Restoring peat for the climate's sake

The LIFE PeatCarbon project team are working to restore peatlands across Finland and Latvia, helping save the peat carbon storage and mitigate the impact of climate change, as the project experts Dr. Māra Pakalne, Dr. Tuula Aalto, Dr. Sari Juutinen, Dr. Jenni Hultman, Msc. Rūta Abaja-Felce and Indigo Janka explain.

A significant proportion of Europe's peatlands have been drained over the past few centuries, often for use as agricultural land, which has led to rising emissions of carbon dioxide (CO_2), a major greenhouse gas. Peatlands act as a vast carbon sink in their natural wet state, but when the water level goes down, decomposition is strongly enhanced, leading to the emission of CO_2 into the atmosphere. "The moment that these peatlands are drained they will start emitting CO_2," explains Indigo Janka, part of the team behind the LIFE PeatCarbon project. There is a balance in peatlands between inputs from plant photosynthesis, and outputs in the form of decomposition, which defines the net carbon sequestration capacity. "The outputs from peatlands, when in a pristine state, are smaller than the inputs, though the difference can be really small. It is question of accumulation over long time. It's a wet environment and anoxic conditions prevail, so decomposition is low. Historically the balance has favoured peat accumulation," says Dr. Sari Juutinen, a senior researcher at the Finnish Meteorological Institute.

LIFE PeatCarbon project

The situation changes however when peatlands are drained, which leads to an increase in decomposition of the accumulated organic matter, and more carbon is then released to the atmosphere than is sequestered through the peatland. In Latvia, a lot of carbon storage capacity has

Välisuo project site in Finland. Photo: Jack Chapman.

been lost in this way over the past century or so. "In Latvia, peatlands have been drained since the '30s, while large quantities of peat have been extracted for export,"

"We have seen **dramatic effects** in a **restoration area** where **dams were built in 2006.** When you **close ditches, water is then kept in the bog.** We have seen that the **water level has been raised** at this site."

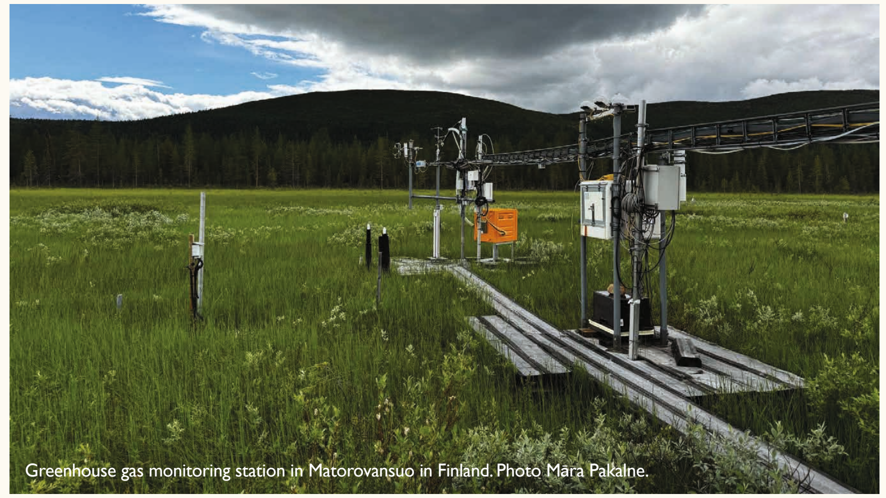
explains Dr. Māra Pakalne, Manager of the LIFE PeatCarbon project. Peatlands in Finland have also changed dramatically over the last few centuries. "Peatlands have been drained extensively in Finland. Around half of the original Finnish peatland area has been drained for forestry," says Dr. Sari Juutinen, a researcher at the Finnish Meteorological Institute. This trend threatens to accelerate climate change if left unchecked. "The amount of carbon in modern peatlands is almost equal to the amount in the atmosphere, so big numbers are involved," stresses Dr. Sari Juutnen.

This issue lies at the core of the LIFE PeatCarbon project, which brings together partners from four European countries (Latvia, Finland, Germany and Denmark) to restore peatlands and help reduce decomposition of old peat layers at four sites in Latvia and Finland. This starts from a deep understanding of the local environment. "In Latvia and Finland we have been carrying out lots of fieldwork, including hydrological, geological and vegetation studies and greenhouse gas flux monitoring, using an applying chamber as well as eddy covariance methods. The combination of methods allows us to get data from a wide area and also truly measure CO_2 exchange over a peatland forest before and after the restoration, and to compare a restored area with the reference one. We have also developed hydro-geological models of the sites," explains Dr. Māra Pakalne.

