Four Post-Doc Stipends to explore effects of peatland forest management on the hydrology and greenhouse gas balance

One million km of ditches have been dug in peatlands and wet mineral soils over the last 100 years in Sweden, primarily to improve forest growth. Many ditches have resulted in new areas of productive forests, while others have only led to large-scale wetland degradation. The question now is what to do with this large number of aging forest ditches: i) restore them to more natural conditions, ii) follow the forest industry's recommendation to increase ditch cleaning activities to maintain high biomass production, or iii) leave them to develop freely? Before any informed decisions can be made, improved knowledge about the implications of the different management options for environmental and climate benefits is urgently needed.

To overcome this lack of scientific knowledge and close the gap between science and management, **we are seeking 4 Post-Doctoral researchers to explore ditch cleaning and restoration effects on the hydrology, water quality, and GHG balances.** This work will be carried out at the experimental ditch management infrastructure, called Trollberget in Krycklan, located in Northern Sweden.

Trollberget includes one of the first fully replicated and controlled experimental catchment system including restored and ditch-cleaned peatlands, as well as historical ditch networks 'left-alone' for free development. This experimental research infrastructure, funded by the Kempe Foundation together with the European Union LIFE Integrated project "GRIP on LIFE-IP" is one of the most well instrumented experiments world-wide for answering questions about the legacy and management aspect of historically ditched wetlands.

Project description

The ambition of this 4-postdoc program is to identify, separate, and quantify the consequences of the different management options on hydrology and water quality as well as carbon/methane dynamics of different management strategies of historical ditches. The program will be organized in four complementary Work Packages (WP) each requiring one dedicated Post-Doc. These include investigations of the effects from ditch-cleaning and wetland restoration on hydrological consequences (Post-Doc 1), fluxes of dissolved organic and inorganic carbon in streams (Post-Doc 2), effects from rewetting of a drained peatland forest on the GHG balance (Post-Doc 3), and on ditch cleaning effects on the GHG balance of a recent forest clear-cut (Post-Doc 4). Throughout the project, the 4 Post-Docs will work as a team with the goal to develop synergistic research collaborations.

Post-Doc 1: Hydrological consequences of ditch-cleaning and restoration

The degree to which groundwater levels and stream runoff are affected by various ditch maintenance strategies is determined by the catchment's ability to store water temporarily and release it over time, thus buffering extreme flooding as well as periods of low flow. While processes by which catchments release water always will remain central to the hydrologic community, we have become increasingly aware of the importance to understand, describe and predict how catchments retain water in order to regulate flow and carbon. From a carbon perspective, groundwater levels determine the uptake, production and release of both CO_2 and CH_4, and stream runoff regulate the export of organic and inorganic carbon through the stream network. Hence, hydrological changes after both ditch maintenance and wetland restoration is not only of relevance for catchments act as sinks and sources of carbon.

To evaluate how different wetland management strategies affect the hydrological processes the Post-Doc will use the unique long-term data from monitoring of groundwater and stream runoff from Trollberget. The data will be evaluated using a storage-release method suggested by Staudinger et al. (2017), to test the effect of

various ditch maintenance strategies with respect to storage and release of rain and snow melt inputs. In boreal regions, wetlands are areas with very large total water storage potential, but with small dynamic storage, which makes them especially prone to disturbance. Hence, an important goal of the project is to evaluate how ditch-cleaning and restoration affects the storage of groundwater as well as the processes that govern the release of water into streams to link these processes to WP2-4.

***For further information please contact*: Hjalmar Laudon (Hjalmar.Laudon@slu.se; https://www.slu.se/en/ew-cv/hjalmar-laudon/)**

Post-Doc 2: Stream carbon losses of various ditch maintenance strategies

Peatlands play a major role in regulating carbon release to the stream network. High concentrations of dissolved organic carbon (DOC) and dissolved inorganic carbon (DIC) are defining features of streams draining these large carbon-storing peatlands. In fact, stream export of DOC and DIC combined can be substantial – and even turn peatlands from an apparent carbon sink to an actual carbon source as the climate changes. Recently, the legacy of peatland drainage was demonstrated by Asmala et al. (2019), who showed that the extent of the ditch network in Finland is an important reason for the recent increase in stream water DOC (sometimes called “brownification”). What role historical drainage has had on DOC in Sweden is unknown. Even less is known about what past, present, and future ditch-cleaning and restoration activities may have on export in streams of other forms of carbon such as CO2 and CH4.

This Post-Doc will evaluate how the different management options of ditch-cleaning, wetland restoration, or being left alone for free development affect stream carbon losses using the before-after-control design. The focus here will be on evaluating the effect of the different wetland treatments on the export of both DOC, as well as gaseous loss from streams as both CO2 and CH4.

