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Peatland Programme

UK Peatland Restoration

demonstrating success

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The International Union for the Conservation of Nature (IUCN) is a global organization, providing an influential and authoritative voice for nature conservation. The IUCN National Committee UK Peatland Programme promotes peatland restoration in the UK and advocates the multiple benefits of peatlands through partnerships, strong science, sound policy and effective practice.

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UK Peatland Restoration

demonstrating success

CONTENTS

UK PEATLAND RESTORATION — DEMONSTRATING SUCCESS

Common hawker on peat pool, Tarn Moss © Robin Sutton

UK PEATLAND RESTORATION — DEMONSTRATING SUCCESS

FOREWORD

In the language of the policy makers, peatlands perform vital and multiple ecosystem services. What does that actually mean?

Perhaps this is the evocative mournful whistle of a golden plover calling forth from our clouded hills of purple and green above an industrial town in South Wales or Lancashire. Or maybe, the taste of tannin and a tang of smoke in a glass of amber fiery nectar from the rain-soaked peat bogs of western Scotland. Or is it wonderful tasting soft mineral water emanating from the taps of Bradford and garnered from the high peat moors of the Dales? Or the sense of pure elation striding forward across the moors above Manchester — "I might be a wage slave on Monday, but I am a free man on Sunday", goes the ramblers' song. Is it Gaia in action, gently pulling excess carbon out of the atmosphere depositing it as peat and, given time, locking it away as coal? Or simply, a jewel of glistening drops of carnivorous sustenance, a million tiny mirrors arcing around a pad of tender red — the dew of the sun set against a *Sphagnum* carpet of piercing green, magenta and red.

All of this, and more — peatlands are truly amazing habitats. Yet, like most habitats in the U.K., our peatlands are hugely damaged. Over-burnt, over drained, over and under-grazed, dumped on, built over or simply cut away, the U.K.'s peatlands are not in a good state. The IUCN-UK National Committee Peatland Programme has set out a cogent case for the restoration of a million hectares of peatland — the lot: the complete restoration of Britain's peatlands.

This could seem laughably ambitious in the face of year-on-year damage but, as this booklet shows, it is not just consistent with Government policy, in the form of Nagoya biodiversity commitments or the European Habitats and Birds Directives, but immensely do-able. For in every part of the UK, in every peatland landscape, people — land managers, companies, conservationists, policy makers and scientists — have come together to restore these damaged ecosystems.

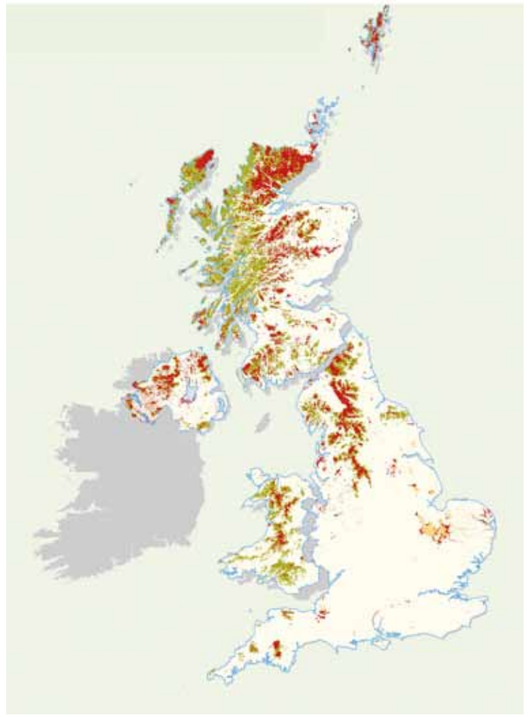
In the U.K. and the British Oversees Territories, we can now peek across towards a brighter and boggier future where we finally turn the tide away from a year-on-year diminution of habitat and the wildlife it supports. We can restore our peatlands and set that vital example to the global community. And with this example of concerted and coordinated effort, we can begin the restoration of our global peatland resource giving the Earth a fighting chance to re-absorb some of the fossil-fuelled atmospheric carbon and avert a climate catastrophe. The stakes have never been higher.

This booklet has been produced in preparation for the joint British Ecological Society/ IUCN UK Peatland Programme symposium 'Investing in Peatlands: Demonstrating Success' in Bangor, UK, in June 2012, and the IUCN Conservation Congress in Jeju, Republic of Korea, in September 2012.

Rob Stoneman
IUCN UK Peatland Programme Chair and Chief Executive of the Yorkshire Wildlife Trust

1. INTRODUCTION

Peatlands are areas of land with a naturally accumulated layer of dead plant material (peat) formed under waterlogged conditions. In the UK mosses, mainly *Sphagnum* species are the main formers of peat. UK peatlands cover 26,000 km^2 with over 60% in Scotland and include some of the world's best examples of oceanic blanket bog, as well as raised bogs and fens.



Peat and peaty soils of the United Kingdom (map reproduced from JNCC 2011). Deep peat soils (dark brown), shallow peaty soils (green), wasted deep peat soils (light brown). Peat in South-East England is largely fen peat. Reproduction by permission of OS on behalf of HMSO @ Crown copyright and database Right 2010, MLURI 100019294, AFBI 1:50000 soil digital Data, National soil Maps @ Cranfield University, BGS 1:50000 digital data (license 2006/072

Peatlands are high priority for biodiversity conservation with species and habitats of international importance depending on the extreme, waterlogged conditions. As an ecosystem, peatlands are extremely important for human well-being, particularly as a long-term carbon store. In undamaged peatlands the wet conditions slow down decomposition and enables dead plant remains to be laid down as peat. Carbon removed from the atmosphere by the plants is stored in the peat and can remain there for millennia provided the habitat remains wet. Peat is also an archaeological and environmental archive — it preserves bodies and artefacts, and a lot of what we know about past environmental conditions is based on the pollen record stored in peat. Since peatlands occur in areas of high rainfall, peatland catchments are also often the source of drinking water and play an important role in flood water regulation. In a densely populated country like the UK, peatlands provide places of solitude with a sense of freedom and inspiration for millions of people.

Peatlands are important for wildlife and provide benefits for climate mitigation and adaptation and water regulation.

The importance and value of the wide range of peatland ecosystem services has been underestimated in the past and large areas were drained for agriculture and forestry. This often had limited economic gain, but did have considerable impact on the functioning of the peatland. Now there is greater understanding of the huge

UK PEATLAND RESTORATION — DEMONSTRATING SUCCESS

costs to society arising from damage to peatlands. Unfortunately, the legacy of damage means that over 80% of UK peatlands have been affected in some way by drainage, fire, grazing or extraction. The challenge now is to bring peatlands back into a state where they are functioning to their full natural potential.

The IUCN UK Peatland Programme (Bain et al 2011) identified a shared goal to bring 1 million hectares of peatlands into good condition or under restorative management by 2020 — a timescale consistent with international biodiversity, climate change and water objectives. While this may seem ambitious, there is considerable expertise in the UK and internationally which can be applied to restoring and repairing even some of our most damaged peatlands.

Over the last few decades the number of peatland restoration projects has grown as techniques for tackling different forms of damage have become available. Importantly, there has been considerable progress in our understanding of how to manage ecosystems in a way that involves stakeholders and brings together partnerships that can deliver results, even at a landscape scale with a broad range of different interests. Central to this success is ensuring that economic and social considerations are addressed so that the benefits of peatlands as a functioning ecosystem is recognised and valued by those who manage and look after them and the wider society.

Eroding Peat © North Pennines AONB Partnership's Peatland Programme

Working together © North Pennines AONB

Monitoring and scientific research on peatland restoration projects is providing ongoing valuable evidence to better quantify the benefits that peatlands provide, helping instill confidence for investment in their future.

The case studies in this volume set out to illustrate some of the positive achievements and lessons learned in conserving and restoring peatlands in the UK and British Overseas Territories.

Bain, C., Bonn, A., Stoneman, R., Chapman, S., Coupar, A., Evans, M., Geary, B., Howat, M., Joosten, H., Keenleyside, C., Lindsay, R., Labadz, J., Littlewood, N., Lunt, P., Miller, C., Moxey, A., Orr, H., Reed, M.S., Smith, P., Swales, V., Thompson, D.B.A., Van de Noort, R., Wilson, J.D. & Worrall, F. (2011) Commission of Inquiry on UK Peatlands. IUCN UK Peatland Programme, Edinburgh.
http://www.iucn-uk-peatlandprogramme.org/resources/188

JNCC (2011) Towards an assessment of the state of UK peatlands. Joint Nature Conservation Committee report No 445.
http://jncc.defra.gov.uk/page-5861#download

2. UK PEATLAND RESTORATION – DELIVERING RESULTS THROUGH AN ECOSYSTEM APPROACH

Peatlands are impacted by and impact on a wide range of people and their interests. These include:

- Local people who live near or manage the land.
- Households and businesses in towns and cities downstream, that depend on clean drinking water that comes from often remote peatlands (e.g. Liverpool receives water from Lake Vyrnwy in North Wales).
- Wider communities of interest, such as those who use peatlands for recreation and enjoy their cultural and natural heritage.

Restoring peatlands is a good example of employing an ecosystem approach aligning conservation goals and sustainable development in line with the principles of the Convention of Biological Diversity. The IUCN Commission on Ecosystem Management suggests five key steps towards an Ecosystem Approach (Shepherd, 2008). The case studies in this volume showcase the application of these steps in practice.

Engaging Stakeholders and area
Through open and transparent partnership working, peatland projects have demonstrated the benefits of bringing on board different interest groups. Gaining agreement on restoring peatland ecosystems in a way that meets stakeholder's needs at an early stage has helped overcome potential conflicts. Cross-sector partnerships of local authorities, businesses, private land managers and conservation organisations are important in encompassing the range of interests in managing peatland ecosystems. For example, in the peatlands of Caithness and Sutherland, where forestry planting on blanket bog led to national controversy, the close cooperation of farming, forestry, sporting and wildlife interests led to an agreed strategy for the protection of the peatlands (see Flow Country and May Moss case studies C, H).

In many projects, stakeholders have included businesses with a direct interest, such as water companies keen to avoid the increased water treatment costs arising from damaged peatlands and working towards biodiversity benefits (see eg. Exmoor, Keighley Moor and SCaMP case studies B, E, M). Working with farmers, environmental organisations and sporting organisations, the shared goal of securing functioning peatland helps to bring benefits for biodiversity, while supporting farming and game management (eg. Pumlumon and Anglesey & Llyn case studies L, X). Having a strong lead body with a project manager able to coordinate across the different groups, resolve conflict, tackle concerns and to report back on progress, has been important in successful projects.

Public participation is vital in ensuring that the multiple benefits of peatlands and the costs of damage are understood. The Yorkshire Peat Partnership and Somerset Levels and Moors project (case studies O, W) are examples, where different groups and individuals were engaged at an early stage to identify any potential concerns, resolve conflicts and provide assurances.

Peatlands and people © Norman Russell

UK PEATLAND RESTORATION — DEMONSTRATING SUCCESS

Ecosystem structure, function and management
Peatland biodiversity provides an indicator of the health of the ecosystem and underpins the processes and services that peatlands provide. Several projects have been extending their scientific work to help build the evidence base for other ecosystem benefits such as carbon and water quality (e.g. Migneint and North Pennines AONB case studies I, K).

Monitoring and surveys demonstrate, that peatland restoration works, even in the most degraded ecosystems. In many cases rewetting brings back key peat forming vegetation within 5 to 10 years. Studies of greenhouse gas fluxes have shown that peatland restoration brings long-term greenhouse gas benefits, helping to mitigate climate change.

Gas flux monitoring at Forsinard © Norman Russell
'Brown water' with high levels of dissolved organic carbon from peatlands © Martin Evans

Damaged peatlands release higher concentrations of organic carbon, with particles of peat giving it a characteristic brown colour, which has to be removed from drinking water at high cost. Blocking peatland drains has been shown to reduce dissolved organic carbon in streams, and re-vegetation of bare peat reduces erosion.

Peatlands provide important breathing spaces for millions of people and restoration projects have enhanced visitor experience by providing better access and interpretation, extensive programmes of community events, such as guided walks and talks, and school education programmes (e.g. Active Blanket Bog in Wales, Blawhorn Moss, Lancashire Mosslands or Great Fen case studies F, P, R, V).

Peatlands also harbour a rich archive of cultural and environmental change stretching back over 10,000 years. As water logged soils, peatlands have preserved some of the oldest and most intriguing archaeological remains including roads, tracks, houses and settlements, monuments, artefacts and bog bodies. The archive, that is peat itself, has contributed greatly to our understanding of global climate change. Restoration can help to safeguard this living history (see e.g. Humberhead Levels case study Q).

Economic Issues
Restoring peatland biodiversity has helped to draw in much needed national and international resources to often remote and economically disadvantaged areas. Peatland restoration attracts EU funding under the LIFE programme (case studies C, F, J & X). CAP support through agri-environment schemes has been essential in ensuring sustainable land management whilst maintaining livelihoods in rural areas. Although, as the Commission of Inquiry on Peatlands recommended, much more could and should be done to align the CAP with peatland restoration.

