

MOORE

IN RHEINLAND-PFALZ

Layman 's report

The EU LIFE project
in Hunsrück and Eifel

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LIFE bogs and mires

Importance and history

1 Importance of bogs and mires

Peatlands develop over the course of thousands of years due to incomplete decomposition of plant residues gradually forming layers of peat. Under natural conditions the water table usually reaches the upper layer of living peat moss. Only in longer periods of draught the water table will fall below the terrain surface. Over the past decades, these habitats have been in constant decline and are now among the most endangered forms of landscape in Germany. For centuries, peatland has been drained for agricultural and forestry use or peat extraction.

The species composition changed dramatically due to drainage and plant species of dry habitats were able to grow in bogs and mires. Frequently, drained areas were afforested with spruce further drying the peat soil due to the high use of water of these trees.

Adjoining open landscape habitats were overgrown due to abandonment or likewise afforested. Flora and fauna typical for bogs and mires did find no suitable conditions anymore and can now be found among endangered species.

Peatland areas are often surrounded by open landscapes. These transition zones harbour a large variety of species. In the transition zones around raised bogs, the rain-fed bog water mixes with mineral-bearing groundwater. Better aeration and

nutrient supply in these zones allow trees to grow whereas no or only dwarf stunted trees occur in an intact peatland environment. The downy birch which can frequently be found within the project sites is able to adapt to even the wetter areas of peatlands. The further away from the core area of the bog or mire, the denser and higher the surrounding vegetation will grow.

To achieve long-term conservation of the open landscape and its typical species adjoining bogs and mires, extensive farming (cutting/grazing) is essential. Oligotrophication of these areas helps to revitalize bogs and mires by minimising nutrient input from these areas.

Peat mosses (*Sphagnum spec.*) are the key species of bogs and mires which at the same time are the basis for peat formation. Through acidification of the habitat these small and unobtrusive plants have an influence on the entire area securing themselves a locational advantage over other species. Due to the large water-holding capacity of the cells they have a strong influence on the water balance in their environment.

Peat mosses grow on their own remnants: as the plant grows, its lower parts die due to lack of oxygen and light. The slowly and only incomplete decomposing plant remnants develop into peat.

The peat layer is growing by only about one millimetre per year and the formation of one metre peat will therefore take a thousand years.

Only few flowering plants are able to coexist with peat mosses. Among these are dwarf shrubs like cranberries, cross-leaved heath, bog rosemary, bog bilberry and other berry shrubs. Next to the probably best known peatland plant, the carnivorous round-leaved sundew, several different grasses like cotton grass, several species of sedges as well as rushes are adapted to boggy conditions.

The primary tree species of bog woodlands, the due to its downy shoots easily identifiable downy birch, is fairly common in all of the project sites.

Next to butterflies like the *cranberry fritillary* and dragonflies like the *common hawker* peatland plants host other insects like specialised beetles and a vast variety of spider species. Unicellular organisms live in the bog water and within the cells of peat mosses.

Peatland areas and the adjoining open landscapes serve as retreat and hunting ground for various amphibians and different bat and bird species.

Peatlands provide a wide range of **ecosystem services**:

- Support of the seasonal **water retention** within the landscape
- Buffer for the regional **microclimate**
- Reservoir for **carbon** (the only type of ecosystem continuously and permanently absorbing a significant amount of carbon)
- Partially serves as **nutrient buffer**
- **Archive** for the history of vegetation, climate and mankind the last 10,000 years
- **Habitat** for especially sensitive, rare plants and animals (ice age relict species)



2 The peatland project in Rhineland-Palatinate

Due to their rarity, endangerment and exceptional locations, bogs and mires in Hunsrück and Eifel with their unique plant communities and species inventory are part of the Natura 2000 network, designated as Special Areas of Conservation (SACs) under the EU Habitats Directive and were chosen as project sites for the LIFE bogs and mires project. The following project sites should be mentioned in particular:

Drainage, peat extraction and afforestation resulted in significant changes and partly even loss of peatland habitats. The project aimed to renaturate these bog and mire areas to allow for recolonization by plants and animals typical for these habitats. Additionally, rewetting will stop the gradual decomposition of peat. New peat will be able to form in the medium term thus absorbing carbon from the atmosphere – an important contribution to climate protection.