***For further information please contact*: Eliza Maher Hasselquist (Eliza.hasselquist@slu.se; https://elizamaherhasselquist.weebly.com/)**

Post-Doc 3: Evaluating the GHG balances of drained and restored peatland forests

Natural peatlands provide a small but persistent long-term C sink. However, their extent in Sweden has declined by about 1.5 to 2.0 million hectares over the past century due to drainage for forestry. Presently, extensive efforts are being launched by governmental agencies and forest stakeholders in Sweden to restore these disturbed ecosystems back towards a more natural state with the aim to reduce potentially major GHG emissions from these areas. Despite this high interest and activity level, the empirical foundation for evaluating the implications on the GHG balance is lacking. Thus, the actual GHG mitigation potential of rewetting measures is at present highly uncertain.

In WP3, the Post-Doc will make use of a unique GHG measurement program in a rewetted boreal peatland forest that combines ecosystem-scale eddy covariance and spatially extensive plot-scale chamber measurements of CO_2 and CH_4 fluxes, soil environmental variables, vegetation composition and biomass. Together with similar data from adjacent drained and natural sites, these data will enable direct evaluations of the effects of restoration activities on the GHG dynamics and balances of drained peatland forests in boreal Sweden.

***For further information please contact*: Järvi Järveoja (Jarvi.Jarveoja@slu.se; https://www.slu.se/en/ew-cv/jarvi-jarveoja1/)**

Post-Doc 4: Ditch-cleaning effects on the GHG balance of a boreal forest clear-cut

In the boreal region, many forests have been grown on historically drained areas. Since the original drainage ditches are commonly degraded by the end of the forest rotation period, post-harvest ditch-cleaning is considered an effective practice to restore the drainage function and thereby facilitate tree seedling establishment. According to the Swedish National Forest Inventory (NFI), ditch-cleaning activities have more than tripled

during the past decade accumulating to over 82 000 ha of forest area in Sweden. However, empirical evidence for the effects of ditch-cleaning on the GHG balance of forest clear-cuts is lacking at present. This knowledge gap hampers the evaluation of the overall benefits from post-harvest ditch cleaning when taking into account its implications on both forest biomass production and climate impacts.
In WP4, the Post-Doc will utilize measurements from a recently established experiment within the Trollberget area that includes a pair of adjacent watersheds that were clear-cut in autumn 2020. Both clear-cut sites have been equipped with eddy covariance towers to measure the ecosystem-scale exchanges of CO2. In addition, transects have been established to quantify soil CO2 and CH4 fluxes using the chamber method to further investigate their spatial variability, particularly with respect to distance from drainage ditches. Both watersheds were monitored in parallel during 2021 before the ditches at the treatment site were cleaned in autumn 2021. This unique experimental set-up will deliver a first-time estimate of ditch-cleaning effects on the GHG balance of forest clear-cuts in boreal Sweden. WP4 will therefore provide invaluable empirical data to evaluate the climate impact of ditch-cleaning activities and to guide management-decisions towards climate-responsible forestry.

***For further information please contact*: Matthias Peichl (matthias.peichl@slu.se; https://www.slu.se/en/ew-cv/matthias-peichl/)**

Qualifications:

• The candidates must have a PhD awarded in the fields of environmental sciences, hydrology, meteorology, physical geography or any other closely related subject
• Demonstrated experience with hydrology and catchment biogeochemistry (WP1&2), eddy covariance (EC) data and micrometeorological theory and/or the chamber technique (WP3&4), including data processing and interpretation is required
• The candidates must be able to independently conduct field work, which also requires a driver's license valid in Sweden.
• The candidates must be fluent in English to be able to write, communicate and interact in an English-speaking environment.
• The candidates must have documented experience in writing and publishing scientific articles
• Experience in either one or more of the following is considered a merit: carbon or water cycle research in boreal landscapes (i.e. forests, peatlands and aquatic systems), EC flux measurements in complex terrain, flux footprint modelling, as well as skills in GIS, logger programming and/or in the handling and processing of large data sets

Place of work: The postdoc location is at the Forestry Faculty of the Swedish University of Agricultural Sciences (SLU), Department of Forest Ecology & Management, in Umeå, Sweden.

Employment status: This is a 2 year stipend (scholarship) postdoc awarded through the Kempe Foundation

Starting date: During winter/spring 2022

To apply:

Please send aCV, publication list, PhD diploma, copies of up to three relevant publications and a motivation letter (max. 2 pages) outlining previous research, current research interests and other activities of relevance for the position. Names and contact information of at least two reference persons are also required. All application documents should be written in English.

Please submit your application in electronic form to:
Hjalmar Laudon (Hjalmar.Laudon@slu.se) for Post Doc 1

Eliza Maher Hasselquist (Eliza.Hasselquist@slu.se) for Post Doc 2
Järvi Järveoja (Jarvi.Jarveoja@slu.se) for Post Doc 3
Matthias Peichl (Matthias.Peichl@slu.se) for Post Doc 4
Reviewing of applications will begin on **December 15** and will continue until a suitable candidate is found for each position.
Information about living and working in Sweden:
https://pub.epsilon.slu.se/16119/17/stephan_k_stephan_j_190506.pdf
https://sites.google.com/view/slupostdocs/useful-info/sweden#h.p_4gO5lPVuAQgB