Restoration and conservation management also brings employment opportunities in areas where jobs are often hard to come by. In addition, direct public investment through NGOs has helped to fund peatland restoration considerably, e.g. the first Flow Country appeal to buy peatland raised £1.25 million in only six weeks.

Well managed peatlands can also attract wider economic resources through e.g. tourism and conservation management (see e.g. Cuilcagh Mountains case study G). Better understanding of the benefits of peatlands for carbon and water quality can lead to new funding opportunities from a broader range of public and private sources. The multiple benefits of peatland conservation helps give greater priority in attracting funding from national and international bodies.

Adaptive management over space
Peatland ecosystems are not bound by political or administrative units. Some sites are very localised (e.g. Langland Moss, Malham Tarn Moss, Lancashire Mossland and Redwood Moss case studies P, R, S, U) whereas others cover expansive blanket bogs (e.g. Flow Country, C). Effective restoration projects operate at the best geographical scales for the site bringing together different public and private sectors as needed.

While initial trials of restoration in the 1980's and 90's were small scale, many UK restoration projects are now using landscape scale approaches to bring about major peatland restoration over large areas, involving numerous land owners and managers (e.g. LIFE Active Blanket Bog and MoorLIFE case studies F, J). This work enables major capital investment and project management, drawing in public and private funds, at a scale beyond what could be achieved by individuals alone. The projects also take into account wider landscape considerations, to address impacts of the surrounding land management on peatlands and vice versa. Under a changing climate, adaptation effort to secure remaining peatlands will involve re-instating peatland function over larger areas to improve resilience and support any species movement. The Great Fen and the Somerset Level and Moors projects, for example, aim to reconnect remnants of previously large expansive peatland landscapes to form wider ecological networks (case studies V, W). The role peatlands can play in flood alleviation and water quality regulation, both in the lowland fens and blanket bog situations, under future climate scenarios of heavier rainfall is prompting many projects to work across water catchments to provide the best solutions (e.g. Somerset Levels and Moors, Exmoor, Keighley Moor and SCaMP case studies V, B, E, M).

Adaptive management over time
Project management is based on the best available evidence to date, but often projects have to operate under conditions of imperfect knowledge and uncertainties (Andrade, 2011). Uncertainties include the response of the ecosystem, the level of impact from land management and different restoration methods as well as future climate and weather conditions. Adaptive management therefore requires testing and monitoring to feed back into decision making.

Projects have developed expertise in restoration management through working with local knowledge and contractors, trialling new techniques and learning over time. This includes testing the best design of dams, development of new machinery for re-profiling ditches, preparing plant seed for helicopter application, and sophisticated techniques for propagating *Sphagnum* moss (e.g. Dove Stone, MoorLIFE, North Pennines AONB, Blawhorn Moss case studies A, J, K, P).

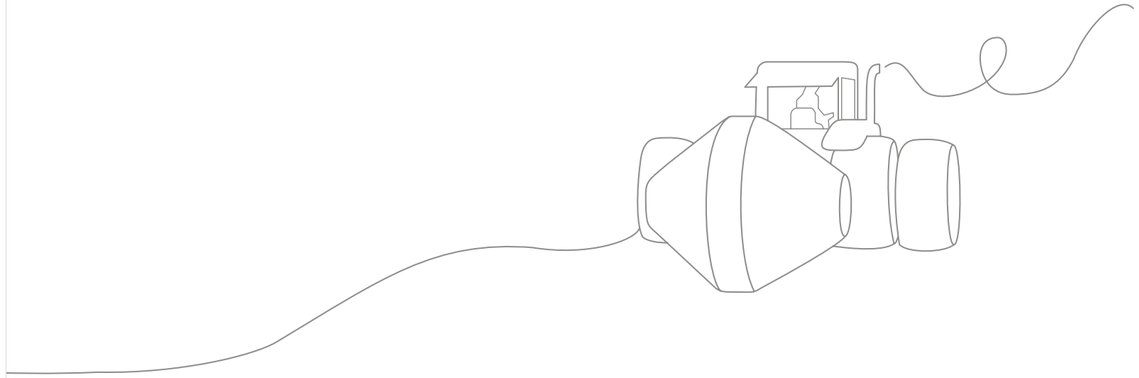
Sphagnum © Norrie Russell

Lindow Man — the Iron Age bog body retrieved during peat cutting in Lindow Moss, Cheshire, in 1984 © Trustees of the British Museum

Project design and set up, as well as flexibility in approaches, is essential to adaptive management. Restoration projects work in close collaboration with private land managers and local communities to address short-term challenges whilst at the same time promoting long-term resilience of the peatland ecosystem (e.g. Yorkshire Peat Partnership case study O). Enabling active participation of local staff from private and public bodies and involving local communities including volunteers leads to knowledge sharing, learning and ownership (e.g. Falklands case study D). Addressing the concerns of local communities, such as the lack of resources, skill shortages or employment and marketing opportunities is also essential. Discussing these issues has led to the development of local branding of products from peatland catchments (e.g. Anglesey & Llyn LIFE project case study X and beer from the Allandale brewery in the North Pennines AONB). In this way, peatland management becomes a wider, long-term goal for businesses and communities in the area. Many of the peatland restoration projects have links with research initiatives. A few examples are listed below.

Restoration-research initiative examples

- CEH Carbon Catchments (Flow Country, Migneint)
- Defra research strands on peat soils, ecosystem services and greenhouse gas flux, including collaborations of research institutes with eg. MoorLIFE, Yorkshire Peat Partnership, Migneint and others; Defra Peat Compendium, EMBER project and Ecosystem Knowledge Network
- Defra/Environment Agency Making Space for Water project with the University of Manchester and MoorLIFE
- Environment Agency hydrological monitoring in collaboration with universities (e.g. Exmoor)
- National Research Council (NERC) projects and consortia, such as UKPopNet (LIFE Active Blanket Bog) or the Valuing Nature Network on Valuing Peatlands
- Natural England national peat depth survey (North Pennines AONB)
- Scottish Government research programme, including Hutton Institute Review of restoration of blanket bogs
- Sustainable Uplands Rural Economy and Land Use (RELU) project
- Water company funded research with e.g. Universities of Leeds and Durham



National events such as the annual ‘Investing in Peatlands’ conferences hosted by the IUCN UK Peatland Programme have helped share this knowledge across science, policy and practice. Regional and national knowledge networks facilitate information exchange, such as the Scottish Moorland Forum, Moors for the Future, the English Upland Peatland Network and the Wetland Vision Partnership.

The IUCN UK Peatland Programme was established out of the desire to deliver peatland restoration in the UK and promote the multiple benefits of peatlands through partnership, strong science, sound policy and effective practice. Knowledge and good practice has been synthesised in resources such as the Fen Management Handbook (McBride et al. 2010), briefing notes, websites (see page 44), the FSC Sphagnum Field Guide (2012), as well as scientific reviews (e.g. in Bonn et al. 2009) and others. The IUCN UK Commission of Inquiry on Peatlands presents one of the most extensive assessments of peatlands undertaken in the UK to date. It identifies the state and value of peatland ecosystems and includes recommendations to safeguard and restore their natural capital.

Outlook
The case studies in this volume demonstrate how an ecosystem approach is put into practice promoting living peatlands and communities.

Andrade, A. (2011) Draft Principles and Guidelines for Integrating Ecosystem-based Approaches to Adaptation in Project and Policy Design. A Discussion Document. CATIE, Serie técnica, Boletín técnico no. 46.
http://cmsdata.iucn.org/downloads/draft_guidelines_eba_final_7_12.pdf

Bonn, A., Allott, T., Hubacek, K. & Stewart, J. (2009) Drivers of environmental change in uplands. Routledge Studies in Ecological Economics. Routledge, London and New York.

FSC (2012) Field guide to *Sphagnum* mosses. Produced in collaboration with Heather Trust, Moors for the Future and IUCN UK Peatland Programme

McBride, A., Diack, I., Droy, N., Hamill, B., Jones, P., Schutten, J., Skinner, A. & M. Street (2010) Fen Management Handbook. Scottish Natural Heritage, Perth.
http://www.snh.gov.uk/docs/B823264.pdf

Shepherd, G. (2008) The Ecosystem Approach: Learning from Experience. IUCN. Gland, Switzerland.
http://data.iucn.org/dbtw-wpd/edocs/CEM-005.pdf

Dropping off heather brash
© Moors for the Future Partnership

UK PEATLAND RESTORATION — DEMONSTRATING SUCCESS

LOCATION OF CASE STUDY SITES

A. Dove Stone
B. Mires-on-the-Moors, Exmoor
C. Falklands
D. Flow Country
E. Keighley Moor
F. LIFE Active Blanket Bog, Lake Vyrnwy
G. Marble Arch Caves, Cuilcagh Mountains
H. May Moss
I. Migneint
J. MoorLIFE, Moors for the Future Partnership
K. North Pennines AONB Partnership’s Peatland Programme
L. Pumlumon
M. SCaMP, Forest of Bowland
N. Whitelee
O. Yorkshire Peat Partnership
P. Blawhorn Moss
Q. Humberhead Peatlands
R. Lancashire Mossland
S. Langlands Moss
T. Malham Tarn
U. Red Moss
V. Great Fen
W. Somerset Levels and Moors
X. Anglesey and Llyn LIFE project

Location of case study sites. Some case study projects comprise more than one site or extend over a much larger area, not depicted here. Overall, information on over 120 UK peatland projects was collated in the UK Peat Compendium (see http://www.peatlands.org.uk).

Biodiversity Sundew, Flow Country © Norman Russell

A. ECOSYSTEM ENGINEERING IN ACTION

Dove Stone

Volunteers and *Sphagnum* mosses working together in the Peak District

In 2010, the RSPB formed a new partnership with United Utilities at Dove Stone in the Peak District in order to improve water quality, carbon stewardship and biodiversity as key objectives of a landscape-scale approach to peatland habitat restoration.

Landscape-scale restoration
As with many of the Peak District peatland restoration projects, the ongoing restoration at Dove Stone is happening at a huge scale. Over 100 ha of once bare peat have been successfully re-vegetated by the application of heather brash, geojute, grass seed, and a programme of lime and fertiliser application. In addition to these management techniques, grazing has either been reduced or excluded to allow vegetation recovery.

Volunteers and Sphagnum mosses in action
Developing local involvement through volunteering has been an important aspect of the project partnership. Volunteers are currently involved in two aspects of restoration; heather bale installation to raise water tables and trialling different *Sphagnum* restoration techniques. Raising water tables is a key target for peatland restoration and conservation volunteers at Dove Stone are actively creating higher water tables with spade and bale, acting as Ecosystem Engineers for the site. It is hoped that *Sphagnum* mosses will act as natural 'Ecosystem Engineers' by actively creating and maintaining a high water table in their surroundings, as they can store up to 20 times their own weight in water and help keep the bog surface saturated.

Ecosystem Engineering #1:
Water table restoration using heather bales
Led by Site Wardens, Kate Hanley and Jon Bird, volunteer groups have installed over 1,400 heather bales at Dove Stone over the past year. This work is concentrating on peat pans (relatively flat areas of redeposited peat), where heather bales can significantly raise the water table. If rain follows, new pools are created and surface wetness is retained for long periods.

Ecosystem Engineering #2:
***Sphagnum* mosses introduction trials**
Set up in consultation with Natural England, these trials include on-site translocation plus introductions primarily from non-SSSI (Sites of Special Scientific Interest) donor sites in Bowland and the North Pennines, as well as the spreading of nursery-grown *Sphagnum* beads. Thanks to funding from Natural England and Grantscape, beads, whole clumps and fragmented *Sphagnum* have been introduced to *Sphagnum*-free but relatively intact cotton grass dominated blanket bog in a number of trial areas. In addition to the *Sphagnum* itself, which will hopefully establish and provide a new population and in turn colonise the surrounding area, these introductions will create a suitable habitat for other specialist blanket bog plant and animal species to re-colonise the area. Trials have also taken place on more recently re-vegetated sites and survival rates are being monitored throughout 2012.

UK PEATLAND RESTORATION — DEMONSTRATING SUCCESS

Volunteers Ian Garland and Mike Stangroom installing heather bales © Ian Hughes

Installing bales requires a combination of judgement and brute force that is very satisfying - It's amazing the difference we are seeing out here.

Ian Garland, On-site volunteer working out on the remote and often bleak blanket bog.

Bead-aMoss: Gel-encapsulated *Sphagnum* fragments, developed by Micropropogation Ltd, are being trialled on-site in spring 2012. Five species are included in the mix, including both colonising more typically flush-type species such as *Sphagnum fallax* and *Sphagnum* fimbriatum, and bog builders such as *Sphagnum* papillosum © Dave O'Hara

B. RESTORING THE MIRES-ON-THE-MOORS

Exmoor Mires, Exmoor National Park

Addressing issues at the source of the catchment in South West England

The Exmoor Mires Project is a carefully planned restoration programme targeted at over 2000 ha of Moorland. Part of South West Water's Upstream Thinking Catchment Management Programme, this £10 million investment is a radical shift in water supply management, addressing issues at source in the catchment, rather than investing in storage and treatment works further down the river.

