



Project Results Booklet

LIFE09 NAT/IE/000222 / End of Project Conference

Demonstrating Best Practice in Raised Bog Restoration in Ireland
January 2011 to December 2015



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Background to the Project

Raised bogs are valuable wetland habitats that are becoming increasingly rare in Ireland. They once formed extensive wetlands over much of the central lowlands of Ireland. Raised bogs consist of domed masses of peat, which can be up to 10 metres deep, formed by the accumulation of dead plant material. They originate in former lake basins or shallow depressions and are mainly concentrated on the Carboniferous Limestone of the central lowlands of Ireland. Raised bogs retain large volumes of water and have a water level generally higher than the local water table. They are very acidic and poor in nutrients due to the fact that once developed, they are sustained by rainwater only, with no groundwater input (ombrotrophic).

Raised bogs have been developing in Ireland for thousands of years and once covered over 310,000 hectares (ha) - about 4% of Ireland's land area, mostly in the midlands. Peat bogs were once viewed as wastelands, to be converted to more productive use. The utilisation of bogs increased during the 20th century, when peat was removed on a commercial scale for the production of both fuel and horticultural compost, and many raised bogs were drained for agriculture. Forestry was also viewed as a potentially viable land use, and some raised bogs were drained and converted to plantation forests. This project focusses on restoring raised bogs that were affected by afforestation in the 20th century.

Today, there is a growing realisation that raised bog ecosystems are unique and irreplaceable. Irish raised bogs represent some of the most important examples of this habitat in the world. This is Coillte's fourth LIFE project, and its second on raised bog restoration. This project, which began in 2011, set out to implement restoration actions on 636 ha of raised bog habitat on the Coillte estate. Through the restoration of an additional area at one site, this increased to 685 ha. During the lifetime of the project, a significant improvement in the quality of raised bog habitat was observed. The ongoing aim is to create the conditions which will allow raised bog habitat regeneration in future years.



Raised Bog



Aerial View of Bog

The Importance of Irish Raised Bogs

Bogs are hugely important for the environment, and because of this, conserving them has become a matter of critical importance. They hold a record of past climates and also act as carbon sinks, which means they absorb the greenhouse gas carbon dioxide from the atmosphere and store it in peat which reduces the impact of climate change. Due to their waterlogged condition, raised bogs hold and preserve archaeological and organic remains.

The best raised bog habitat is actively peat-forming, i.e. very wet, with lots of open water forming pools over the bog surface, and a high cover of different species of Sphagnum moss, which is known as the bog-builder. Along with many species of Sphagnum moss, the bog is also home to some of Ireland's most unusual and beautiful plants, such as bog cotton, lichens, bog asphodel, cranberry and sundew.

A diversity of animals can also be found on our raised bogs, ranging from insects such as dragonflies, to frogs and lizards, and birds such as red grouse and curlew.

Raised bog ecosystems contain different types of habitat, which are described below.

Wet raised bog has a soft, spongy, sometimes even quaking surface, with pools of open water and flat lawns of coloured bog mosses. The wettest areas are usually found in the central part of the high bog, where you often find hummocks, pools, Sphagnum lawns, flushes and soaks. Sometimes, wet bog can develop in the cutover areas, wherever drainage is poor.

Dry raised bog tends to be firm underfoot, with little surface water to be seen. This habitat occurs on parts of the bog that are no longer actively peat-forming due to the effects of drainage. The bog mosses are scarce

here. Heathers and bog cotton species are plentiful, also lichens and the beautiful yellow bog asphodel.

Naturally-growing birch woodlands have always been a feature of Irish raised bogs. These woodlands are found on the margins of raised bogs, where the peat is shallow. Typical species are birch, willow and Scots pine, with ferns and mosses. On some areas of the project sites where water levels remain low, **birch woodland** will develop, providing an additional natural habitat for wildlife.

Depressions on Peat Substrate of the Rhynchosporion is habitat that occurs on wet quaking areas of active raised bog in depressions, pool edges and erosion channels. The vegetation is dominated by white beaked-sedge in association with common cotton-grass, bog bean, sundews and a range of Sphagnum mosses.

The ultimate aim of raised bog restoration projects, such as this one, is to re-wet raised bog habitat, and to create, wherever possible, the conditions for active peat formation in future. Raised bog habitats that are actively peat-forming are referred to as "Active raised bog" on the EU Habitats Directive, which gives these habitats a high level of protection. Recent monitoring and mapping work completed by the National Parks and Wildlife Service shows that many of Ireland's protected raised bogs have only very small areas remaining that are still wet enough to be actively peat-forming. While some of the sites within this project may not themselves include "active raised bog", restoration of these habitats is essential to create the conditions for active peat-formation elsewhere on the raised bog - they are referred to as "supporting habitat".



