# Peatland restoration for carbon sequestration and climate change mitigation in three Latvian peatlands – LIFE Peat Restore project

**Māra Pakalne, Līga Strazdiņa, Agnese Priede, Krišjānis Libauers**
mara.pakalne@lu.lv, University of Latvia, Kandavas Street 2, Riga, Latvia

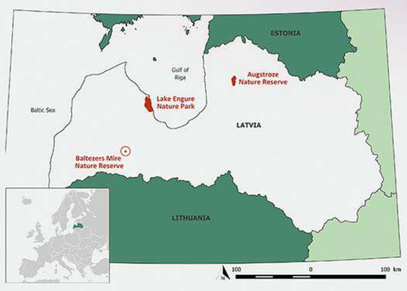


**Figure 1.** Location of project sites in Latvia

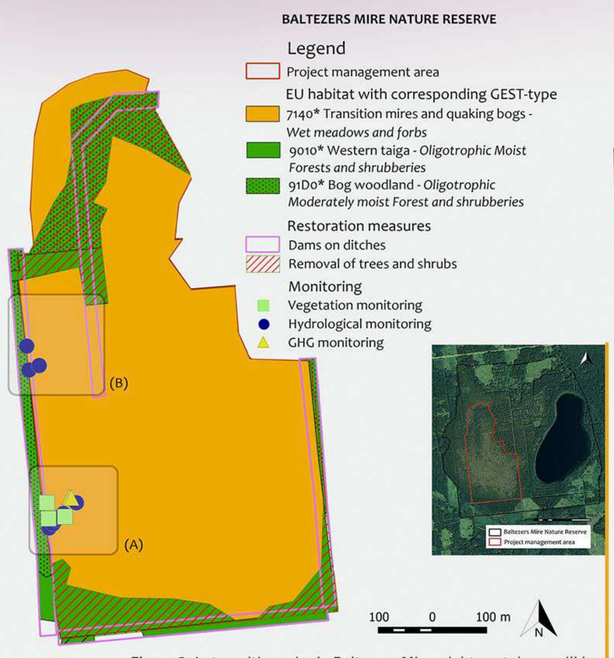


**Figure 2.** In transition mire in Baltezers Mire, eight peat dams will be built on ditches in the mire periphery. Since the tree cover in the restoration area has established mostly due to drainage impact and considerably contributes to evapotranspiration, it is planned to remove the trees and shrubs in 34 ha area. Dominant EU habitat type in management area is 7140 Transition mires and quaking bogs that correspond to GEST type Wet meadows and forbs.

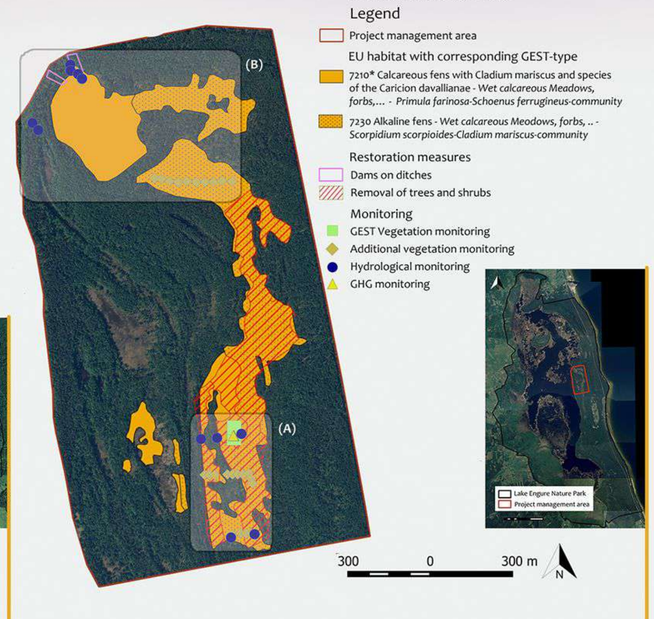


**Figure 3.** In Engure site, overgrowing of an alkaline fen will be prevented by removal of shrubs and trees in 20 ha area. Fluctuations of water table will be reduced by blocking of two ditches using plastic piling. Dominant EU habitat types in management area are 7230 Alkaline fens and 7210* Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*, that both correspond to GEST type Wet calcareous meadows, forbs,...