Re-awakening the mires
For years, the Mires of Exmoor have been regarded only as a source of peat fuel or grazing land to be cut into and drained to maximise production. This damage has changed the eco-hydrological functioning of the mires, leading to a purple moor grass Molinia dominated vegetation and reducing the provision of ecosystem services. The Exmoor Mires Project is working with land-owners and moorland users to re-assess the way bogs are regarded and managed. With the support of this partnership, hundreds of kilometres of old ditches and abandoned peat cuttings are being blocked up, gradually restoring their ecological and hydrological functions. The end result will be wetter, healthier peatlands, which supply a wide range of ecosystem services.

The Exmoor Mires Partnership
When the Exmoor Mires Partnership formed in 1999, the group started to think about how the function of Exmoor Rivers was linked to the Mires on the Moors above. They began a small programme of ditch blocking at the head of the River Exe and in 2006 with the inclusion of a new funding-partner, South West Water, they expanded the project. Since 1999, the partnership has continued to grow, and in 2010 the project evolved once again to a major landscape restoration and research project with a target of 2000 ha of mire restoration on Exmoor. The Exmoor Mires Partnership now includes representatives from all of the groups concerned with managing moorlands.

The governance and decision making of the Exmoor Mires project is now firmly in the hands of the moorland stakeholders and this has resulted in significant changes on the ground.

By 2010, the project had blocked over 50km of ditches, bringing positive re-wetting benefits to over 350 ha of moorland.

Exmoor Mires are unique
The thin peats and steep slopes of the mires on Exmoor lead to innovative solutions to ditch blocking and the techniques used on moorlands elsewhere in the UK have been adapted to suit the Exmoor situation.

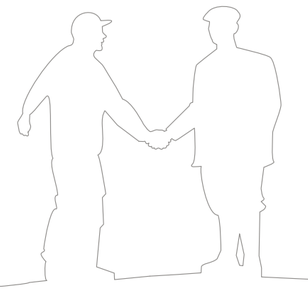
Delivering ecosystem services and creating sustainable future for mire landscapes
To restore the Mires, ditches and old peat cuttings are being blocked up using natural on-site materials, such as peat and bale dams and locally sourced timber. The aim is to widen the range of ecosystem services delivered from blanket peatlands in the South West of England.

The Mires Restoration Project is now monitoring the consequences of contemporary restoration of damaged mire landscapes in a holistic manner. The specific elements being monitored include water quality, supply, flood risk change, carbon storage and greenhouse gas fluxes, agricultural economic impacts, historic environment and biodiversity changes. A comprehensive pre-restoration understanding of mire structure and function has been established, describing all relevant ecosystem services. This data will be compared to the post-restoration data to determine the effect of mire restoration on all the ecosystem services listed. The information will enable the quantification and valuing of key services such as clean water supplies and greenhouse gas emissions reduction, leading, it is hoped, to a sustainable way of rewarding moorland land-owners for the provision of these services alongside food production.

UK PEATLAND RESTORATION — DEMONSTRATING SUCCESS

Blocking with wood, North Twitchen, Devon 2009 © Exmoor Mires

Public Walk © Exmoor Mires



The Mires on the Moors visit made all that I'd read and heard come to life, and reinforced my view that carefully targeted and simple actions have the potential to create enormous (and multiple) benefits.

Ian Barker, Environment Agency, Head of Water Land and Biodiversity

C. BRITISH OVERSEAS TERRITORIES PEATLAND RESTORATION

Falklands, BOT

Halting erosion of dry coastal peat in the Falkland Islands

Tussac restoration is increasing local engagement to reduce coastal erosion in the Falkland Islands' most-visited National Nature Reserve.

Peatlands in the Falkland Islands
The Falkland Islands have the largest peat resource (approximately 5,500km²) of all the British Overseas Territories and all island groups globally. Peat has formed slowly in the dry, cool climate and now covers most of the islands in some form. The focus of this restoration project is the dry, deep (some over 10 metre) coastal peatlands that are largely formed and dominated by the tall, tussock-forming grass Poa flabellata. The resulting habitat, Tussac, helps prevent coastal erosion, harbours significant bird and insect populations and, when properly managed, provides a valuable and sustainable winter forage resource for livestock.

The need
It is estimated that the area covered by Tussac has decreased by over 80% since human habitation. This loss has occurred largely through a combination of inappropriate grazing, fires, and wind erosion. The loss of Tussac affects both biodiversity, and farming, where properly managed Tussac can be integrated with adjoining poorer quality heath communities. It was recognised that to conserve these areas, grazing control and replanting were essential. Research indicated the most appropriate way to restore Tussac was to plant out propagated seedlings of Poa flabellata (rather than sow seed directly) which then increases its cover by tillering.

Local involvement
Over 70% of land in the Falkland Islands is privately owned making it vital that landowners realise the value of restoring Tussac along their coastlines. To increase awareness of this important resource, Falklands Conservation (FC) has set up a restoration site on the most visited local National Nature Reserve at Cape Pembroke, near the capital, Stanley. The Falkland Islands Government (FIG) agreed to fence off a section of the south coast from horse grazing, and a full programme of restoration of eroded coastal peat has been established. Replanting is being carried out entirely by local volunteers and FC staff, and the site will be monitored long term by FC's youth group.

Success
Good publicity for Tussac restoration was generated through interviews for the local radio and television. This significantly increased the amount of support provided by Falkland Islanders.
A hare-proof fence was also erected within the Tussac planting site. In areas where Tussac peat has been too severely eroded, other native colonists are being trialled to provide soil stabilization. This latter work has been made possible through the recently (2009) established native plants nursery set up in a novel collaboration between FC, Stanley Nurseries and the Royal Botanic Gardens Kew. There is a commitment in principle from FIG to continue to fence and aid restoration of all eroded peat areas along the south side of the Cape Pembroke NNR.

UK PEATLAND RESTORATION — DEMONSTRATING SUCCESS

Peatland in the Falkland Islands © Jim McAdam

Planting out Tussac Grass at Cape Pembroke © Natalie Simpson

Tussac restoration is one of the most successful conservation efforts of recent years. Initiated by Falklands Conservation as well as other conservation-minded individuals, the planting of tussac grass is a very visible conservation effort which will have huge benefit in the long-term. As a habitat for important wildlife and additionally as a crop for livestock when carefully managed, increased tussac cover is a tremendous resource which has the potential to benefit biodiversity and agriculture together.

Nick Rendell, Environmental and Planning Department, Falkland Islands Government

D. BRINGING LIFE BACK TO THE BOGS

Flow Country

A new beginning for Scotland's Flow Country

The Flow Country holds over 10% of the UK's blanket bog, and almost 5% of the world's resource, covering over 400,000 ha. Due to changes in land use over the years, we have lost or damaged much of this habitat. Together with partners, the Royal Society for the Protection of Birds (RSPB) is working to restore the Flow Country to its original state.

What is the problem?
The Flow Country is the common name for the vast peatlands bogs of Caithness and Sutherland — mainland Scotland's most northern counties. Peat has been forming here for thousands of years and reaches, in places, up to five metres in depth. As well as storing over 400 million tonnes of carbon, this area is a stronghold for a wide variety of wildlife, such as otters, water voles, red deer, mountain hares, hen harriers, waders and waterfowl.

After remaining largely untouched for millennia, the Flow Country has undergone a massive change in land use over the last 30 years. In the 1980s, vast areas of peatland habitats were destroyed or damaged through drainage and planting of commercial conifer plantations, despite having been naturally treeless for over 4,000 years. The unfortunate result was huge damage to the habitat and the disappearance of much of the special wildlife. Damage to the habitat also meant that instead of the peat bogs actively sequestering carbon from the atmosphere the peat is continuously degraded and emits carbon to the atmosphere.

Taking a stand
In 1988, following a major campaign led by the RSPB in Scotland and the Nature Conservancy Council, a network of SSSIs (Sites of Special Scientific Interest) was established to protect the Flow Country. This was followed in 1992 with the launch of a Peatland Management Scheme, funded by Scottish Natural Heritage (SNH), which involved making direct payments to land-owners and occupiers to support maintenance activities in this network of areas. In 2001, a partnership of RSPB, SNH, the Forestry Commission and Plantlife began a £2.8 million project, funded by the European LIFE programme, to bring conservationists and foresters together to restore damaged blanket bog at a landscape scale. The Scottish Government has also provided funds for peatland research and restoration in the Flow Country.

Making a difference
Practical restoration work has included blocking drains across 15,600 ha of blanket bog, (over 18,000 dams installed), and removing trees from 2,300 ha of former blanket bog. These activities have raised the water tables in the drained peatland and provided the conditions for bog mosses and other vegetation to recover. This prevents the loss of carbon to the atmosphere from the peat and allows the creation of new peat — turning the habitat back into a sink for carbon. In addition, restoring the bog habitat has attracted more wading birds like golden plovers, dunlins and greenshanks.

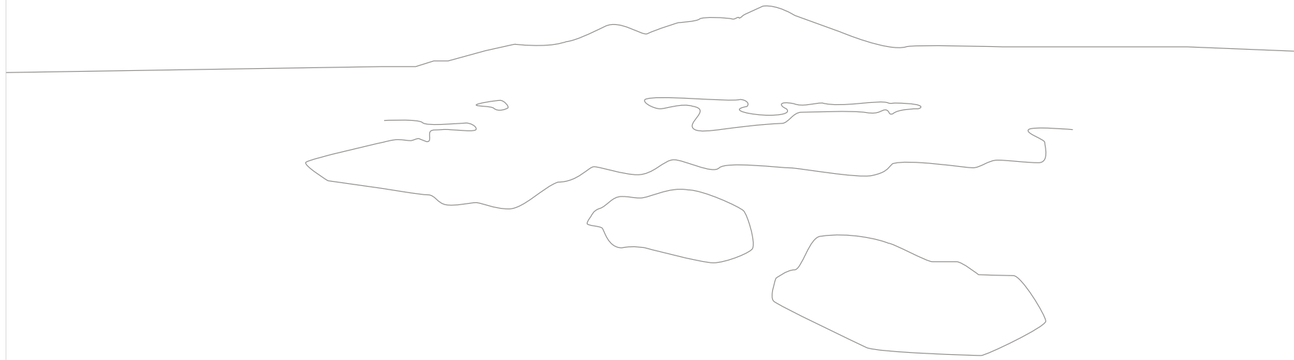
An example: Progressive conservation
The RSPB Forsinard Flows reserve was established in 1995 and lies in the heart of the Flow Country. Run by locally-based staff, the reserve is emerging as a major centre for research on peatland ecology, hydrology, carbon and restoration, in collaboration with many research institutes. Bog habitat condition is subject to extensive monitoring, including vegetation deer indices, birds and water tables. In addition to the research, Forsinard Flows attracts over 4,000 visitors each year, who contribute £190,000 to the local economy.

Looking forward
By tackling issues at a landscape scale, the current management strategy aims to cover the full ecological function of the peatlands and resolve different land-use pressures. For example, by identifying areas where trees could be planted, as well as areas for removal, it should be possible to create a sustainable forestry future in the area. This is a shared strategy across land managers, crofters, foresters and conservationists; working together for restoration.

UK PEATLAND RESTORATION — DEMONSTRATING SUCCESS

Afforested peatland in the Flow Country © RSPB

Monitoring Flows © Norman Russell



I love this place. Here, the ground quivers when you walk on it — a rich carpet of moss covering deep peat below. Forsinard Flows lies at the heart of the biggest area of West Atlantic blanket bog in the world. It is essential that we protect and restore this place.

Norrie Russell, Senior Site Manager, RSPB Forsinard Flows Nature Reserve

E. FROM SOURCE TO SEA

Keighley Moor

An inclusive approach to catchment management on Keighley Moor, South Pennines

Yorkshire Water's work on Keighley Moor shows that an inclusive approach to upland catchment management can deliver improved water quality in a cost-effective way, whilst supporting the many other functions of the moorlands.

A valuable resource
The South Pennines are a major water catchment area for Yorkshire, with 120 reservoirs providing 50% of the drinking water for the surrounding population. With more unpredictable weather patterns and ongoing climate change implications, adapting these water catchment areas to be more resilient is becoming increasingly important. Keighley Moor is one of a number of individual moors making up the 25,000 ha of the Pennines owned by Yorkshire Water. Its value is recognised in its designation as part of the South Pennine Moors Site Special Scientific Interest (SSSI), Special Area of Conservation (SAC) and Special Protection Area (SPA). The moor is rented to shooting tenants who manage it for grouse shooting, and to tenant farmers who use it for sheep grazing.

The cost of clean water
Traditional management of heather moorland by muirburn, along with wildfires, historical air pollution and drainage, has led to degrading peat on moorlands and discoloured raw water supplying moorland-fed water treatment works. This discolouration has increased over recent years. The processes for removing peat stain from water are energy and thus carbon intensive, and the cost of treatment raises our water bills.

Colour comes primarily from degrading peat
Many things can cause peat to break down, but it is compounded by how the vegetation on the surface is managed. Many upland water catchment areas, such as Keighley Moor, are also farmed for sheep, and managed for grouse shooting.

Grouse moor management creates the mosaic of heather moorland with its purple bloom in late summer which defines some of the character of the Yorkshire Pennines. More naturally a moor would be a mosaic of heather on drier areas, and wetter areas of blanket bog where heather is replaced by bog cotton and *Sphagnum* mosses. Past management by burning and grazing has led to the bogs drying out, which means they can be colonised by heather, which further dries out the peat.