Sundew



Sphagnum pulchrum



Lizard at Scohaboy



Cranberry at Derrinlough



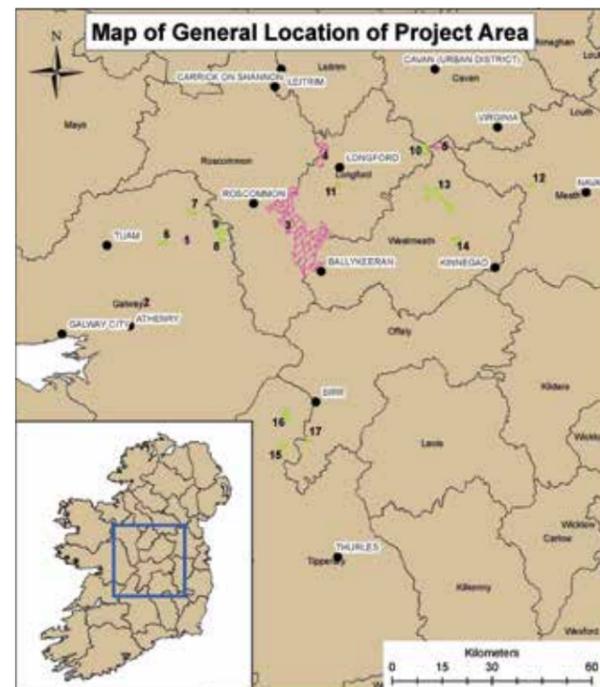
Scohaboy Bog landscape



Bog Asphodel.

Planning for the project

Raised Bog Project Sites



LIFE Project Site no.	Protected area name	Restoration area (ha)
1	Curraghlehanagh Bog SAC 002350	11.08
2	Monivea SAC 002352	8.65
3	Lough Ree SAC000440	44.44
4	Lough Forbes Complex SAC 001818	16.17
5	MoneyBeg & Clareisland Bogs SAC 002340	14.16
6	Derrinlough Bog NHA 001254	58.81
7	Keeloges Bog NHA 000281	4.21
8	Ballygar Bog NHA 000229	28.41
9	Aughrim Bog NHA 001227	109.45
10	Lough Kinale & Derragh Lough NHA 000985	36.67
11	Mount Jessop bog NHA 001450	71.17
12	Girley Bog NHA 001580	33.08
13	Lough Derravaragh NHA 000684	22.31
14	Wooddown Bog NHA 000694	50.55
15	Scohaboy Bog NHA 000937	72.06
16	Arragh More Bog NHA 000640	90.83
17	Cangort Bog NHA 000890	13.22
		685.27

The 17 project sites were identified in conjunction with the National Parks and Wildlife Service of the Department of Arts, Heritage and the Gaeltacht as having the best ecological value and potential for restoration of wetland conditions.

Prior to commencement of restoration activities at the sites, a series of field meetings were held with Coillte staff, project ecologists and representatives from both the National Parks and Wildlife Service and the Forest Service. All restoration techniques used in Coillte's previous and very successful project LIFE04 NAT/IE/000121 were discussed and applied.

The restoration work undertaken in the project was discussed and overseen by a Project Management Group, which included representatives from Coillte, National Parks and Wildlife Service, the Forest Service and project ecologists.

Every year a meeting of a Project Advisory Panel took place where participants, drawn from a wide range of interested organizations (including Irish Peatland Conservation Council, Birdwatch Ireland, The Heritage Council and Teagasc), were invited to contribute their views to the Project Management Team. These various meetings have been beneficial and have resulted in improvements to the overall running of the project.

Demonstration Sites

Two of the project sites were selected as demonstration sites as they displayed a range of project actions and are located close to population centres. At each of these sites, visitor information panels describe the overall LIFE project and features particular to that site.

Girley Bog (Site No 12) is located 7kms south-west of Kells, Co. Meath. This site contains a significant area of high bog which includes typical bog vegetation and topography, including hummock / hollow systems.

Scohaboy Bog (Site No 15) is located just outside the village of Cloughjordan in Co. Tipperary.

This site supports a good diversity of raised bog microhabitats, including extensive pools and hummock / hollow complexes. The presence of curlews has recently been recorded. This raised bog is one of the more southerly raised bogs in the country which also adds significantly to its ecological value.