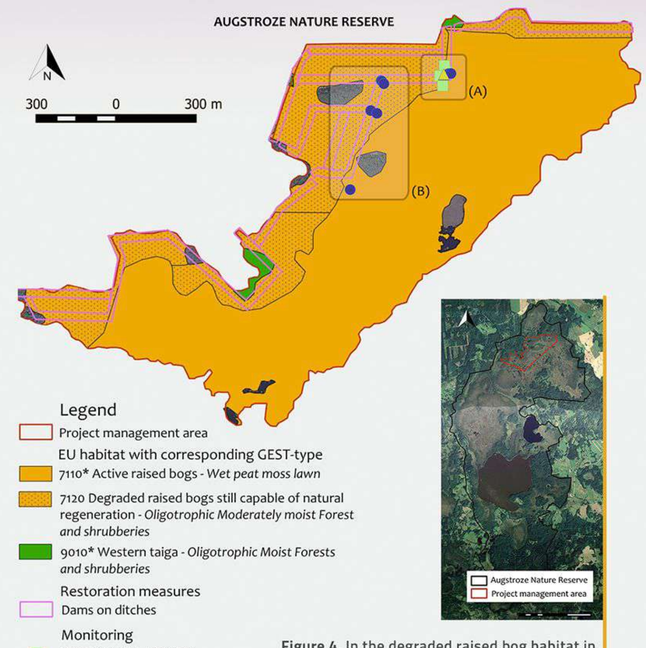


**Figure 4.** In the degraded raised bog habitat in Madiešēnu Mire, 25 peat dams will be built on drainage ditches in total length of 6.2 km. Dominant EU habitat types in management area are 7110* Active raised bogs and 7120 Degraded raised bogs still capable of natural regeneration that correspond to two GEST types, respectively, Wet peat moss lawn and Oligotrophic Moderately moist forests and shrubberies.


Fly Orchid *Ophrys insectifera*

## INTRODUCTION

For restoring drained peatlands to reduce greenhouse gas (GHG) emissions, within LIFE Peat Restore project (LIFE15 CCM/DE/000138) re-establishment of natural carbon sink function is planned in three Latvian peatlands. Additionally, GHG emissions are being measured before and after restoration to demonstrate the role of peatland restoration in climate change mitigation. LIFE Peat Restore is an international project and the results will be comparable among involved partners from Latvia, Estonia, Lithuania, Germany, and Poland.

## GEST APPROACH

LIFE Peat Restore is testing an innovative indirect method to assess GHG emissions before, during and after restoration based on the recently developed GEST (Greenhouse gas Emission Sites Types) approach. This approach allows rapid and cheap assessment of GHG emissions (including Global Warming Potential) on basis of vegetation maps. Vegetation forms, integrating flora as well as environmental parameters (soil moisture, trophic level, etc.), can be categorised as particular GEST-types.

## MATERIALS AND METHODS

Restoration of peatland ecosystems will be performed in three sites (Figure 1). In all sites, drainage ditches will be blocked. To evaluate the efficiency of restoration, vegetation in each site is monitored in 3–4 sample plots with 9 subplots in each, and groundwater fluctuations are measured in 29 wells (Figure 2-4).

## GHG MEASUREMENTS

In each project sites in five permanent collars, $CO_2$ fluxes are measured directly on the field using transparent chambers and portable gas analyser (Figure 5). Other GHG – $CH_4$ and $N_2O$ – emissions are measured using manual gas sampling technique and gas chromatography. Collected GHG samples will supplement the results from the GEST approach.

**Figure 5.** Transparent chamber is set up on collar to measure the ecosystem respiration (dark mode without light inside the chamber). To measure the Net-Ecosystem-Exchange, cover will be removed to provide transparent mode with light inside the chamber.

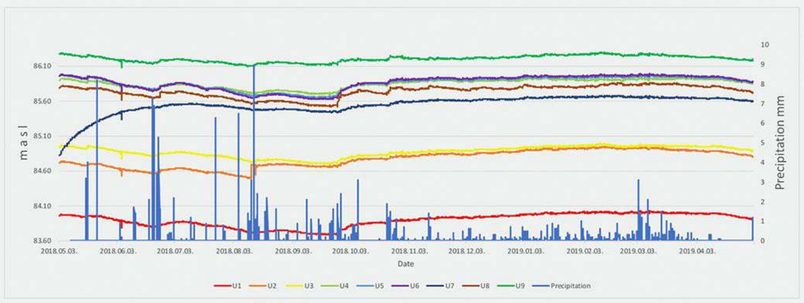


**Figure 6.** Groundwater table fluctuations in Madiešēnu Mire in Augstroze Nature Reserve from May 2018 to April 2019. Water table in all project sites was low due to low amount of precipitation. It reached the peak in spring, but dropped down during the vegetation season. In all sites, the largest amplitude in water table fluctuations was observed near the drainage ditches – in Augstroze site, in wells U1 and U7.

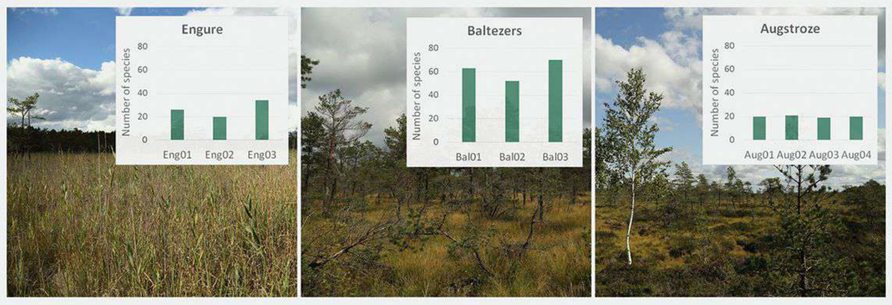


**Figure 7.** Species richness in monitoring plots of three Project sites. In total, 127 species were found in all 90 subplots. It was significantly higher in Baltezers than in other sites.