Managing Keighley Moor for everyone
The aim of this project is to find more sustainable, longer term solutions to tackle the problem of water quality at source. However, the management of Keighley Moor is not all about drinking water. It is also about the upkeep and sustainability of Yorkshire's moorlands. Taking an inclusive approach ensures that there is a fair balance between water quality and the needs and interests of the tenants who earn their livelihoods from the moor.

A vision for the future
The restoration plans on Keighley Moor are based on raising the water table within the peat, to keep it wetter for longer during the year. Keeping it wet protects it from damage, and helps recreate the conditions which formed the peat in the first place. The moor will still be managed for grouse and sheep, but the growth of the heather will be slower, reducing the need to burn it as frequently. This work will not only achieve better water quality but also ensure the long-term viability of the tenants' interests in the land. Keighley Moor is also part of the Natural England Ecosystems Services Pilot in the South Pennines, whose aim is to value all the services that upland catchments provide: water provision; agricultural produce; biodiversity; flood protection; recreational opportunities; and climate regulation.

UK PEATLAND RESTORATION — DEMONSTRATING SUCCESS

Natural England's Conservation Officer, Dave Key, Andrew Walker (YWS) and the NE Board of Directors discuss restoration techniques on Keighley Moor © Ian Stevens

Newly formed pools behind blocked gullies are rewetting the moor and helping to propagate more peat building *Sphagnum* moss on Keighley Moor © Ian Stevens, YWS

> At Keighley Moor we've taken a partnership approach, showing how these landscapes can be managed for multiple benefits, rather than solely water quality. We need to think about the water environment from source to sea, and consider greater integration of clean and waste water processes.
>
> Andrew Walker, Yorkshire Water

F. BREATHING LIFE INTO WELSH BLANKET BOGS

LIFE Active Blanket Bog, Lake Vyrnwy

Aiming for significant and sustained improvement in moorland management

Practical restoration work at two Special Areas of Conservation in mid-Wales has aimed to bring the blanket bog in these two locations into favourable condition. Work has included a combination of ditch blocking, plantation forestry removal and the extraction of invasive, non-native plant species.

Active Blanket Bog in Wales
It is estimated that 70,000 ha of deep blanket peat soils occur in Wales, although probably more than 10% of this no longer supports blanket bog vegetation. The LIFE Active Blanket Bog in Wales project aimed to achieve significant and sustained improvement in the condition of blanket bogs across key areas of two Special Areas of Conservation (SAC) in mid-Wales;

1. The Berwyn and South Clwyd Mountains SAC (27,221 ha)
2. The Migneint-Arenig-Dduallt SAC (19,968 ha).

The primary problems affecting the condition of blanket bog in the project areas included drainage ditches, forestry plantations, inappropriate grazing levels and encroachment by non-native species. In addition to practical restoration work, the project wanted to increase the knowledge and understanding of blanket bog habitats in order to improve their future management.

Working with communities
The moorlands of Wales are a significant part of Welsh cultural heritage. Working with the local farming community was of particular importance to this project as this was the first time practical upland restoration work had been carried out in the area. Farmers were invited to visit the project in conjunction with an extensive programme of community events, such as guided walks and talks, attendance at local shows and a large school education programme. Initially there was considerable unease about the management programme, however towards the end of the project a significant shift in perception was observed.

The expansion of the project to block 179 km of ditch across 2,610 ha of land, belonging to 11 private farmers, demonstrates the success of the advisory work carried out.

Measurable success
The LIFE project has been successful in restoring significant areas of important habitat, developing skills, refining techniques and gaining the interest and support of the local community. The project far exceeded its targets for restoration work, rewetting a total of 7,200 ha of upland habitat. In total 485 km of grips were blocked, 249 ha of forestry plantation was removed and non-native plant species were removed across an area of 6,300 ha. Furthermore, the associated scientific knowledge gained during this project has also helped add to the understanding of moorland management and its effect on climate.

Farms in the catchment also produce organic wool, and organic Welsh black beef and Welsh mountain lamb. As well as being used as a conservation tool for habitat management purposes, sheep and cattle form the basis of a commercial farming operations, which contribute to the local economy.

Wider than Wales
This project has been successful at many levels, changing attitudes locally and bringing blanket bogs and their importance to the notice of decision makers and policy makers. The combination of practical work on a landscape scale, supported by rigorous monitoring and cutting edge science has enabled this high profile project to help inform policy across the whole of Wales and has contributed to the understanding of this ecosystem on a UK and international platform.

The LIFE Active Blanket Bog has won the LIFE Nature ‘Best Project Award’ in 2012.

UK PEATLAND RESTORATION — DEMONSTRATING SUCCESS

Removal of self-seeded non-native Sitka spruce at Lake Vyrnwy
© gorgorscymru

Lake Vyrnwy in particular created an exemplar that demonstrates how a reservoir catchment, providing drinking water for a major city, can also be managed as a nature conservation habitat of European importance and as farmland providing local employment and a quality organic product.

Katie-jo Luxton, Director, Royal Society for the Protection of Birds, Cymru

Project Manager Jared Wilson addressing a group of local farmers at a demonstration event at Lake Vyrnwy © gorgorscymru

G. PEATLAND RESTORATION FOR ENJOYMENT

Marble Arch Caves, Cuilcagh Mountains

Allowing visitors to enjoy a newly-restored bog and the Marble Arch Caves

The Marble Arch caves are a major tourist attraction and in 1989 severe flooding raised concern about visitor safety and the threat to tourism. Investigations revealed that the cause of the flooding was changes to the flow of water off the Cuilcagh Mountain. Commercial peat cutting, over-grazing, burning of vegetation and quad bike tracks had all contributed to this change.

The setting
Cuilcagh Mountain (2,700 ha) is situated in Fermanagh in the west of Northern Ireland along the border with the Irish Republic. It is one of the largest expanses of blanket bog in Northern Ireland formed on a relatively high elevation upland landscape. In the late 1980s, this bog habitat was in bad shape. Years of overgrazing, mechanized peat harvesting and other mistreatment had damaged the sensitive bog ecosystem.

Peat Cutting
For generations peat has been cut by hand as a source of fuel on Cuilcagh Mountain. The peat cutters were careful to remove the living layer, or sods of vegetation, off the bog surface before cutting the peat. After cutting, they replaced the sods of vegetation on the exposed peat surface helping to ensure that the bog was not irreparably damaged. However, since the 1980's, machines have been used all over Ireland to cut peat. These machines are attached to the back of a tractor and one person can now cut in a few hours what it would have taken a week to cut by hand. An area of 28 ha of blanket bog within Cuilcagh Mountain Park has been severely damaged by mechanical peat extraction. In addition, 11 km of drains were dug within the area.

A decade-plus-long restoration project
Marble Arch caves are a series of natural limestone caves near the village of Florencecourt in County Fermanagh. Water from Culicagh mountain drains into the caves, and the damage to the bog there meant water drained faster into the caves, raising the risk of flooding. Restoring the bog habitat on the slopes of Cuilcagh Mountain back to its fully functioning form was essential to ensure the safety of visitors to Marble Arch Caves. The Fermanagh District Council initiated a long-term project in conjunction with the RSPB using EU LIFE and UK Heritage Lottery funding. In 1998, the Council set up the Cuilcagh Mountain Park. The aim was to protect unaffected areas of the blanket bog and increase awareness of this rare habitat. This involves blocking drains using a variety of materials including hay and straw bales; recycled plastic and wooden sheeting; forestry 'brash'; and the peat itself.

Visitor solutions
The visitors centre at the Marble Arch Caves includes displays on the story of the Cuilcagh and its restoration. Water level monitoring stations were established upstream of the Marble Arch Caves and sophisticated measuring equipment warns of increasing water levels, ensuring the safety of visitors to the caves. In addition, a geotextile-lined aggregate path, sometimes called a 'floating trail,' allows hikers to enjoy the now-restored bog without damaging it. Similar paths are used all over Ireland, Scotland, and other bog-laden countries.

A long process
Many Government bodies, conservation groups and academics have had to work together to repair the damage to the blanket bog and protect it for the future. The restoration process is ongoing and it may take many years before the vegetation recovers fully. Scientific monitoring by Queen's University Belfast ensures that restoration action and development is recorded, so that experiments can be repeated and the work can inform others restoration projects.

Cuilcagh Mountain Park Blanket Bog © Fermanagh District Council

In 1992, we were suddenly faced with a major, unexpected dilemma when damage to the peatlands in the upland catchment of Marble Arch Caves threatened the long term viability of the caves as a visitor attraction. Twenty years on, we have turned the problem around by restoring the blanket bog, reinstating the natural hydrology, raising public awareness and providing public access. As a huge bonus, on the back of our restoration project, we became the first place in the UK to be accepted as a UNESCO Global Geopark because of our special geological heritage and later became the world's first international geopark when we expanded across the Irish border into neighbouring county Cavan.
A good result I would say.

Richard Watson, Manager, Marble Arch Caves Global Geopark, Fermanagh District Council

H. FELLING TREES AND BLOCKING DRAINS

May Moss

Restoring the lost half of May Moss, North York Moors National Park

In 2009, working with partners and funding from the SITA Trust, the Forestry Commission started restoration work on May Moss, a blanket bog covering about 150 ha at the head of the Yorkshire Derwent.

Deep peat is a rare feature on the North York Moors
May Moss is situated in the North of England in the North York Moors National Park, an area dominated by dry, upland heath with old pastures and lime-rich grasslands. Much of the upland area is part of the North York Moors SSI, which is also an SPAfor birds, such as merlin and golden plover. North of the National Park runs the River Tees and its estuary, while to the south is the Vale of Pickering, an area undergoing partial wetland regeneration.

Between 1919 and 1983 the United Kingdom's forest policy was targeted at creating a strategic reserve of timber following centuries of woodland destruction which had reduced forest cover to 5%. Many forests were created on Britain's peatlands. Peat was ploughed and drained in many places, including May Moss. However, awareness of the value and vulnerability of peat and its associated habitats has greatly increased in recent years, resulting in an urgent programme of work to halt and repair damaged areas.

The May Moss mosaic
Currently, May Moss is partially drained and planted with conifers. With peat up to 6 metres deep, the area is a mosaic of dwarf shrub and blanket bog with common heather (*Calluna vulgaris*), cross-leaved heath (*Erica teralix*), cotton grass (*Eriophorum sp*), cranberry (*Vaccinium oxycoccos*) and the only known population of bog rosemary (*Andromeda polifolia*) on the North York Moors. Although severely damaged due to the intense ploughing and draining, the 150 ha blanket bog is also home to populations of adder and the large heath butterfly.

In 2009, the Forestry Commission began work to restore the 'lost' half of May Moss by clearing conifers and blocking drains. Intensive work finishes in 2012 when more than 70 ha of peat will have begun the process of recovery.
Using a range of different restoration methods, the Forestry Commission overcame the practical difficulties of tree removal by implementing a combination of felling and mulching or pulverising. Drains have been blocked with peat 'plugs' and timber weirs and, finally, a monitoring programme has been put in place to better follow and understand the recovery process. Thanks to North York Moors National Park Volunteers and P.L.A.C.E (People, Landscape And Cultural Environment of Yorkshire), annual vegetation surveys have been carried out on May Moss for over 40 years. This data will now be complemented by additional recordings of climate and changes in hydrology being collected by Liverpool University, a new project partner.

Mighty oaks from little acorns grow
The peat restoration work begun at May Moss provides a model for other peat restoration on other forest sites and has provided both Forestry Commission staff and contractors with a new set of highly transferable skills. With careful management, this habitat will be able to continue producing significant amounts of timber, whilst at the same time being a major contributor to landscape-scale ecosystem services.

The volunteers working on this project have a long-term vision for May Moss and plan to monitor the vegetation for decades to come, enthusiastically learning and implementing the skills needed. Alongside these committed volunteers, the data gathered from frequent monitoring of the habitat's climate and hydrology ensures that our knowledge and understanding of blanket bogs, such as May Moss, will continue to increase.

UK PEATLAND RESTORATION — DEMONSTRATING SUCCESS

Following mulching of the tree tops, the forest drain has been blocked with a peat 'plug'
© Forestry Commission

May Moss is possibly the most unique and important peat bog in the east of England.

Dr. Richard Chiverrell, University of Liverpool

North York Moors National Park Volunteers carrying out vegetation surveys on a forty year old transect at May Moss
© Forestry Commission

I. CARBON NEUTRAL CATCHMENT

Migneint

Implementing an effective management scheme for the Migneint, Snowdonia National Park

The Migneint is an extensive area of blanket bog in central Snowdonia and one of the largest stores of carbon in Wales. While currently extensively drained and ditched, it has the potential to become a nationally important carbon sink if the appropriate management regime is identified and implemented.

The Upper Conwy Catchment Project
The Ysbyty Estate is one of the largest agricultural estates in Wales and possibly the largest estate in National Trust ownership. Extending to some 8,000 ha, the estate includes enclosed farmland, as well as a mountain and moorland extending to over 600 metres above sea level. The Upper Conwy Catchment project is working to restore the Ysbyty Estate back to a healthy and robust catchment with well managed soil and water resources, including a fully functional peat bog ecosystem. Most importantly, the project emphasises the importance of this system existing alongside a viable and vibrant agricultural community, and a widely held recognition of the natural and cultural heritage interest of the area.

