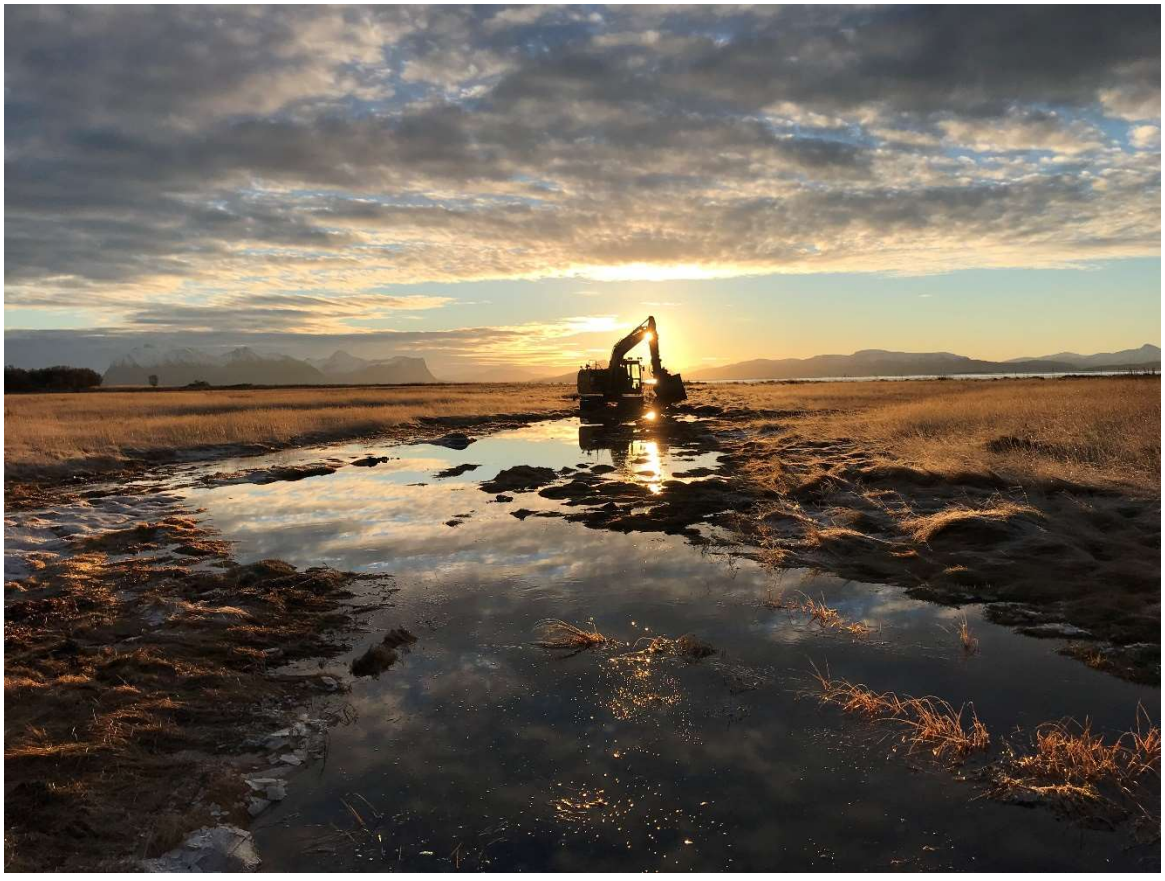

Photo 3. Wetland restoration. Photo: Michael Eklo

Seminar conclusions

- Mires and wetlands are undoubtedly very important and productive ecosystems; as carbon storage, water reservoir, water purification effect, flood prevention, important for biodiversity just to name a few important issues.
- Wetlands are also relatively stable ecosystems if one does not "mess and damage" the hydrology.
- Countless ecosystem services – provisioning, regulatory and maintenance and cultural services.
- Several ecosystem services and cultural are known but still many are not described. The ecosystem services should preferably be enlightened.
- Palsa mires a speciality for the northernmost Fennoscandia and circumpolar arctic countries. Palsa mires are "witnesses from" the little ice age.
- Palsas are disappearing fast – if the current climate regime is continuing the next generation may only look at this unique biotope from pictures – very sad. Crazy solution could be a “palsa mire museum” (cooling the ground).
- "Palsa is an endangered type of nature."
- Protecting *still* intact mires and wetland systems is important.
- Restoration of wetlands is important where you do not have/ or have only a few wetlands left.
- Trails, terrain driving, ditching, cultivation and agriculture, forestry, take out peat is degrading mires and wetlands in a fast paste.
- There is much to learn from each other across the borders.
- There could be a need to harmonize existing monitoring methods in northernmost Fennoscandia.
- Research activities are already in a fairly good collaboration through projects.
- Stable funding is a challenge for both monitoring, and research activities.