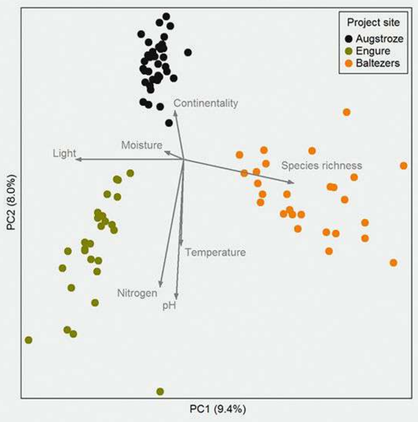


**Figure 8.** PCA ordination using vegetation monitoring plots indicating differences in the species community structure of Project sites. Joint plot vectors (grey lines) represent Ellenberg values and their directional trend along the two axis plot. Monitoring plots of Engure and Baltezers sites show similarities in species composition regarding the soil/peat pH parameters, whereas Engure and Augstroze sites they share similar light conditions opposed to half-shaded and shaded plots in Baltezers.

**Table 1.** Classified GEST-types in project sites with their corresponding habitats and protected habitats of EU importance (Annex I of the EU Habitats Directive). In total 14 GEST-types were identified.

| GEST-TYPE | CORRESPONDING EU HABITAT TYPE | PROJECT SITE |
|---|---|---|
| **OPEN PEATLAND AREAS (UNUSED)** | | |
| Moderately moist (forb) meadows | 6270* Fennoscandian lowland species-rich dry to mesic grasslands, 6510 Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*) | Augstroze |
| Very moist meadows, forbs and small sedges reeds | 7140 Transition mires and quaking bogs; fens | Augstroze |
| Wet meadows and forbs | 7140 Transition mires and quaking bogs | Baltezers |
| Wet calcareous meadows, forbs,... | 7230 Alkaline fens, 7210* Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* | Engure* |
| Wet tall sedges reeds | - | Engure* |
| Wet tall reeds | 3130 Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoeto-Nanojuncetea* | Baltezers, Augstroze |
| Wet peat moss lawn | 7110* Active raised bogs | Augstroze |
| Wet peat moss hollows resp. flooded peat moss lawn | 7140 Transition mires and quaking bogs | Baltezers, Augstroze |
| **OLIGOTROPHIC PEATLANDS** | | |
| Dry forest and shrubberies | 9050 Fennoscandian herb-rich forests with *Picea abies* | Baltezers, Augstroze |
| Moderately moist forests and shrubberies | 7120 Degraded raised bogs still capable of natural regeneration, 91D0* Bog woodland | Baltezers, Augstroze |
| Moist forests and shrubberies | 9010* Western Taïga | Baltezers, Augstroze |
| **MESOTROPHIC AND EUTROPHIC PEATLANDS** | | |
| Moderately moist forests and shrubberies | 9020* Fennoscandian hemiboreal natural old broad-leaved deciduous forests (*Quercus, Tilia, Acer, Fraxinus or Ulmus*) rich in epiphytes, 9080* Fennoscandian deciduous swamp woods, 9160 Sub-Atlantic and medio-European oak or oak-hornbeam forests of the *Carpinion betuli* | Baltezers, Augstroze |
| Moist forests and shrubberies | 91E0* Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) | Baltezers, Augstroze |
| Very moist forests and shrubberies | 9080* Fennoscandian deciduous swamp woods | Augstroze |

* For Engure site, only project restoration area (fens) was analyzed.

## RESULTS & CONCLUSIONS

1. Restoration activities in project sites in Latvia will directly affect six GEST-types and significantly eliminate GHG emissions, and improve the mire ecosystem functions including carbon sequestration capability. Additionally, restoration will improve the quality of protected habitats of EU importance and environmental conditions for many threatened species.

2. GHG measurements in peatland rewetting projects, including LIFE Peat Restore project, contribute to understanding the importance of hydrological restoration. Direct measurements are necessary for quantitative evaluation of rewetting. Therefore, the results of LIFE Peat Restore project will improve the understanding of GHG emissions in peatlands of northern and north-eastern Europe.

3. However, direct GHG measurements are not always possible due to limited funding. Hereby, indirect emission assessment methods are useful. Testing GEST approach in five countries within LIFE Peat Restore project will allow assessment of the suitability and further use of this approach in similar rewetting projects.


Great Fen-sedge *Cladium mariscus*