Region	SAC area	Project site
Hunsrück	Idarwald	Nature conservation area "Hangbrücher bei Morbach"
		Ortelsbruch and Auerhahnbruch
		Hangbrücher bei Hochscheid
		Nature Conservation area "Engelswasgeswiese"
	Hochwald	Nature conservation area "Ochsenbruch"
Eifel	Eifelmaare	Nature conservation area "Dürres Maar"
		Nature conservation area "Mürmes"
		Nature conservation area "Mosbrucher Weiher"
		Nature conservation area "Strohner Määchen"
	Gerolsteiner Kalkeifel	Gerolsteiner Moß
	Moore bei Weißenseifen	Nature conservation area "Truffvenn"
		Dreiherrige Stein
		Heidemoor bei Weißenseifen
Schneifel	Bragphenn bei Ormont	



3 Project summary

The project aimed to **restore** and protect important **bog and mire habitats** in Rhineland-Palatinate as well as adjacent open landscape habitats and peatland catchment areas. In the **Hunsrück** this concerned the SACs Idarwald and Hochwald, in the **Eifel** the SACs Eifelmaare, Gerolsteiner Kalkeifel, Moore bei Weißenseifen and Schneifel.

To achieve these goals, the most important step was to restore the naturally high water levels through rewetting measures such as backfilling of drainage ditches or renaturation of roads. Regeneration of peatland areas can only be achieved through permanent rewetting. Various different rewetting measures were carried out during the project period (288 manually constructed dams, 35 dams constructed using excavators, 4 vinyl sheet pile walls using excavators, increase in height of the Mürmes weir, adjustment of the water flow in the Oberluderbruch system, renaturation and reconstruction of roads in seven areas). Measures had an influence on some 50 ha per region. Excellent cooperation with the Bergwaldprojekt e.V., the state forestry as well as the Hunsrück-Hochwald national park and forest rangers was of major importance for the success of the project.

Removal of **non-indigenous shrubs and trees** was a further measure to achieve the goal. Peatland areas are severely affected by afforestation and natural regeneration of non-indigenous shrubs and trees (transpiration, interception, shading). In combination with rewetting measures, clearance work enables the original site-specific habitat communities to settle

and spread. Trees were removed from a total of 58 ha and shrubs from some 45 ha. Measures were carried out using cable crane systems, chainsaws, a Pistenbully with mulcher and other low ground pressure machinery.

A bulldozer-like track vehicle (**Moorraupe**) purchased for this project proved to be of great help to foresters and rangers in their rewetting and scrub clearance activities.

Further tree and scrub removal took place on adjacent ecologically valuable **open landscape habitats** to restore open structures and typical plant communities on some 20 ha. Forest clearance, milling and “hay seeding” have created a further 10 ha of species-rich meadows adjacent to the bogs and mires. These measures particularly benefit the habitats of the **cranberry fritillary** (*Boloria aquilonaris*), a butterfly endangered in Rhineland-Palatinate. This butterfly species has been successfully reintroduced on at least one site.

Numerous public relations activities helped to raise awareness and promote acceptance of the project, of LIFE and of NATURA 2000. Training courses, many excursions and information events have taken place already. Print materials (flyers, identification leaflets, posters, calendars, memory game) as well as the new walks with info boards created around peatland areas are very popular.

The relevant administration bodies have been closely involved, including nature conservation authorities (Oberste (MUEEF) and Obere Naturschutzbehörde

(SGD Nord)), the four district administrations, municipalities and other organisations. To ensure involvement of local stakeholders, the forestry administrations (ZdF/Neustadt) as well as seven forestry districts and the national park administration were participating too.

In addition, forestry personnel, local service providers, local consultancies and local contractors (e.g. dredgers) were engaged wherever possible to strengthen support for and understanding of the projects in the region. In particular the forest offices and the national park administration as well as services of consultancies, contractors, forestry operations and agricultural holdings need to be mentioned.