Annex 1 Program and venue

Nordkalottrådet
Pohjoiskalotin neuvosto
The North Calotte Council

Time and place: 2.-4. October 2019, Vadsø Norway
Venue: Vadsø Fjord hotel, https://www.vadsoe.com/nb/vadso-fjordhotell
Funder: North Calotte Council

Participants: Nature protection authorities in the North Calotte region, researchers and other relevant stakeholders. C. number 15-25 persons (5-10 persons/ country – Finland, Sweden and Norway)

Seminar language: English

Program (all times are local Norwegian times)

Tuesday 1st October – Arrival for some participants

Wednesday 2nd October Day 1 – Arrival and seminar start
~13 Arrival and accommodation at Vadsø Fjordhotell
C. 13-14 Lunch at hotel
14-18.45 Session 1: Meeting/ seminar (4 h), incl. 1 break
19-20 Evening walk - short walk to Vadsøya cultural and nature trail
20 Dinner at hotel

Thursday 3rd October Day 2 – Seminar and excursion
c. 7- Breakfast
8.30-12 Session 2: Meeting/ seminar commences (3,5 h), incl. 1 break
12-13 Lunch at hotel
13-c. 20 Excursion to palsa mire/ mire near Vadsø (7 h), coffee and sandwiched in the field. Transport: cars
20 Dinner at the hotel

Friday 4th October Day 3 - Return home
Breakfast
Return home

Annex 2 Seminar agenda

Welcoming words and presentation of participants

2nd October (time 14-18.30, 4 h) Session 1 – Wetlands of the North Calotte	
Protection of wetlands	14-14.30 Protection of mires and wetlands in Arctic Norway: Jan Petter Hubert Hansen, Norwegian Environment Agency (over skype) 14.30-15.00 Protection of wetlands in Sweden: Michael Löfroth, Ministry of the Environment and Energy, Sweden 15-15.30 Wetland protection in Finland: Eira Luokkanen, Lapland ELY- centre, Finland
Palsa mires *Biodiversity and monitoring*	15.45-16.30 Monitoring of palsa mires in Norway: Annika Hofgaard Norwegian Institute for Nature Research (NINA) 16.30-17 Monitoring of palsa mires in Sweden: Susanne Backe, County Administrative Board of Norrbotten, Sweden 17-17.45 Palsa mire research in Sweden: Britta Sannel, Dept. of Physical Geography, Stockholm University, Sweden 17.45-18.30 Palsa mires and monitoring in Enontekiö, Finland: Mariana Verdonen, University of Eastern Finland

3rd October (time 8.30-12, 3,5 h) Session 2 – Wetlands and ecosystem services in a changing climate	
Ecosystem services and climate change issues	8.30-9.15 Ecosystem services and climate change issues: Paul E. Aspholm Norwegian Institute of Bioeconomy (NIBIO)
Restoration status and measures	9.15-10 Arctic Wetland Project and Swedish wetland inventories, conservation and restoration: Michael Löfroth, Ministry of the Environment and Energy 10-10.45 Wetland monitoring and restoration in Sweden: Helena Oberg, Swedish Environmental Protection Agency 10.45-11.15 Restauration of wetlands in Finland: Eira Luokkanen, Lapland Ely-centre, Finland 11.15-11.45 Restoration of wetlands in Norway: Jan-Petter Hubert Hansen, Norwegian Environment Agency (over skype)

Concluding remarks and closing of the seminar
Excursion to Karlebotn palsa mire, Varangerbotn and Nesseby Nature Reserves along the way

Annex 3 Participants list

Finland	**Organisation**
Eira Luokkanen	Lapland ELY centre
Mariana Verdonen	University of Eastern Finland
Sweden	
Ellinor Bomark	County Administrative Board of Norrbotten
Susanne Backe	County Administrative Board of Norrbotten
Britta Sannel	Dept. of Physical Geography, Stockholm University
Michael Löfroth	Ministry of the Environment and Energy
Helena Oberg	Swedish Environmental Protection Agency
Norway	
Annika Hofgaard	NINA Trondheim
Paul Eric Aspholm	NIBIO Svanhovd
Heidi Marie Gabler	Office of Troms and Finnmark County Governor
Liv Mølster	Office of Troms and Finnmark County Governor
Asgeir Blixgård	Reisa National Park Board (National Park Manager)
Tor Asbjørn Aslaksen Simonsen	Office of Troms and Finnmark County Governor
Tiia Kalske	Office of Troms and Finnmark County Governor

Photo 4. Participants. Photo: Paul E. Aspholm