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INTERNATIONAL CLOSING CONFERENCE

SUSTAINABLE MANAGEMENT OF DEGRADED PEATLANDS AND CLIMATE CHANGE MITIGATION

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PEATLAND RESTORATION FOR CARBON SEQUESTRATION AND CLIMATE CHANGE MITIGATION IN THREE LATVIAN PEATLANDS – LIFE PROJECT "PEAT RESTORE"

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Introduction

During the previous decades the Latvian peatlands are influenced by drainage and peat harvesting. To restore the drained and degraded peatlands and to diminish the greenhouse gas (GHG) emissions, within the LIFE Peat Restore project (LIFE15 CCM/DE/000138) re-establishment of natural carbon sink function of peatlands is planned in three sites in Latvia. Additionally, GHG emissions are being measured before and after restoration to demonstrate the role of peatland restoration in mitigation of climate change. Since the LIFE Peat Restore project is international (involves partners from Latvia, Estonia, Lithuania, Germany, and Poland), the results can be compared at international level.

The aim of the LIFE Peat Restore project is improving the functioning of mire ecosystems, including carbon sequestration capability.

Materials and methods

Restoration of peatland ecosystems will be performed in three sites: Lake Engure Nature Park, Baltezers Mire Nature Reserve, and Augstroze Nature Reserve. In all sites, drainage ditches will be blocked. In Engure site, overgrowing of an alkaline fen will be prevented by cutting shrubs and trees in 20 ha area. On the same time, fluctuations of water table will be reduced by blocking of two ditches using plastic piling. To eliminate the drainage impact 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 cut the trees and shrubs in 34 ha area. In the restoration area of degraded raised bog habitat in Madiešēnu Mire, 23 peat dams will be built on drainage ditches in total length of 6.2 km.

To evaluate the efficiency of restoration actions, vegetation and water table monitoring was established in summer 2018 in all project areas in Latvia. Vegetation in each site is monitored in 3–4 square-shaped sample plots of size 100 m^2 (10 x 10 m) located close to transects of water table monitoring wells (piezometers). For detailed description of vegetation, the large plots are subdivided into small units, 1 x 1 m internal subplots, in total nine within each large square. To measure the groundwater fluctuations, in total 29 water table piezometers were established at different distances from the ditches

where building of dams is planned. Each piezometer is equipped with automatic data logger that measure the groundwater table each hour, i.e. 24 times per day.

LIFE Peat Restore is testing an innovative indirect method to assess GHG emissions in all project sites. Based on the recently developed GEST (*Greenhouse gas Emission Sites Types*) approach (Cowenberg, 2012; Günther et al., 2018), GHG are quantified before, during and after restoration. 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. It is expected that the data provided by monitoring will demonstrate the potential of peatland restoration for climate change mitigation.

Furthermore, GHG samples will be collected for laboratory analysis using closed chambers in all project sites, thus supplementing the results from the GEST approach. Additionally, there are three data loggers, one in each project site, that measure air temperature, air moisture and light intensity. Linking the relevant data on hydrology, peat depth, pH, trophic level and land use will enable the project experts to develop and improve the present GEST catalogue and fill existing gaps.

Results

Detailed description of necessary and planned actions to restore peatlands is given in three plans prepared by the LIFE Peat Restore project: Mire Restoration Plan for Alkaline Fens in Lake Engure Nature Park, Management Plan of the Baltezers Mire Nature Reserve, and Management Plan of Augstroze Nature Reserve. According to these plans and technical designs, dam building in project sites will be performed in 2019 and 2020.

All three Project restoration areas have distinct vegetation, and are characteristic with different hydrological regime, peat properties, land use history and impacts. Engure site represents alkaline fen communities, Baltezers Mire – transition mire communities with elements of alkaline fens and raised bogs, and Augstroze site – typical raised bog communities at different degrees of degradation. Monitoring plots of Engure and Baltezers show similarities in species composition regarding the soil/peat pH parameters, whereas Engure and Augstroze share similar light conditions opposed to half-shaded and shaded plots in Baltezers. In total, 127 species were found in all 90 subplots. The species richness was significantly higher in Baltezers than at both other sites.