Many **additional measures**, a further LIFE project as well as a state-wide **peatland protection programme** were initiated.

The following sections describe the essential measures to enhance peatland habitats giving an overview of standard methods for rewetting of peatland areas. More details can be found in the guidelines. Further topics are soil-protective removal of spruce, renaturation of roads, enhancement of species-rich grassland as well as reintroduction of the cranberry fritillary and nutrient reduction at the Mürmes denitrifying woodchip bioreactor.



4 Rewetting

Rewetting of bog and mire sites aimed to mitigate further peat erosion and to work towards conditions stabilising this sensitive habitat to provide a solid livelihood for these threatened species. Due to restoration of the natural water levels, areas with blocking of the drains strengthen the competitive power and vitality of typical peatland plant communities and the characteristic vegetation can re-establish. Plant communities unsuitable for the conditions will be displaced and stopped from spreading. Rewetting creates an increased number of small structures, complementing the biotope complex typical of bogs and mires and promotes recolonization and propagation of various typical peatland plants and animals. Ideally, the formation of new peat will be enabled.

Dams and partial backfilling of the ditches aim to restore water-logged conditions in the area through a raised water level as the water will be retained in the area.

Depending on the local conditions (subsoil, thickness of the peat layer, geology, degree of disruption, transport logistics, etc.) different methods were applied with the support of state forestries, the National Park, the Bergwaldprojekt e.V. and contractors:

- Ditch backfilling and peat and wooden dams
- Horizontal wood plank wall
- Vertical wood and vinyl sheet pile wall

Especially in case of steeper slopes, the chambers were filled with a mixture of wood chips and sawdust based on the method used in the canton of Zug. Reduced erosion and better hydrological connection with peatland areas are a major advantage.

Ditches were blocked in seven sites, permanently rewetting more than 50 ha each in the Hunsrück and Eifel area. A total of 288 dams of different designs were erected manually and 39 with the help of excavators. Increasing the height of the Mürmes weir resulted in a raised water table in the area.

Renaturation of roads in the Ochsenbruch, Auerhanbruch and Rehbruch among others, percolation trenches in the Rundbruch as well as further nature conservation measures were able to considerably enhance the water regime in peatland areas.



5 Removal of non-indigenous shrubs and trees

In peatland areas, spruce displaces the naturally occurring vegetation. Furthermore, spruce forests are often characterised by a high stocking density; stands are dense and dark and will reduce groundwater and backwater production.

The higher degree of interception (rainwater retained by the needles) of conifers in comparison to broad-leaved trees adds to the effect and stemflow down trees with barked trunks will be lower than down trees with smoother bark. Removal of the non-indigenous spruce forests aims to counteract shading and withdrawal of water from the area.

More than 50 ha of water-logged soil were therefore cleared of spruce, Douglas fir and larch using low ground pressure machinery and cable-cranes.

Shrub encroachments in peatland areas and adjoining areas encouraging forest growth possibly leading to species decline was reduced as well. Cutting and grazing were re-introduced where appropriate.



6 Enhancement of species-rich grassland

Due to their location in kettle holes a number of grassland communities were and still are historically and morphologically closely associated with the peatland communities of mires in the Eifel. Some of the typical zoning from *Nardus* grassland over tall oat-grass meadows, moist meadows, wet meadows/sedge reeds and lagg to mire still exists.

Due to falling fallow, shrub overgrowth and afforestation many of the associated communities were lost. In almost all of the project sites in the Eifel reuse of grassland, grassland restoration in areas cleared of bushes, hay transfers to cleared and milled areas and manual re-seeding lead to considerable enlargement of species-rich grassland areas with a significantly enhanced or restored species diversity. This applies to the natural habitat types 6510 (Lowland hay meadows (*Alopecurus pratensis*, *Sanguisorba officinalis*)), 6230 (Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and submountain areas in Continental Europe)), 4030 (European dry heaths), 4010 (Northern Atlantic wet heaths with *Erica tetralix*) listed in the Habitats Directive as well as wetland meadows and oligotrophic grassland protected under regional nature conservation law.