On-the-ground action and monitoring
The project is working to improve soil and water management practices in the catchment area and restore and improve the condition of the peat and the habitats by:

- Blocking grips in core areas of drained peat
- Stabilising areas of eroded peat
- Developing a fire prevention plan and an action plan for an outbreak of wildfire including fire- breaks and cutting heather in some areas to reduce risk
- Developing sustainable farming systems and adding value to the agricultural produce
- Identifying and taking action to reduce farm pollution risksImproving the fisheries habitat
- Introducing river corridor management e.g. floodplain woodland
- Implementing the Countryside Council for Wales' Upland Framework

A LiDAR (Light Detection and Ranging) survey has allowed the catchment to be broken down into high, medium and low priorities for peatland action, overlaid with nature conservation priorities.

Significant outcomes
Approximately 270 km of ditches have been blocked by peat dams and re-profiled between January 2011 and February 2012. Grip blocking large areas of the Migneint will have long-term beneficial impact on habitat restoration, flood management and carbon sequestration. The significant majority of the grip-blocking work has been undertaken by local contractors who are either tenants on the estate or have direct linkages with the tenants and the local community. This has forged strong support for the work, and communication between tenants and the contractors has provided a greater level of understanding about the work.

Moving forward together towards carbon neutral catchments
The National Trust is planning to develop a Ysbyty Estate Carbon and Energy Plan and is currently researching the potential to harness the rivers, at the confluence of the Serw and the Conwy, in order to create hydroelectric power for the site. Plans for the future place estate tenants at the forefront of technology, and demonstrate that traditional Welsh farmhouses can be sustainable and carbon neutral. Significant investments have been made in the local community, including insulation of all farmhouses and cottages, where practical, with wool product sourced from Wales. The agricultural estate will be an exemplar of holistic catchment and soil management, providing a spectrum of ecosystem services and good traceable food to feed a growing population.

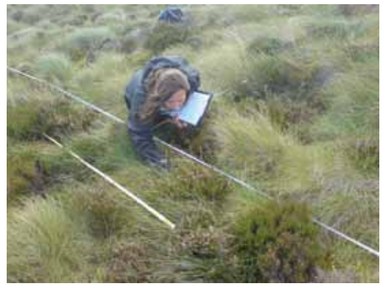
The Project was awarded one of the 'Best Project Awards 2011' for an EU LIFE Nature Project. The strong partnership links, high quality science, excellent community links and expert restoration techniques were of particular note in this project and all involved are delighted to have been recognised with this award.

UK PEATLAND RESTORATION — DEMONSTRATING SUCCESS

School group on a visit to Lake Vyrnwy © gorgorscymru

The project was designed to be a demonstration project as much as practical restoration. By carrying out work on land owned or managed by the partners we were able to show landowners the true impacts of drain blocking in the Welsh mountains and allow them to make up their own minds about the work. Site visits by National Trust staff and tenants from the Ysbyty Ifan Estate to Lake Vyrnwy allowed us to talk to a vitally important group of people and, in time, to work directly with them. The close partnership between the project and National Trust staff added an extra element to the project that no-one anticipated at the start, and considerably more drain blocking.

Mike Morris Senior Project Manager, Severn Rivers Trust



Vegetation monitoring © ECUS

Grip blocking © gorgorscymru

J. MOORLIFE: BRINGING BACK THE BALANCE

Moors for the Future Partnership

Conserving the Peak District and South Pennine peat moorlands

The Bleaklow landscape is an extraordinary one; hectare after hectare of moorland is stripped of almost all vegetation, showing nothing more than bare black peat. Led by the Moors for the Future Partnership, the MoorLIFE moorland restoration project is working towards restoring Bleaklow to the healthy wet bog it should be.

Aiming to restore over 800 ha of South Pennine moors by 2015, the MoorLIFE project has been made possible by a £5.5m grant from the European Union's LIFE+ programme. Protecting Active Blanket Bog by restoring bare and eroding peat in the South Pennines Special Area of Conservation (SAC) and Special Protection Area (SPA) is key to its success.

"Almost a moonscape"

Bleaklow and the surrounding area demonstrate the result of two centuries of airborne pollution carried over from the industrial areas to the west of the Pennines, combined with the effects of wild fires. Where you would expect to find healthy wet bogs complete with a wide variety of creeping shrubs and mosses, there is instead a desert-type environment. As Chris Dean of Moors for the Future states, "it is a situation which has to be changed". It isn't only the ecology which suffers when peat bogs dry out and crumble away. As well as storing incredible amounts of carbon, the drinking water for many of the big cities of northern England comes off Bleaklow and the neighbouring Pennine hills. However, treacle-coloured water carrying small particles of peat from degraded peatlands increases treatment costs for water companies and, as a result, for all of us.

Rewetting the bogs

The Moors for the Future Partnership project has come up with various ways of rewetting the bogs and giving them back a proper clothing of vegetation. Specially harvested heather 'brash' is spread on the peat, providing a protective blanket for grass seed to take root. Lime is put down, to try to neutralise the excessively acidic nature of the soil, caused by past atmospheric pollution. Helicopters are used to drop grass seed; gullies are blocked and geotextiles laid. The spongy *Sphagnum* moss — the sign of a healthy wet bog — is reintroduced along with native plug plants.

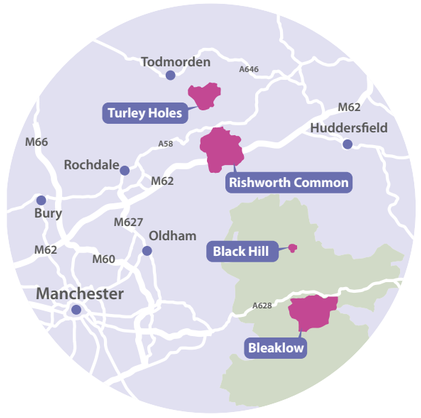
Little by little, the bare surface of the moors around Bleaklow is turning green once again.

Integral components...monitoring and public awareness

Hundreds of vegetation quadrats and manual dipwells have been set-up to monitor the impact of the conservation works on plants and water table. This will provide key data for future policy and conservation work plans. In addition, local, regional and national communication initiatives are being delivered to reach different audiences and transfer knowledge, both through new media and traditional communication vehicles.

Collaborative effort

Bleaklow is just one of four MoorLIFE sites. The sites are Black Hill, Turley Holes and Rishworth Common. MoorLIFE's scale and success is very much the result of partnership working. The project is co-ordinated by the Peak District National Park, delivered by Moors for the Future Partnership and co-funded by the European Commission's Life+ Programme. Partners include Environment Agency, Natural England, National Trust, United Utilities and Yorkshire Water.



MoorLIFE restoration sites in the Peak District and South Pennines.

Marshalling bags of heather brash on to bare peat © Moors for the Future Partnership

This restoration project is a remarkable success story. You win in terms of water quality, you win on carbon, you win on landscape, and you win on wildlife conservation.

Professor Sir John Lawton, British Ecologist, currently advising the UK government on their approach to the Natural Environment

Restoring bare peat © Moors for the Future Partnership

K. RESTORATION, RESEARCH AND CELEBRATION

North Pennines AONB Partnership's Peatland Programme

Restoring peatland in the North Pennines AONB (Area of Outstanding Natural Beauty)

The North Pennines Area of Outstanding Natural Beauty (AONB) Partnership's Peatland Programme is a multi-year peatland conservation effort that aims to restore and conserve the internationally important peatland resources within the North Pennines.

Peatland resources
The United Kingdom has about 12% of Europe's peatlands and 13% of the type of peatland which is internationally rare: blanket bog. The North Pennines has almost 30% of England's blanket bog and contains the largest area of contiguous bog in England. At over 100,000 ha the North Pennines AONB peatland complex is one the largest bogs and carbon stores in Europe.

Drained on an industrial scale
Almost 10,000 km of drains have been cut into these North Pennine peatlands over the last 60 years in an attempt to make them more agriculturally productive. This drainage has left the peat bog damaged and in a deteriorating condition. North Pennine peatlands provide numerous ecosystem services including carbon storage and sequestration, water resources, wildlife habitat and flood amelioration. It is important, therefore, to restore this habitat and increase the resilience of peatlands under climate change impacts.

A multi-year peatland conservation effort
The Peatland Programme has four basic objectives:

- **Restoration**: Supporting peatland restoration and management work;
- **Research**: Supporting and disseminating of new and existing research;
- **Celebration**: Raising appreciation and understanding of peatlands;
- **Promoting best practice**: Provision of peatland management advice.

Since 2006, the Programme has worked with partners to assess and block 6,200 km of drainage. It has restored 7,000 ha of peatlands in the North Pennines by directly financing and managing 1,100 km of drain blocking by installing 110,000 peat dams.

Contributing to research
The Programme has supported over 15 scientific research projects, including the ongoing National Peat Depth Survey funded by Natural England. By contributing to the peatland research community, engaging with local residents and visiting tourists, the project is also working to raise the profile of peatlands with decision makers, funders, land managers and the general public.

Future restoration efforts
A recent remote sensing survey identified over 4,800 eroding peat sites in the North Pennines, with a total area of more than 2,800 ha. An initial review of the data indicates that approximately 2,460 ha of these eroding peat bodies require restoration. A ground survey of these sites is planned for 2012 which will begin to classify, quantify and prioritise the eroding peat sites. The next several years will then be spent restoring some of the largest and most damaged eroding peatland areas, as well as continuing to block the remaining 3,800 km of drains in the North Pennines.

UK PEATLAND RESTORATION — DEMONSTRATING SUCCESS

Grip reprofiling © North Pennines AONB Partnership's Peatland Programme

North Pennines AONB Partnership's Peatland Programme

We are entering a very exciting time for peatlands. There is a real momentum of coordinated effort in the UK gathering pace as a new, long overdue, appreciation for peatlands is beginning to materialise. Peatlands provide many essential ecosystem services for of all us ranging from water provisioning to climate regulation. It is important that we continue our conservation efforts to ensure a sustainable future for our peatlands.

Paul Leadbitter, Peatland Programme Manager

L. ECOSYSTEMS AND ECONOMIES

Pumlumon

Pioneering a Welsh upland economy built around wildlife, ecology and long-term sustainability

The Pumlumon Project is a long-term vision for the countryside, a pioneering experiment in an area of Mid Wales which contains 250 farms, 15,000 inhabitants and catchments for five rivers (including the Severn and Wye) which supply water to four million people.

Long-term vision
Wales's rural, upland areas are having a hard time with jobs and incomes under threat. Continued erosion, over-grazing and damage to wildlife, offer no better environmental or economic future, especially when factoring in climate change. Managed by Montgomeryshire Wildlife Trust as part of Wildlife Trusts Wales' Living Landscapes initiative, the aim of the Pumlumon project is to find new solutions to current and future land use problems. Focussing on restoring or building ecosystems and economies relevant to today's conditions, the project's objectives are to halt biodiversity decline, inspire people about the natural world and create a sustainable landscape. These objectives can only be met with a landscape-scale strategy that forges new partnerships between conservation, land managers and tourism.

A model for all upland farms
The Pumlumon project aims to test a range of new business models for upland communities. In traditional economics, the goods and services an ecosystem provides often have no market value. However, it is now widely accepted that uplands can deliver not just food but biodiversity gain, sustainable soil management, and flooding and climate change mitigation. As a result, the models being tested by the Pumlumon project are largely based on the sale of 'ecosystem services' or 'natural capital'.

Pilot schemes
Over the last three years the project has trialled 10 pilot schemes focused on the following four restoration approaches:

1. Blocking drainage ditches on degraded peatlands, which leads to the re-establishment of the peat-forming mosses which lock up carbon
2. Switching from sheep to low density cattle grazing, which tends to improve habitat quality and therefore biodiversity
3. Planting willow, birch and rowan trees and restoring hedgerows to create connecting woodlandbetween upland habitats and lowland woodland.
4. Fencing out riparian areas to create gully woodlands, which help filter the water draining off adjacent grasslands as well as slowing the flow of water during flood events.

With local farmers and contractors paid to undertake these projects, the results have been positive. Habitat has been restored, created and connected, floodwater management and carbon safeguard has improved, and there are new visitor access opportunities. Between 2008 and 2012, conservation management was carried out on over 1140 ha of land and the project was responsible for restoring 270 ha of peatland habitat. Work is still being carried out on over 330 ha, with ditch blocking, bog restoration and cattle grazing being put in place to protect raised bog, blanket bog, woodland, acid grassland and mire.

Can Pumlumon really work?
The underlying premise of the land use jigsaw (see image below) is that if you take action on the ground to improve biodiversity and ecosystem health, you cannot help but have a positive impact upon ecosystem services (e.g. water and carbon) which as part of a viable market mechanism will ultimately support the sustainability of upland economies. In turn, the communities engaged with these economies will have a vested interest in supporting the resilience of these habitats as ecosystem health underpins their livelihood. In this respect, the work at Pumlumon is not only sustainable, but also provides the opportunity to find out what might be workable in the future; ecologically sustainable land management that is economically viable.