Water table in all project sites during first year (2018) was low, mostly due to low amount of precipitation. It was the highest in spring, but dropped down during the vegetation season. Water table fluctuations in Engure site are quicker than in raised bog and transition mire with larger peat deposits. In all sites, the largest amplitude in water table fluctuations was observed near the drainage ditches.

GEST mapping, first time used in Latvia, showed wide range of GEST-types. In total 14 GEST-types were identified (Table 1). Similar to large EU habitat diversity, the highest number of GEST-types was found in Augstroze Nature Reserve (11 types). In this site, the largest area is covered by Wet peat moss lawn (analogue to habitat 7110* Active raised bogs) followed by Wet peat moss hollows resp. flooded peat moss lawn (= 7140 Transition mires and quaking bogs). Eight GEST-types were found in Baltezers Mire Nature Reserve. Dominant types are Oligotrophic moist forests and shrubberies (= 9010* Western Taïga), Wet tall reeds (represent water vegetation of the Lake Baltezers), and Wet meadows and forbs (= 7140 Transition mires and quaking bogs). Two GEST-types are common in restoration area of Engure site – Wet calcareous meadows, forbs,... (include two habitat types of EU importance: 7230 Alkaline fens, and 7210* Calcareous fens with *Cladium mariscus...*) and Wet tall sedges reeds. Six GEST-types might be directly affected by restoration actions within the project. Comparing the baseline scenario with post-restoration scenario (after 50 years), the total predicted amount of GHG emissions in Baltezers and Madiešēnu Mires (Augstroze) is significantly smaller after restoration, thus reaching the project goals. In Engure site, in short term no significant changes in GHG emissions are expected.

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).

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	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.

Conclusions

Restoration activities in project sites in Latvia will significantly eliminate GHG emissions and improve the mire ecosystem functions including carbon sequestration capability. According to GEST estimation, successful restoration can reduce emissions by more than one half in Madiešēnu Mire in Augstroze (raised bog). Additionally, restoration will improve the quality of protected habitats of EU importance and environmental conditions for many threatened species. In Engure site, though the estimated GHG emissions might remain similar to the baseline scenario, the drainage effects will be eliminated, thus ensuring the peat formation and carbon sequestration in the future.

GHG measurements in peatland rewetting projects, including LIFE Peat Restore, contribute to understanding the importance of hydrological restoration. Though it is well known that blocking the drainage ditches and removal of trees contribute to reduction of GHG emissions, still direct measurements are necessary for quantitative evaluation of rewetting actions. Therefore, the results of LIFE Peat Restore will improve the understanding of GHG emissions in peatlands of northern and north-eastern European countries.

However, direct GHG measurements are not always possible due to limited funding. Hereby, theoretical 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.

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RESTORATION EXPERIMENT OF SPHAGNUM MAGELLANICUM IN THE PYRENEAN MIRES

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Introduction

Mires landscapes have a high conservation interest, hold various Habitats of Community Interest (HCI) and occur in temperate and boreal regions, however, in Catalonia (Spain) are exclusively in the Pyrenees, linked to places where the topography or circulation of water is favorable (Pérez-Haase & Ninot, 2004). In the case of the Pyrenees, these habitats are often altered by flocks. On the other hand, they have also been locally affected by the construction of hydroelectric dams in their basin that have altered the natural hydrological cycle (Ventura et al., 2014). Given the degradation of the mires, the restoration of these systems has become an important issue over the last decades. The restoration of mires seeks to restore a vegetation cover and hydrological conditions dominated by peat mosses (*Sphagnum* spp.), which play an important role in this process.

The aim of the study is to identify in which experimental conditions a greater response is obtained in the survival and growth of *Sphagnum magellanicum,* a vulnerable species (VU) according to the Red List of threatened bryophytes in Spain and included in the Catalog of threatened flora of Catalonia and to establish the bases for the restoration of their populations.

Materials and methods

Based on the combination of different flood situations (three different water levels) and the interaction of species (intraspecific and interspecific), it is desired to identify under which experimental conditions a greater response is obtained in the survival and