Project actions included

- Felling and removing trees
- Blocking drains using peat or plastic dams
- Removal of regenerating non-native tree and shrub species
- Creation and maintenance of fire breaks
- Fencing project sites where necessary
- Monitoring vegetation change and water levels
- Producing promotional material informing people about the project

Restoration Methods

The objective of the project team was to raise water levels in order to support the regeneration of bog habitat.

The main restoration work carried out was the felling of conifers and the blocking of drains. In some areas felling was carried out manually by chainsaw and the material left on site. On other sites the felling was carried out by machine with the timber being removed from the sites. The remaining brash was gathered in lines (windrowed) which cleared most of the bog surface of woody material and also allowed access for drain blocking and removal of natural regeneration.



Peat Dams at Aughrim

The aim of drain blocking is to slow the rate at which water leaves the raised bog while re-wetting the cutover areas giving them a greater opportunity to regenerate in the future. Either peat or plastic dams were installed, the latter in wetter areas where machine access was hindered.

Removal of natural regeneration has been carried out and is ongoing on all sites in order to prevent the regrowth of unwanted trees such as Lodgepole pine, birch and willow and also shrub species like laurel and rhododendron.

Recording Ecological Change

Monitoring the effect of the various restoration measures has been a very important part of the project. Monitoring has allowed the recording of changes in the hydrology and vegetation of the raised bog sites and this has been done in a number of ways.



Scohaboy Boardway with Bog Cotton



Plastic dam at Aughrim

Hydrological Monitoring

Hydrological monitoring for this project has involved the installation of WALRAGs (WATER-LEVEL RANGE GAUGES) on each of the project sites to record the hydrological recovery of the raised bog habitat following tree removal and drain blocking. In total 130 Walrags were installed on the project sites. Water levels were recorded monthly by Coillte staff and readings collated by the Project Ecologists. This has enabled the investigation of water level fluctuations in the upper levels of the peat throughout the year. It has been noted that the intact areas of high bog have higher water levels and less fluctuation throughout the year. Drain-blocking has re-wetted the damaged areas and, over time, water levels will rise to levels similar to intact bog. This rise in water levels can be quite dramatic, as can be seen in the Hydrological Monitoring Graph for Mount Jessop Bog.

Vegetation Monitoring

The recovery of the raised bog vegetation has also been monitored throughout the project. The main purpose of this survey work is to document the changes that have taken place following the felling of conifers and blocking of drains at the project sites. This has been achieved by documenting the changes in plant species composition and cover in 108 permanent quadrats (10 metres x 10 metres) over time. A photographic record of these quadrats has also been undertaken.

Habitat Monitoring

In addition to monitoring vegetation changes within permanent quadrats, habitat surveys of the entire project sites have been carried out using the NPWS national standard raised bog mapping method on open high bog. These surveys recorded the habitat present before, during and after restoration works. These surveys will allow the recording of habitat change resulting from restoration works and allow integration of project monitoring results with the NPWS National Raised Bog Monitoring Program. This habitat mapping will also demonstrate habitat recovery into the future.



Flooded cutover at Aughrim



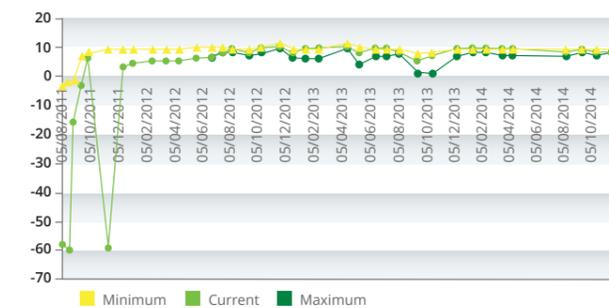
Bog Cotton

The following graph shows the monthly water-level range for a WALRAG on Mount Jessop Bog. A reading of 0 cm represents surface level and the aim of restoration is to maintain water-levels within 10 cm of the bog surface. The WALRAG was installed in May 2011.

This WALRAG was located in a closed canopy conifer plantation on cutover bog. Since tree felling it can be clearly seen that water-levels have increased dramatically and remained high over the course of the past 3 years. After clear-felling in Autumn 2011, water-levels increased from 60cm below ground level to 10cm above ground level and remained at the peat surface throughout the winter months of 2011. In 2012, water-levels remained 10cm above the bog surface, throughout the year. In 2013, water-levels remained 10cm above the bog surface apart from a slight decline in the summer months. With the blocking of drains in Summer 2013, water-levels have remained 10cm above the bog surface throughout 2014. If water-levels remain high, active raised bog or bog woodland habitat should become established.