Next to restoration and creation of relevant natural habitat types, measures had further positive effects on peatland areas:

- reduced evapotranspiration in the surrounding area
- nutrient removal through cutting of grassland in the surrounding area
- reduced shading/leaf fall/needle litter on peatlands
- creation of habitats for endangered specialist peatland species (e.g. *Boloria aquilonaris*)

Within the framework of the project more than 12 ha could be restored and enhanced in Hunsrück and Eifel in similar measures. Examples are the Dürre Maar (right), the Strohner Määrchen, the Truffvenn, the Heidemoor, Dreiherrige Stein bei Weißenseifen and smaller areas in the Hangbrücher bei Morbach..



7 Return of the cranberry fritillary

In Rhineland-Palatinate, the cranberry fritillary (*Boloria aquilonaris*) only occurs in two natural regions. Up until 2013, occurrence was limited to three smaller areas.

This butterfly is therefore considered to be critically endangered in Rhineland-Palatinate. A number of populations of this species, which is an important indicator species of raised bogs and transition mires, have already disappeared completely.

Scientific investigations of the donor populations as well as the habitat suitability of the target area were carried out prior to reintroduction. Additionally, genetic comparisons between the populations in the Palatinate Forest (Eppenbrunn) and the Volcanic Eifel (Dürres Maar, Strohn Määrchchen) were done.

In the early stages of the project, 40 egg-bearing females were relocated to secure and expand the cranberry fritillary population at the Mürmes (SAC Eifelmaare). In the following years, the presence of more than 100 individuals feeding and laying eggs on cranberries could successfully be confirmed.

During the project period, the Heidemoor bei Weißenseifen and the Dreiherrige Stein were identified as possible sites with a sufficiently large number of cranberries (egg deposition) and blooming plants (nectar plants) for reintroduction of the cranberry fritillary. Removal of spruce as well as hay transfers and maintenance of the areas contributed

to create these habitats. In early July 2016, 30 females of *Boloria aquilonaris* were caught at the Dürren Maar and transferred to the two peatland areas near Weißenseifen.

More individuals than ever before since the project started were counted in areas where measures to improve habitats have been carried out. Here, maintenance measures appear to already have a positive effect on the habitat of *Boloria aquilonaris*.



8 Denitrification at the Mürmes

Along with the growing global population and the involved increasing demand for food, use of fertilisers is constantly increasing putting ecosystems as well as ground- and drinking water at risk through excess input of nutrients.

A possible solution to conserve vulnerable ecosystems in the proximity of farmed areas is the installation of denitrifying woodchip bioreactors. In this kind of system, the drainage tile water is retained in beds containing woodchips serving as source of carbon and energy for a microbial community.

During oxidation of plant material or its degradation products under anoxic conditions microorganisms reduce nitrate through a series of sequential steps (NO_2^- , NO , N_2O) to elemental nitrogen which escapes into the atmosphere.

The denitrifying woodchip bioreactor implemented at the Mürmes, whose water quality is affected by agricultural drainage, is the first of this design and serves as a pilot project.

Regular sampling carried out by the University Karlsruhe (KIT) prior to and after construction monitors nitrate concentration and removal performance.



9 Publicity work

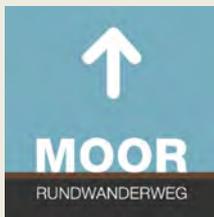
Visit the trails around the bog

Interest of the public, media, political representatives and further stakeholders remained constantly high throughout the entire project period. In more than 50 **excursions** and a **conference**, ecosystem services like flood control and climate protection as well as species and habitat protection addressed further interested parties.

To make these interesting topics available to the public after the project has ended, the **web-site** www.life-moore.de was created together with the LIFE Hochwald sister project. Additionally, **posters, pocket guides, calendars** and a memory game have been developed.

In the Eifel, two **circular walks with info boards** were created at the Mosbrucher Weiher and the Mürmes as an attraction for visitors. In the Hunsrück, a duckboard trail invites to experience the bog as part of the Ochsentour trail.

You are welcome to explore these walks!



Further information on the (circular) walks can be obtained from the Foundation or regional tourist information centres.