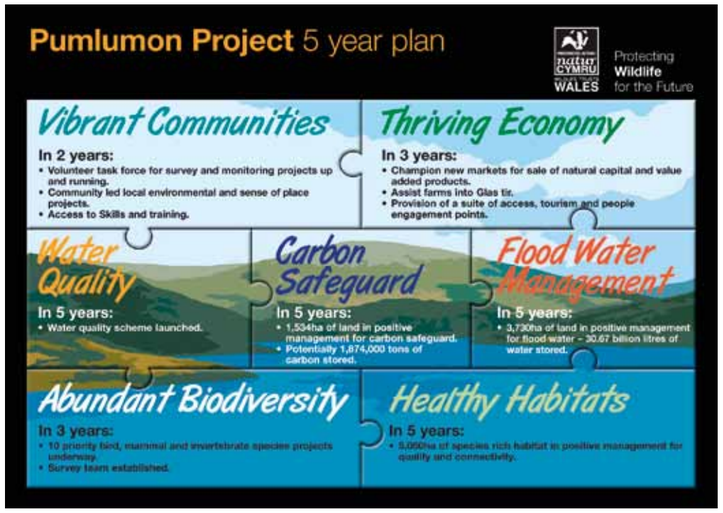
UK PEATLAND RESTORATION — DEMONSTRATING SUCCESS

First suite of Pumlumon Project ditch blocking works being carried out on private farm land by a local contractor © MWT

Launch of the Pumlumon Project Audio trail, a downloadable MP3 application which tells the story of the Project areas © MWT

The Pumlumon Project inspired my thinking. This progressive model could light the way to sustainable land management of marginal areas right across the UK and beyond.

Jane Lloyd Francis, Small business owner and Pumlumon Project Farmer



5-Year-Plan Jigsaw © Elizabeth Lewis-Reddy

M. IMPROVING THE QUALITY OF OUR DRINKING WATER

SCaMP

United Utilities Sustainable Catchment Management Plan (SCaMP), North-West England

SCaMP is a partnership between United Utilities, the RSPB, local farmers and a wide range of other stakeholders, including Natural England and the Forestry Commission. It is an ongoing programme (2005-2015) that aims to restore and enhance water catchment and moorland areas, and to introduce more sustainable land management practices.

Improving water quality
The primarily moorland project area covers 56,385 ha of United Utilities owned catchment land in North West England, 17,000 ha of which is designated as SSSI. Like many upland areas in Britain, much of the land in SCaMP consists of peaty, wet soils. These peat soils have water regulating properties, retaining rainwater, filtering and cleaning it before it reaches reservoirs and rivers. Thus, a major ‘use’ of the land is gathering water for human consumption.

Previously this land had been managed by tenant farmers for purely agricultural purposes. However, the environmental impact of these farms, and other factors, was leading to poor SSSI condition and increasingly discoloured and turbid water. By incentivising improvements in land management, the SCaMP scheme has sought to improve the condition of the SSSI’s, reduce risks to water quality, whilst also providing additional benefits through improvements in ecosystem quality.

SCaMP 1
The first programme of work, across 20,000 ha of land including 13,000 ha of SSSI, aimed to improve water quality, especially colour and sediment, and meet SSSI targets for favourable condition. Between 2005 to 2010, the main restoration works included:

- Re-wetting 5,500 ha of blanket bog through 85km of drain blocking
- Re-vegetating 470 ha of eroding bare peat
- Reducing grazing pressure and restoring dwarf shrubs
- Installing 200 km of fencing to allow for moorland restoration and woodland planting
- Protection of watercourses

As a result of this work, United Utilities returned 98.6% of its SSSI land into a favourable or recovering condition. Vegetation monitoring is demonstrating improved ecological condition and raw water quality monitoring indicates that SCaMP 1 is beginning to have a positive effect for turbidity and colour.

SCaMP 2
After the success of SCaMP 1, additional funding was sourced to carry out further restoration work. This programme of work is similar in nature to the work carried out successfully in SCaMP 1 and is focussed on 53 farms holdings in Cumbria and Lancashire. It aims to:

- Protect and improve water quality
- Deliver government targets for SSSIs
- Enhance biodiversity
- Improve carbon and green house gas fluxes
- Ensure a sustainable future for agricultural tenants

Brown syke grip © Andrew Keen

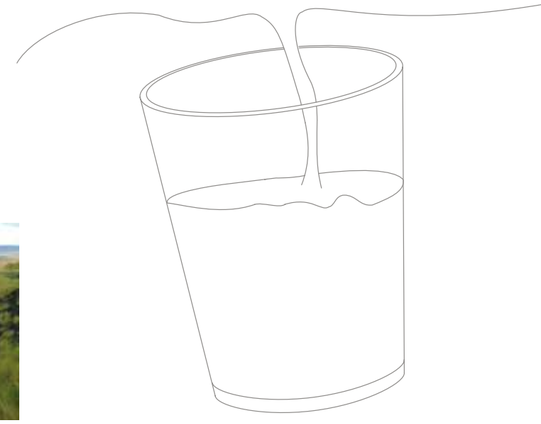
UK PEATLAND RESTORATION — DEMONSTRATING SUCCESS

Benefiting the local community
SCaMP boosts the local economy by improving infrastructure and creating work in the area. The capital investment made by the project also supports the upland farming community by enabling tenant farmers to access and maximise agri-environment funding for their businesses. In addition, the improvement to the landscape has benefits for recreation and tourism.

Bringing global benefits
The restoration and management measures undertaken as part of SCaMP have resulted in significant improvements to water quality and nature conservation condition, as well as contributing to National Biodiversity Action Plan targets. In total, the project has brought 5.1% of England’s priority habitat Blanket Bog resource into government target condition. By working with contractors and continuing long-term SCaMP monitoring over the next five years, this project will continue to increase understanding of moorland restoration techniques. By engaging with Durham University to measure the carbon benefits, the restoration work carried out as part of SCaMP can contribute to the global search for solutions to the rise in greenhouse gases.

I believe that the business case to implement catchment management and act responsibly is made. The challenges we face, both existing and emerging, affect all of us in some way, and only by working together can we all make a positive difference.

Chris Matthews, United Utilities Head of Sustainability



Quiet Shepherd Steep BB6b 2007 © Penny Anderson Associates

Quiet Shepherd Steep BB6b 2009 © Penny Anderson Associates

Ashway Gap BB1 treatment plot 2006 © Penny Anderson Associates

Ashway Gap BB1 in 2009 © Penny Anderson Associates

N. BRINGING BACK BLANKET BOG

ScottishPower Renewables

Restoring peatland habitats on windfarm sites
ScottishPower Renewables, Scotland

ScottishPower Renewables is a leading developer of windfarms in the UK with over 1000MW of installed capacity. Acknowledging the sensitivities of development in upland locations, ScottishPower Renewables has made a commitment to restore peatland habitats covering over 8000 ha across its windfarm sites.

Looking back
In many areas of the UK, large expanses of blanket bog have been drained and replaced with trees for commercial forestry. This afforestation has resulted in the loss of large areas of peatland and, as a result, a loss in the UK's biodiversity and soil carbon storage potential. However, as there is greater recognition of the immense value of peat bog habitats there is a move towards restoring this afforested blanket bog back to its original condition.

Making the commitment
ScottishPower Renewables aims to restore blanket bog habitat across several of its windfarm sites, including the largest sites at Black Law and Whitelee where large expanses of blanket bog were historically drained and planted with commercial forestry. During windfarm construction the forestry was either conventionally harvested or mulched on areas of deep peat. A Habitat Management Plan was developed for both sites with the core aim to restore these areas to blanket bog habitat.

Breaking new ground
Trials have been set up at both Black Law and Whitelee to assess which techniques will provide the best conditions for blanket bog to recover from commercial forestry.

These trials involve:

- traditional ditch blocking with peat and plastic dams
- ditch in-filling with brash, stumps and peat
- brash/mulch manipulations on the bog surface
- low intervention "ground smoothing", where the ridge/furrow pattern is flattened with a tracked vehicle
- high intervention "ground smoothing", where the ridge/furrow pattern is mechanically re-graded using an excavator

Monitoring includes detailed measurements of erosion processes, hydrological response, water chemistry and the rate of vegetation growth. In areas where conifers are regenerating from seed, their resilience to survive the above treatments is also being monitored.

Working together
To ensure all the different stakeholder organisations have input to this peatland restoration project, a Habitat Management Group has been set up which includes representatives from Scottish Natural Heritage, the Royal Society for the Protection of Birds, Forestry Commission Scotland and various local authorities. This forum discusses the results of monitoring and shares knowledge and learning. This collaborative approach also allows close working with landowners to ensure the project objectives are realistic and deliverable without compromising existing land management practices.

Moving forward
Early results show the techniques used have been successful in raising water levels and within 12 months characteristic peatland plants, such as *Sphagnum* mosses, have started to re-colonise the trial areas. Ongoing monitoring will now serve to inform which methods are most effective in different situations and allow the development of a programme for treatment in priority order. This work will be crucial for ensuring long-term success of the bog restoration, as well as informing future projects on the best techniques for landscape-scale restoration of blanket bog from commercial forestry.

UK PEATLAND RESTORATION — DEMONSTRATING SUCCESS

Digger turbine © Peter Robson

Magellanicum Turbine © Peter Robson

ScottishPower Renewables recognises that development of sensitive upland areas requires careful site selection, planning and delivery. Our current undertaking to restore over 8000ha of peatland habitat across our windfarm sites demonstrates our long-term commitment to responsible development.

Simon Christian, ScottishPower Renewables UK Managing Director

O. A PEAT PARTNERSHIP

Yorkshire Peat Partnership

Working to restore Yorkshire's disappearing blanket bog

The Yorkshire Peat Partnership was established in 2009. Managed by Yorkshire Wildlife Trust, the partnership's aim is to restore 50% (35,000 ha) of Yorkshire's blanket bog by March 2017. The partnership is funded by Yorkshire Wildlife Trust, the Yorkshire Dales NPA; the North York Moors NPA; Natural England; Environment Agency; Yorkshire Water and the National Trust.

The Yorkshire region contains about 20% of England's remaining blanket bog
In addition to 70,000 ha of blanket bog, the region is home to 100,000 ha of degraded upland peatland that no longer supports blanket bog vegetation. The vast majority of this resource is degraded due to:

- Changing climate
- Historic atmospheric pollution
- Drainage
- Grazing
- Wildfire or poorly managed burning
- Recreational erosion e.g. from footpath erosion

Restoration planning
In order to address all of the underlying causes of peat degradation on a site, the Yorkshire Peat Partnership has developed an innovative set of methods that combine remote sensing, field surveys and mobile GPS enabled computers.

A two-stage survey of the site is carried out. The first part is a desk-based analysis of aerial photographs involving digitising areas of grip and gully and the use of spectral analysis software to identify areas of bare peat. This is then ground-truthed through a field survey during which grips and gullies are classified based on their size and levels of erosion, habitat variables are recorded and peat depths taken. This is mapped and used to draw up a Peatland Restoration Plan which, once agreed, forms the specification document for the restoration works. One of the advantages of this rigorous site assessment is that it makes the development of a contract and estimation of labour and materials required easier.

Site assessment
Site assessment has provided invaluable information as to the extent of the problem in the Yorkshire Peat Partnership area. The estimated total length of grips is 5850 km and the total length of gullies and hags estimated to be eroding is 1768 km together with 340 ha of bare eroding peat.

Restoration achievements
The result of the programme of works carried out following site assessment are summarised in the following table:

Achievement by December 2011	Quantity
Area of land surveyed	16,542 ha
Area under restoration	3283 ha
Length of grips blocked	334 km
Length of eroding gullies revegetated	40 km
Area of bare peat revegetated	17 ha
Number of peat dams installed in grips	33,000
Number of timber sediment traps installed in larger grips and gullies	300
Number of peat depth records	20,000
Number of volunteers involved	40

A team effort
In addition to the funding provided by the organisations in the Yorkshire Peat Partnership, sporting and farming landowners, agents and gamekeepers contribute significant amounts of their time and in-kind expenses without which the partnership could not function. In addition the Partnership's Steering group is supported by representatives from the Moorland Association, National Gamekeepers Association, National Farmers Union, Nidderdale AONB Partnership, Yorkshire Dales Rivers Trust and Pennine Prospects.

UK PEATLAND RESTORATION — DEMONSTRATING SUCCESS

Ceri Katz measuring peat hags © Yorkshire Peat Partnership

By working together to engage the key players, the Yorkshire Peat Partnership is able to pool resources, coordinate activity, develop new technology and jointly overcome barriers. This enables the Partnership to achieve much more peatland restoration across Yorkshire than a single organisation or individual working alone could have done.

Tim Thom, Programme Manager, Yorkshire Peat Partnership

Peter Christopherson classifiying grips © Yorkshire Peat Partnership

Biodiversity, Red Sphagnum, Flow Country © Norman Russell

P. GOOD PRACTICE IN PEATLAND DITCH BLOCK CONSTRUCTION

Blawhorn Moss

Ditch blocking for peatland restoration at Blawhorn Moss, Central Scotland

Blawhorn Moss is a National Nature Reserve in the Central Belt of Scotland.
Easily accessible, Blawhorn Moss provides a good demonstration site for bog restoration and different types of ditch blocking. The main threat to the hydrology of the mire came from the continued erosion of the larger gullies and the lowering of the water table through the extensive ditch network.