Reading Walrags



Hydrological Monitoring Graph Mount Jessop Bog – Project Site No. 11 May 2011 – December 2014

Additional Monitoring

Through collaboration with a range of third-level institutions and NGOs, additional monitoring has been facilitated by the raised bog restoration project:

Birdwatch Ireland carried out a bird survey on Scohaboy Bog prior to restoration work and they have carried out a follow-up survey in 2015 after restoration works have been completed. The initial survey recorded breeding Curlew on the Project Site, which adds to the scientific interest of the site.

In 2011, transects were established at four demonstration sites (Scohaboy Bog, Girley Bog, Ballygar Bog and Lough Forbes) and two bird survey visits were made. A total of 246 birds from 23 species were recorded from the four sites. Species composition largely reflected the habitats present when surveyed. Bog specialists such as Curlew, Snipe, Skylark and Meadow Pipit were found on sites with intact raised bog whilst the bird communities on sites with woodland were dominated by Coal Tit, Lesser Redpoll and Goldcrest. On recently clear-felled sites Wren and Blackbird were common, but on older clear-fell sites, open-habitat species, such as Meadow Pipit, were recorded. Survey work on these transects was repeated in 2015 to examine the impacts of the habitat management work on the bird populations and, specifically, to see if bird species typical of bog habitats, many of which are of conservation concern, were responding to the restoration being carried out. Data is being analysed, and the results will be submitted as a scientific paper to an appropriate technical journal.

Biological Water Monitoring

The Aquatic Services Unit of University College Cork (UCC) conducted biological water quality studies as part of the project at Cloonkeen Oughter and Sopwell Forest Properties (Derrinlough Bog and Scohaboy Bog respectively). The work involved annual collection of macroinvertebrate samples, upstream and downstream of felling areas. Pre-felling surveys were conducted in 2011, with five years of post-felling survey from 2012 to 2015. Biological water quality metrics were calculated based on macroinvertebrate communities present at each sampling site, using standard methods in line with Environmental Protection Agency (EPA) and Water Framework Directive (WFD) monitoring protocols. Due to the presence of native White-Clawed Crayfish (*Austropotamobius pallipes*) population a study was carried out at one of our sites. The presence of this species, which is listed as protected under Annex II of the EU Habitats Directive (92/43/EEC), was considered unusual given the nature of in-stream habitat at the site.

Greenhouse Gas Emissions in rewetted former peatland forests

Funded by the EPA and based in the University of Limerick, the aim of this PhD study is to measure greenhouse gas emissions from peatlands which were previously forested and have in recent years been clear-felled and rewetted with the aim of returning their active peatland status. The study was set up on Scohaboy Bog in early 2014 and monitoring is ongoing. Carbon Dioxide (CO₂), Methane (CH₄) and Nitrous Oxide (N₂O) are being

measured using chamber methods and soil temperature. Water table and vegetation sampling is being conducted in conjunction with gas measurements. Initial findings have shown correlations between soil temperature, water table levels and emission levels. Once monitoring has been concluded, emission factors and annual emission rates of CO₂, CH₄ and N₂O will be determined for rewetted peatland forests.

Survey Work on Girley Bog

Work to date on Girley bog has focused on investigating the impact of afforestation on raised bogs by monitoring water-levels in the formerly afforested section and comparing it to the baseline conditions observed on the adjacent high bog. Over 160 piezometers have been installed across the bog, making Girley bog one of the most instrumented raised bogs in Ireland. These piezometers enable routine monitoring of water-table depth and fluctuation throughout the year.

Main Results

There was a marked difference in surviving bog vegetation between open canopy and closed canopy conifer plantations. On sites where the conifer crop was relatively young and the trees had not formed a closed canopy, a modified bog vegetation persisted and recovery has been good.

On sites which had closed canopy conifer plantations, very little bog vegetation remained and recovery will

be slower. At these sites, the peat soil had dried out considerably and there was a greater presence of undesirable plant species such as Soft Rush and Downy Birch. Vegetation control has been carried out on these sites. In the driest areas, where the peat soil is often shallow, birch woodland may be the eventual outcome. At a number of sites, the natural regeneration of Lodgepole pine was also a significant problem. The pine has been felled in these sites, and will require monitoring into the future.

The felling of conifers and blocking of drains has resulted in a marked increase in water-levels on most project sites and it is expected that bog vegetation will recover most successfully in the wetter areas which have deep peat and a relatively flat topography. The main species to re-colonize following conifer clearance are Ling Heather, Cotton-grass, Soft Rush and Purple Moor-grass with Willow-herb and Bramble frequent on drier previously cutover areas. As the peat gets progressively more waterlogged, it is anticipated that plant species typical of wetter bog conditions such as Sphagnum mosses, White-beaked Sedge and Bog Asphodel will gradually re-colonize. Over time, Sphagnum mosses will begin to dominate these wet areas and active peat formation will begin.