A deep understanding of local conditions provides a solid basis for restoring peatlands, through measures such as building dams and closing ditches, as well as cutting trees, with the aim of raising the water level and reducing peat decomposition. "Restoration actions in the Finnish sites of Välisuo and Matorova Mires took place in the first half of 2024, and in August 2024 we could already see changes in the water table," says Dr. Jenni Hultman, a senior scientist from the Natural Resources Institute Finland. The ideal location in which to build a dam depends on the local hydrology, and the project team is looking to establish a fuller picture in this respect. "You have to have an understanding of where the water comes from and where it goes in order to restore the natural hydrology of a site," points out Dr. Sari Juutnen. Peat and hydrological studies have been carried out at both the Finnish and Latvian sites, including Lielais Pelečāres Mire, an enormous bog in Latvia covering over 5,000 hectares. "It covers a large area and it's only accessible by one road. So it's a big challenge to even reach it," says Dr Māra Pakalne. "We're also working at the Cena Mire site near Riga, as well as others."

The Cena Mire previously covered around 10,000 hectares, but now only 2,500 remain, with much of the rest now used for urban development and agricultural land. Alongside restoring these and the sites in Finland, Dr. Māra Pakalne and her colleagues are also monitoring the impact of earlier restoration work at other LIFE project sites. "We have seen for example good effects in a restoration area where dams were built in 2006. When you close ditches, water is then kept in the bog. We have seen that the water level has been raised at this site, and die-off of pine trees is observed," she outlines. An ecosystem model is being developed in the project to gain deeper insights into these effects, bringing together data from several sources. "The data collected is being used to train the ecosystem model to better understand the impacts of restoration on GHGs" says Dr. Tuula Aalto, Finland national project coordinator. "We are using different types of remote sensing data in the project. In Latvia we are using airborne and satellite data, while our Finnish colleagues are working with data from drones and satellites," says Rūta Abaja-Felce, a member of the project team.

A large amount of airborne data has been collected from most of the project sites, including some where restoration work has already been conducted. This allows researchers to compare the situation before and after restoration work. "We want to look at the effects of restoration. Does it lead to changes that we can see in the data?" explains Abaja-Felce. Some of the reference data will be gathered using the GEST (Greenhouse Gas Emission Site Types) methodology, an approach which

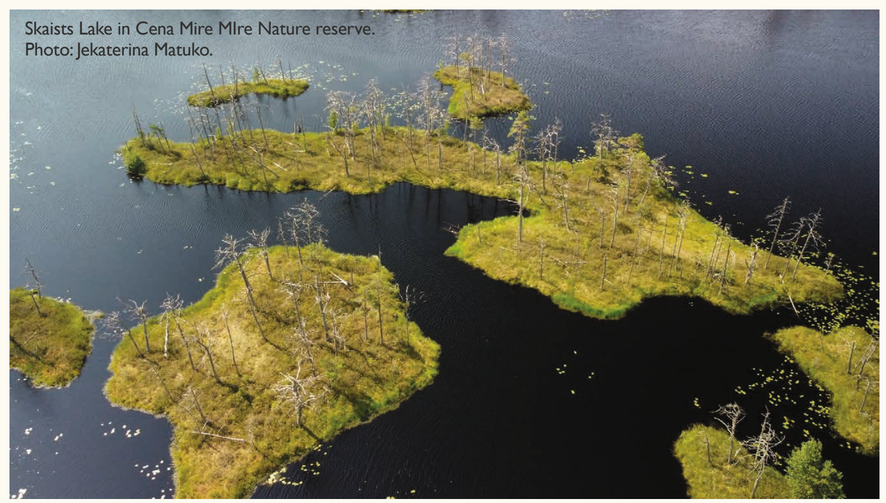


Greenhouse gas monitoring station in Matorovansuo in Finland. Photo Māra Pakalne.

gives researchers an insight into levels of GHG emissions at different sites based on vegetation and water level which can be further mapped using remote sensing images. "With the GEST methodology, the vegetation associated with different sites are linked with specific GHG flux values, using data on groundwater levels as well," continues Abaja-Felce. "We can then map the vegetation from above by using remote sensing. In that way we can then look to produce GHG emission maps for each of the project sites."

This approach is still being refined and modified, as not all GEST types are associated with precise GHG measurements, so scientists are also collecting GHG measurements from the different sites. The relationship between GHG emissions and vegetation types may also vary, depending on the prevailing climate conditions, which Rūta Abaja-Felce says highlights the need for observational data. "There could be some differences between Finland and Latvia for example, so we need these real GHG measurements on the sites, to classify the different vegetation types," she explains. The remote sensing data will be classified using information from the available literature, while GHG measurements gathered during the project will add a further level of detail. "We hope to refine our classifications, which will help us identify what types of GHG emissions could be expected from particular types of vegetation," says Rūta Abaja-Felce.