The ditch blocking approach
The main thrust of management at Blawhorn Moss has been to block the extensive network of drains and reduce the impact of the gullies on the site, particularly the increased run-off and fragmentation of the bog edge. Over the years, different techniques for ditch blocking have been tried. These have included peat, plastic piling, steel sheets, heather bales, timber piles and steel piles.

From trial to implementation
The first trials for ditch blocking started in 1984, when two surface drains were in-filled with peat sods. The drains retained some water upslope but there was still considerable leakage. A major programme of ditch blocking took place between 1987 and 1989. All of the small section drainage channels were blocked at 12-20 metre intervals and stepwise up the gradient along their length. Over 1000 small dams were installed. Six timber pile dams using elm plies were installed in an over-deepened ditch. Following on from this trial, 61 timber dams were installed the next year on all the main erosion gullies. This was followed by over 100 plastic piling dams and more recently peat dams to infill to achieve a higher water table. Today, most of the small drainage channels are filled with water with *Sphagnum* covering the sheet dams in the wettest parts. The timber dams have proven effective at preventing ongoing gully erosion but are often are leaky so cannot raise the water table fully.

In 2001, over 400 heather bales were placed into ditches and are now slowing down water movement and providing a framework for *Sphagnum* moss to grow.

In 2003, 30 large (3.6 metre wide) plastic pile dams were built along a central ditch. These dams successfully hold water and raise water levels in the adjacent ground, encouraging the growth of *Sphagnum* moss. One of the inadvertent biodiversity gains has been the return of Red Grouse to the site. At the time of the initial damming the heather had become rank, but due to the combination of burning and raising the water tables, the grouse have returned to Blawhorn.

The final phase
The most recent damming has involved the construction of large steel piling dams in the largest ditch where it was considered that plastic piling dams would not have the structural strength. Since 1990 we have had a water level monitoring system in place, so now have a long run of data which will soon be analysed.

Community Involvement
Since 2004 the local community have been closely engaged in the site, advising on and designing interpretation, access and the local Primary School has been involved in art projects, making a film, and celebrating the rededication of the NNR.

Effective plastic piling dam at Blawhorn © A McBride, McBride Habitats

After nearly 30 years of hard work, by many people, I can now say with pride that Blawhorn Moss is Scotland's best quality Lowland Raised Bog.

Andrew McBride, Scottish Natural Heritage Wetland Ecologist.

Ditch blocking 1989 © A Panter, SNH

Ditch still blocked 2011 with added biodiversity
© A. McBride, SNH

Q. WORKING TO BENEFIT WILDLIFE AND TO SAFEGUARD NATIONAL TREASURES

Humberhead Peatlands

Restoring a raised bog landscape

Humberhead Peatlands National Nature Reserve is the largest area of lowland raised mire in England, representing 30% of the English resource with 2887 ha. Close to Doncaster in South Yorkshire, the reserve is managed by Natural England and the Lincolnshire Wildlife Trust. It sits within the Humberhead Levels, an area covering a now lost wetland landscape of the upper Humber.

Rich in wildlife
The Humberhead Peatlands, covering most of Thorne, Hatfield and Crowle Moors, are a meeting place for northern and southern species, resulting in a unique species mix. The site is designated as an SAC for its peatland habitats, and an SPA for its large population of breeding nightjars. It is also famous for its invertebrates, which include the Thorne pin-palp beetle and the mire pill-beetle, both found nowhere else in the UK, and the large heath butterfly. The total insect fauna recorded exceeds 5,500 species - around 25% of British fauna - with over 30 Red Data Book species and over 250 nationally scarce species.

Long history of peat extraction
Over many centuries, peat has been lost through drainage, agricultural improvement and peat cutting, largely for fuel. From the 1880s the remaining core of deeper peatland was cut, initially to provide peat for horse litter, and subsequently for horticultural use. By 1994 the whole site had been partly cut or drained, and peat milling, which leaves a bare de-vegetated surface, had been carried out on about half the site.

National treasures
As waterlogged soils, peat deposits provide a rich archive of cultural and environmental change. With over 100 archaeological sites from 8,500 years ago to the Roman period 400 AD, the Humberhead Levels preserved some of the oldest and most intriguing archaeological remains. This includes the oldest plank boats in the world, outside Egypt, a rare Bronze age pathway laid through Thorne Forest 3000 years ago, as well as delicate beetle wings. Restoration helps to safeguard these national treasures.

Restoration management
Humberhead Levels Partnership was established in 2001, aiming to create an internationally renowned, unique wetland landscape, supporting thriving communities, economy, ecosystem services and wildlife. Restoration began in 1994 but only in 2002, when Defra bought out the remaining peat extraction rights for £17 million, did the majority of the peatlands come under restoration management. A system of bunds, with a network of sluices, was created on the milling fields, to create the right conditions for revegetation by cottongrasses and *Sphagnum* moss. Drainage ditches have been dammed and scrub is controlled by cutting and grazing with Hebridean sheep.

Restoration success
Restoration has proved highly successful over the majority of the reserve. Through the careful management of water levels, much of the milled land has re-vegetated, and the peatland archaeological archive is protected. At the same time, the number of nightjars has increased and the reserve has been colonised by breeding common cranes. The legacy of dry tracks created for peat extraction, as well as a substantial area of sand and gravels where peat was stripped prior to quarrying, now provides easy access for visitors.

Further Work
Peatland restoration requires a long-term approach in fine tuning water level management for best results for wildlife and the peatland archive. In addition, the Humberhead Peatlands will provide further visitor access, volunteer opportunities and education programmes to promote enjoyment of the amazing landscape, the rich wildlife and human heritage.

UK PEATLAND RESTORATION — DEMONSTRATING SUCCESS

The Humberhead Peatlands is one of the largest habitat restoration projects in the country, and innovative water management has been the key to successful re-vegetation.

Tim Kohler, Natural England

Humberhead © Natural England

R. BACK FROM THE BRINK

Lancashire Mossland

Recovering, restoring and reconnecting Lancashire's Mosslands

The Lancashire Mosslands Project was set up to address concerns about the fate of lowland raised bog habitat in North West England. Led by Lancashire Wildlife Trust, the aim of the project is to restore and reconnect these sites, helping to reconnect people with their peatland heritage.

The landscape that once shaped our lives
Lowland raised bog habitat in the North West once shaped the region's culture, language and development. However, with only 3% of the original habitat area now remaining, the pressure to develop and exploit these sites has grown and the local population has become increasingly detached from this valuable landscape. Whilst raised bogs have always been islands within the mosaic of lowland habitats, they are now becoming too isolated for ecosystem services to function. Urban sprawl, peat extraction and agricultural intensification are all contributing to the ever increasing number of activities that threaten these bog habitats and the key species that depend on them, including Large Heath Butterfly, Nightjar, Bog Bush Cricket and Sundew.

A restoration toolkit
Originally covering 28,000 ha, the 7,600 ha of remaining Lancashire Mosslands are spread across the entire 335,000 ha of lowland Lancashire, Greater Manchester and North Merseyside. To help rescue and restore such a highly fragmented habitat, the Mosslands project has put together a toolkit of methods. These include purchasing and leasing relevant areas of land, putting management agreements in place, providing expert advice and campaigning, and providing the right information to encourage the uptake of agri-environment schemes. Sensitive to the impact of surrounding land uses and drainage, the Lancashire Mosslands require a well-thought out and effective restoration programme. Re-levelling, peat bunding, plastic piling, plygene sheeting, peat plugs, large tree pulling, scrub removal, ditch re-profiling and scrapes are all being used as and when appropriate.

The importance of engaging people
In such a heavily populated urban area, public engagement is an everyday part of the Mosslands Project. Within just over 2 years, the Project engaged with 4,288 people, enabled 6,770 hours of volunteering, trained 196 individuals, and linked with 63 organisations, from residents associations and schools to Councils, conservation groups, and shooting syndicates.

An example: Chat Moss suffering from economic and agricultural decline
Ten miles from Manchester city centre, Chat Moss was once England's fifth largest raised bog. Only 4% (1.4km^2) of this area now remains. Once used as a dump for Manchester's night waste, industrial peat extraction continues to this day. To tackle the area's problems, a partnership drew up an integrated vision incorporating biodiversity, hydrological management, agriculture, and public enjoyment. Lancashire Wildlife Trust lead the delivery of this vision with a £1.9M Heritage Lottery Fund programme, incorporating a multi-pronged approach of site purchase, campaigning, capital works on the ground, volunteer programmes, providing advice to land managers, and family events.

The progress

Habitat Target: 27 sites (762 ha + 1146 ha lag fen habitat)

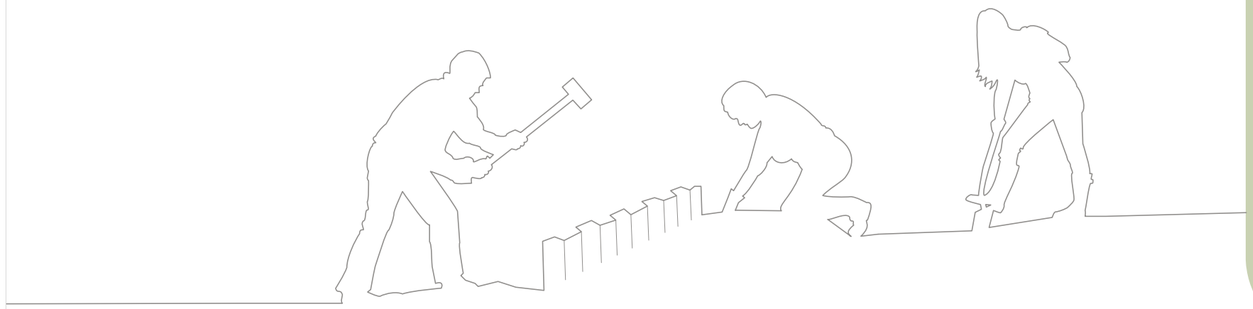
Habitat Achieved: 11 sites (334 ha + 21 ha lag fen habitat)

Volunteer involvement and the belief that any site can be restored, however degraded, continues to drive this project forward and prove that restoration of functioning lowland raised bog is possible, even in a highly fragmented landscape.

UK PEATLAND RESTORATION — DEMONSTRATING SUCCESS

Volunteers learning how to identify *Sphagnum* Moss © Lancashire Wildlife Trust

Partly restored peat extraction site next to an active extraction site © Matthew Roberts



As someone who has spent many years campaigning at a national level for protection of the environment and a more sustainable lifestyle, I understand only too well the importance of restoring these rare habitats. ... [T]he last remaining fragments are enormously important, not only for the wealth of wildlife that they support, but also for the benefits to health and well-being that they give to the local community.

Tony Juniper, Chair of 10:10 Campaign (previously Executive Director of Friends of the Earth)

S. A LOWLAND RAISED BOG TO BENEFIT ALL

Friends of Langlands Moss

Protecting, conserving and improving Langlands Moss Local Nature Reserve (LNR)

Concerned about the condition of the bog and the encroaching impact of industrial development, a group of local people came together in 2006 to form The Friends of Langlands Moss LNR. Working in partnership with the local Council and various conservation and interested parties, this group aims to continue to improve and conserve Langlands Moss for the benefit of all.

A long-running restoration programme
Langlands Moss is a lowland raised peat bog situated on the southern fringe of the industrial 'New' town of East Kilbride, South Lanarkshire. Designated as an LNR in 1996, a programme of restoration of the bog has been in place for nearly 20 years. Introduced by East Kilbride District Council and East Kilbride Development Corporation in 1994, the primary aims of this restoration programme were to improve the condition of Langlands Moss and to enhance public access to the area. As part of this original restoration, a commercial conifer plantation on the peat was felled (using a helicopter to remove the trees), and dams were installed to block drains and raise the water level. In addition, a boardwalk was built across the bog to allow public access.

The Friends of Langlands Moss Local Nature Reserve
Since the designation of Local Nature Reserve status, many of the original drainage dams had become damaged through fire, vandalism and weather. This meant that the bog was slowly drying out. The first task the Friends set themselves was to begin a new damming programme on the Moss. Finance was obtained from The Big Lottery Fund and Scottish National Heritage to purchase the necessary damming material.
To date, volunteers have installed 28 dams in the main ditch which runs across Langlands Moss. This work has resulted in a marked improvement in water levels and *Sphagnum* mosses, and other bog plants are already re-colonising the new pools of standing water.

Continuing conservation
The Friends of Langlands Moss continue to carry out the essential work needed to protect and conserve this lowland raised bog. Currently applying to various funding streams, their next task is to replace the existing boardwalk, which is deteriorating rapidly due to weather conditions. Once installed, a new boardwalk will greatly improve access for visitors to enjoy the Moss and enable the bog conservation programme to continue.
As well as further damming of ditches and tree removal, the long-term plan for Langlands Moss is to create a buffer boundary around the bog to improve water retention in the 'dome' and to continue with the ongoing activities to raise public awareness about the importance of peatlands.