Round-leaved Sundew



Resprouting Rhodo at Aughrim



Site Meeting at Lough Kinale

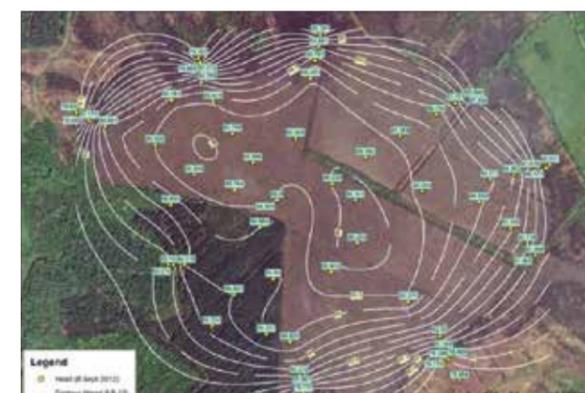


Fig 1: Hydrology Map Girley Bog

Raised Bogs – A LIFE story

A major objective of this restoration project has been to raise awareness of the importance of raised bog habitats. This was achieved through extensive Public Relations which involved a number of approaches and built largely on experience gained from previous successful LIFE projects completed by Coillte on blanket bog and raised bog restoration (LIFE02/NAT/IRL/8490 and LIFE04 NAT/IE/000121). Project information brochures were produced and circulated. Our project website www.raisedbogrestoration.ie has been a very effective way of providing information about the project objectives and actions to an international audience. It also contains links to previous Coillte LIFE funded bog restoration projects. Another very effective method of telling our story has been the production of our promotional DVD which has been circulated to all secondary schools in Ireland, aiming to educate this generation about this very important habitat. The DVD is also available via our website.

In addition to these very effective methods of communication two of our project sites have been designated as demonstration sites where car parks and boardwalks have been constructed and visitor information panels have been erected. These demonstration sites have and continue to be used to host field visits from a variety of groups and organisations near and far. A favoured event is always the guided bog walk bringing neighbours and local groups through the restoration works. Both sites are situated close to population centres where local communities have been hugely supportive of Coillte's

restoration work. These communities have actively participated in the promotion of the project from the very beginning.

Wider Benefits of the Project

In addition to improving both the quality and quantity of raised bog habitat within a number of Irish Natura 2000 sites this project has also provided important insights into raised bog restoration in Ireland. Armed with the valuable experience gained during the course of our previous raised bog restoration project LIFE04 NAT/IE/000121 we have successfully demonstrated best practice in raised bog restoration. The techniques used have now become a benchmark for others. This project has shown that, with adequate funding, large areas of raised bog habitat can be restored. Observations made during this project have also provided important information regarding restoration techniques to other LIFE funded projects such as those in Denmark and newly established projects in the UK.

Through the distribution of promotional material this project has highlighted the importance of protecting the remaining raised bog habitat in Ireland. Encouraging a greater understanding and appreciation of this important wildlife habitat by the general public has been a vitally important objective. Community involvement has been essential and rewarding. Project staff have engaged with several local communities during the lifetime of the project – they include Cloughjordan Community Development Committee, Girley Bog Meitheal and the Community Wetlands Forum.



School outing to Scohaboy



Project Team visiting Denmark Oct 2013



Project Team Members participating in Raised Bog Seminar.

Project Team

A project team from Coillte (coordinating beneficiary) was established to coordinate the restoration actions across all of the seventeen project sites. This team comprised members of Coillte staff, including a Project Manager, an administrator with special responsibility for raising public awareness of the project, an ecologist, an accountant and an EU liaison coordinator. In addition, each project site was managed by the local forest manager with special responsibility to implement the restoration actions. The project and the restoration actions in particular were supported through the works of independent project ecologists who provided technical advice on the ecological aspects of the restoration. This project team received guidance from a project management group which comprised representatives from the Forest Service, the National Parks and Wildlife Service, and Coillte. Expert advice was received from a broader based Project Advisory Panel of relevant stakeholders.

Planning for the Future

An After-LIFE plan will be prepared which will lay out a ten year plan for the ongoing management and maintenance of the project sites. All of the project sites are included within Coillte's biodiversity programme, and are mapped as biodiversity areas. These significant areas of the Coillte estate that are managed primarily for nature. Each year, the best of these biodiversity areas are monitored, and management actions required to maintain the sites are implemented. This will ensure that the project sites are maintained after the restoration project is complete.



Bog pool



Sphagnum regeneration in drains



Site Signage



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