The goal of ecosystem and hydrological modelling is to build a more complete picture of the relationship between hydrology, vegetation and GHG emissions at peatland sites, which can then guide ongoing restoration efforts. A key indicator of peatland health is the presence of original peatland vegetation, for example Sphagnum moss, which leads - together with other peatland vegetation - to the formation of peat, while the absence of it is linked with degradation. "Very dense cover of heath, without sphagnum mosses under the cover, means that a site is quite degraded," outlines Rūta Abaja-Felce. This remote sensing method could be a cost-effective way of assessing the condition of peatlands, and in planning their restoration and ongoing



Skaists Lake in Cena Mire MIre Nature reserve.
Photo: Jekaterina Matuko.

Peatland restoration area in Cena Mire with Skaists Lake. Photo Jānis Bikše.

LIFE PeatCarbon

Mire restoration for greenhouse gas reduction and carbon storage in the Baltic Sea region

Project Objectives

The LIFE PeatCarbon project aims to mitigate climate change by restoring degraded peatlands in Latvia, Finland, Germany and Denmark, applying innovative GHG monitoring tools, and developing replicable models. The project enhances capacity, provides EU-level best practices, and contributes to the Paris Agreement through measurable emissions reductions and improved national GHG inventories.

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Project Partners

https://www.peatcarbon.lu.lv/en/work-packages/work-packages/

Contact Details

Project Coordinator,
Dr. biol. Māra Pakalne
University of Latvia Botanical Garden,
2 Kandavas Street, Riga,
LV 1083, Latvia
T: +371-2951100
E: mara.pakalne@lu.lv
W: https://www.peatcarbon.lu.lv/

Māra Pakalne, Sari Juutinen, Jenni Hultman, Rūta Abaja-Felce, Indigo Janka, and Roberts Grodko (left to right)

Māra Pakalne, University of Latvia, LIFE PeatCarbon project manager.

Sari Juutinen, Finnish Meteorological Institute, expert in GHG emissions.

Jenni Hultman, Luke, Finland, expert in vegetation and microbial studies

Rūta Abaja-Felce, Institute for Environmental Solutions, Latvia, peatland habitat expert.

Indigo Janka, NABU, Germany, public awareness expert.

Roberts Gorodko, University of Latvia, public awareness expert.

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Raised bog plants in spiders net. Photo Māra Pakalne.

Round-leaved sundew – *Drosera rotundifolia*. Photo Māra Pakalne.

management. "This method can help predict what changes you can expect by restoring the vegetation and raising the groundwater level, and the impact of this on GHG emission levels," continues Abaja-Felce.

This work is currently ongoing, with the project team working intensively to both restore peatlands and monitor GHG emissions. A number of hydrogeological studies have been conducted and advanced hydrological models have been developed for all the sites, while on-site measurements have helped researchers pinpoint which types of habitats within peatlands are associated with large levels of GHG emissions.

Knowledge sharing

The remote sensing method will now be tested at the different project sites, and if it proves reliable and effective then it could be applied at other locations in future, with peatland restoration recognised as a major part of efforts to combat climate change. There are many other projects working in this area, and Janka says the LIFE PeatCarbon team are committed to sharing knowledge and helping restore peatlands so they can store more carbon. "For example, we collaborate extensively with the LIFE Multi Peat project, which is focused on restoring peatlands in Germany and several other countries. Experts meet and talk to each other, exchange information about their results and share best practice," she explains. "This is an important aspect of the project and something that we want to continue. We are trying to make sure that the knowledge and insights that we gain in the project are not lost and are shared widely."

The project is set to run until around the middle of 2027, yet peatland restoration and management is very much a long-term job, so the plan is to continue monitoring these sites to some degree in future. While carbon dioxide emissions can be reduced quite rapidly by restoring peatlands to their natural, wet state, the impact of restoration work in other respects may take longer to assess, underlining the need for long-term monitoring. "For example, it may be that returning original vegetation takes quite a long time after restoration work," says Dr. Sari Juutnen. Project partners from Luke are monitoring microbial communities and their function at the sites in Pallas. "Our pre-restoration results show the sites from well drained areas and the ones from the more pristine, waterlogged sites to host different microbial communities. Also microbial metabolism differs and it will be really interesting to see how the communities change with restoration actions and whether the communities become more similar," states Dr Jenni Hultman.

Project team in Välisuo project site in Finland. Photo: Katri Pasanen

Sudas-Zviedru Mire in the Gauja National Park. Photo: Jekaterina Matuko.