Dunlin © RSPB

UK PEATLAND RESTORATION — DEMONSTRATING SUCCESS

Volunteers from The Princes Trust © Maureen Potter

Partnership with the Friends of Langlands Moss has allowed us not just to halt the ecological decline of a lowland raised bog but to engage with a whole community on its regeneration. This project is a model and an inspiration to the growing network of community greenspace groups in South Lanarkshire.

Malcolm Muir, Countryside and Greenspace Manager

Pond dipping near installed dam © Maureen Potter

T. REWETTING THE BOG

Malham Tarn

Mitigating peat erosion at Malham Tarn, Yorkshire Dales National Park

Supported by Biffaward, the National Trust has begun an extensive restoration programme for the Malham Tarn area.

Hydrological complexity
Malham Tarn and its wetlands form the focal point of the Malham Tarn Estate, located in the Yorkshire Dales National Park. Malham is internationally recognised for its geomorphology and natural history. The tarn and wetlands sit at the centre of a basin created by glacial erosion during the last ice age, and in some places overlie superficial deposits left by the glaciers on their retreat. As a result of this, these wetlands receive water from a range of mechanisms. This hydrological complexity has created a diversity of habitats, including watershed and seepage mires, a rain-fed raised bog and a habitat mosaic of interspersed bog and floodplain mire.

A multitude of threats
Malham's raised bog and habitat mosaic are of particular conservation importance. Forming adjacent components of Malham Tarn National Nature Reserve, both the raised bog and the habitat mosaic lie alongside one of Malham Tarn's banks. In the past, these areas have been subject to considerable damage from peat draining and cutting, grazing, burning and mowing. Intact raised bogs are encircled by a lagg fen where water draining from the bog meets surrounding mineral soils, which have a characteristic vegetation. As with *Sphagnum* mosses, this vegetation requires a raised water level, but complete inundation kills the plants. The installation of a sluice gate across the tarn's outflow in 1791 raised its water level by 1.3 metres, destroying the lagg vegetation lying between the west shore and the bog. As a result of this, the bog's peat mass is no longer protected from erosion by the Tarn, which is both destroying the peat directly and damaging the hydrology of the bog by lowering the profile of the water table across the entire bog surface, since water drains rapidly into the tarn instead of slowly through the fen.

Understanding Malham Tarn wetlands
An eco-hydrological survey was instrumental in gaining a better understanding of the Malham Tarn wetlands. The survey produced a hydrological model, which helped to formulate proposals for rewetting the bog and mitigating further peat erosion.

Using cattle for fen restoration
In 2003, a small herd of Dexter cattle were introduced to graze 6.5 ha of the fen habitat. The aim was to increase the area of alkaline fen by removing willow scrub, using the cattle to maintain the open area. Due to their small size, Dexters are an ideal breed to use as they do less damage to the wet ground. Carried out through the Limestone Country project, a partnership project jointly managed by English Nature, Yorkshire Dales National Park Authority and the National Trust, this method has proved successful. On land with cattle, the area of alkaline fen in favourable condition has been maintained, and the area in recovering condition has increased.

Overcoming the challenges
As part of the restoration process, a network of dip wells to measure water level changes has already been installed on the bog, and progress is monitored as part of an ongoing grip-drain blocking strategy. Further work is being planned to complement these projects with water quality assessments of the sources fed by the agricultural catchment. The restoration process will be consolidated with other interests on the National Nature Reserve by realising a joint National Trust/ Natural England management plan that sets out a programme of improvement for the reserve and its catchment.

UK PEATLAND RESTORATION — DEMONSTRATING SUCCESS

Bog Rosemary, Tarn Moss © Martin Davies

The Malham Tarn wetlands are a fascinating place which we manage in partnership with Natural England. We constantly have a number of research and monitoring projects in progress, ensuring that we are always learning new things about this important and highly complex site.

Martin Davies, Countryside Property Manager, National Trust

Bog Bean on edge of Tarn Moss © Robin Sutton

U. MESSY BOGS, ORDERLY FRAMES

Red Moss

Scottish Wildlife Trust, Red Moss, Scotland

Background
Originally the bed of a shallow loch, Red Moss of Balerno is a lowland raised mire on the outskirts of Edinburgh, a city of over 450,000 people. Its domed top includes several species of *Sphagnum* moss including some areas with the two classic raised mire peat builders *S. papillosum* and *S. magellanicum*.

Red Moss is enjoyed by casual visitors as well as specialist naturalist groups, local friends groups, school parties and researchers.

Project Objective
The objective of this project was to enhance the visitor use and understanding of the reserve without compromising the nature conservation value of the various habitats.

Project delivery

- 370 m of disabled access boardwalk made wider with ‘passing places’
- Platform area near small pond constructed to create a pond dipping zone, offering the visitor non-invasive, easy and safe access to observe wildlife
- Access path upgraded with hardcore to allow easier wheelchair user access
- Threshold signs installed to encourage walkers using a road passing nearby to visit the site
- Interpretation panels installed providing information on the history of the bog, the biodiversity of the habitat and the importance of management and conservation
- New dams installed within view of the boardwalk to allow visitors to see restoration at first hand
- The site was also promoted on the Scottish Wildlife Trust website, in the local press and in local newsletters

Key lessons to share
The most important lesson is that ‘framing’ a raised bog such as Red Moss using interpretation panels, threshold signs and accessible boardwalk provides ‘cues to care’ to the public (Nassauer, 1995) . For some sites where tree felling might be required for restoration, such cues might be an essential prerequisite before major works take place. The framing of the site takes people on a learning journey, particularly local people who visit the area regularly and now fully understand the importance of the site and how it is being restored.

No baseline figures for numbers of visitors were available so quantitative data on changes in visitor numbers is not available. The Scottish Wildlife Trust has recognised that this was a shortcoming and would recommend such visitor data is collected when carrying out access projects of this kind, perhaps combined with a Social Return on Investment exercise. Casual observations and interviews with local people all suggest that the access improvements have led to a significant increase in numbers from an estimated 5,000 a year to 7,500 a year.

Finally the site has become something of a ‘media star’ regularly used for radio and TV interviews on wetland and peatland issues due to its proximity to Scotland’s capital city.

Summary of outcomes

- Access - providing access to a unique habitat to a wide range of users of all ages and abilities who would, or could, not otherwise experience such a place
- Community - improvement in community life including increased engagement of Friends of groups and local Scottish Wildlife Trust members
- Education - creation of a new educational resource for local schools through the simple provision of a dipping platform and some interpretation (with more information on the web)
- Protection — through focusing visitors onto the boardwalk the project has successfully protected the mire surface, sensitive plants and breeding birds

References
Nassauer, J. I. (1995) Messy ecosystems, orderly frames. Landscape Journal. 14.2 161-170.

UK PEATLAND RESTORATION — DEMONSTRATING SUCCESS

People using new boardwalk Red Moss 2011 © Scottish Wildlife Trust

The lesson from Red Moss is if a lowland raised bog is ‘framed’ in the right way through access and interpretation, then not only will more visitors come, but the natural asset value of the site, particularly in the eyes of local people, will significantly increase.

Jonathan Hughes, Director of Conservation, Scottish Wildlife Trust

New Boardwalk at Red Moss © Scottish Wildlife Trust

Bog Cranberry © Norman Russell

V. CONNECTING THE FRAGMENTS

Great Fen

Creating a fen landscape for people and for wildlife

The Great Fen is a long-term 50 year project that aims to link two national nature reserves, Woodwalton Fen and Holme Fen, together to create a large national nature reserve of 3700 ha.

A lost landscape
The wild fens once stretched for hundreds of miles across Eastern England. They were home to beavers, otters, and thousands of different types of animals and plants, many unique to the area. When the land was drained for farming, beginning in the 17th century, more than 99% of this wild habitat disappeared.

A landscape fit for the 21st century
Two of the last fragments of wild fen, Woodwalton Fen and Holme Fen, are under threat because both reserves are too small and isolated. By connecting these precious fragments, this project will create 3700 ha of fen landscape between the cities of Huntingdon and Peterborough. To achieve a landscape of many benefits, the Great Fen project has a four pronged strategy:

- Implement restoration and habitat creation
- Improve access and enjoyment
- Foster socio-economic development
- Contribute to climate change adaptation and mitigation

The Great Fen Masterplan
Using maps and images, the Great Fen Masterplan (published in 2010) sets out how the Great Fen project will re-create the 3700 ha of ancient fenland landscape over the coming years and decades, and how it will deliver a wide range of benefits for the surrounding area. Included in the strategy are plans for: ,

- A mosaic of wildlife habitats to support a variety of fen species
- Visitor facilities, including a café trails, natural play areas and events
- New footpaths, cycleways and bridleways linking to local communities
- Areas to store floodwater during high rainfall, to help protect surrounding farmland and communities
- Zones to encourage access to some areas, but protect the most sensitive areas from heavy disturbance

A long-term partnership
The Great Fen is a long-term and ambitious project, requiring the work, expertise and support of many people and partners. The project is delivered by a partnership of five organisations, each bringing their own areas of expertise. This partnership includes Environment Agency, Huntingdonshire District Council, Middle Level Commissioners, Natural England and The Wildlife Trust for Bedfordshire, Cambridgeshire and Northamptonshire.

More than just nature conservation
As part of this project, there are currently more than 866 ha of land in restoration and 1340 ha managed for nature conservation. By the end of 2013, the area managed for nature conservation will increase to 1519 ha. As a result, the project has witnessed increasing numbers of wildlife, from breeding barn owls, kestrels, lapwing and snipe, to rare plants and invertebrates. However, nature conservation is not the only focus of the Great Fen project. Working with and supporting over 100 active volunteers, the Great Fen team works with thousands of people each year. As well as events, the team runs interactive schools programmes for all ages, a range of walks, talks and visits for groups, and many other community projects, including film, photo and audio projects. With this ongoing programme of engagement, the project continues to look at how economic benefit and social wellbeing can be delivered to local people, businesses and farmers.

UK PEATLAND RESTORATION — DEMONSTRATING SUCCESS

A Great Fen volunteer surveying for wetland wildlife © The Wildlife Trust

The Great Fen Project has become one the country's leading landscape-scale restoration projects, conserving internationally important wildlife whilst bringing about socio-economic benefits for local communities. This could not have happened without the dedication and leadership of a broad partnership of organisations.

Chris Gerrard, Director of Living Landscapes

Woodwalton Fen National Nature Reserves, one of the two national Nature reserves within the project area © The Wildlife Trust

W. REBUILDING THE ECOLOGICAL NETWORK

Somerset Levels and Moors

Conservation through collaboration for Somerset Levels and Moors, Somerset

Collaboration lies at the heart of this project, which works to promote peatland restoration and rebuild nature at a landscape-scale in the Somerset Levels and Moors. Many of the initiatives currently being undertaken involve active partnership working.

Outstanding environment interest
The Somerset Levels and Moors is the largest area of lowland wet grassland (floodplain and coastal grazing marshes) and associated wetland habitats remaining in England. The moors are an extensive low-lying basin peat, with a few remnants of raised bog, surrounded by alluvial silt and clay. Overlain in places by a varying thickness of riverine clay, peat is still extracted from certain areas.

Working together towards agreed objectives
There is recognition amongst key stakeholders with an interest in the Somerset Levels and Moors that:

1. Peatland restoration and rebuilding nature will be more successful where schemes are co-designed, co-created and co-delivered by the farming and conservation sectors working effectively together
2. Farming systems must be profitable to provide the best opportunities for landscape scale restoration within the floodplains and wetlands
3. New sources of funding need to be developed, alongside the agri-environment schemes, to provide a wider range of options and enable more farmers and land owners to rebuild the key elements of the ecological network at a landscape-scale
4. New approaches to the management of flood risk, water levels and water quality need to be explored and tested alongside profitable farming to restore and ensure sustainable management of the peatlands, aiming over time to find efficient mechanisms to enable a transition to land use that best delivers the available food, water, nature and carbon benefits the Levels can provide.

A Levels and Moors 'Task Force' has been set up, comprising of key stakeholders who have an interest in the area. This group is lobbying to achieve the best possible future for the area. In addition, a 'Nature Delivery Group', comprising Royal Society for the Protection of Birds (RSPB), Somerset Wildlife Trust, Farming and Wildlife Advisory Group (FWAG SW), National Farmers Union, Somerset Drainage Board Consortium, and Somerset County Council, with the Environment Agency and Natural England, provides a platform to exchange knowledge, ideas, and information on opportunities.

Sustainable approaches to land and water management
The European-funded 'WAVE' (Water Adaptation is Valuable for Everyone www.waveproject.eu) INTERREG IVB NWE project, managed by Somerset County Council, aims to better understand the likely impacts of climate change and the adaptations that will be required to deal with these. The funding is used on projects working to promote more sustainable approaches to land and water management in key areas.

Sphagnum translocation volunteers April 2011 © Somerset Wildlife Trust

UK PEATLAND RESTORATION — DEMONSTRATING SUCCESS

Peatland restoration in action
Theme 1: Delivery for habitats and species through restoration of extant peat workings

Case study: Somerset Wildlife Trust's **Brue Valley Living Landscape** programme covers 12,500 ha of mixed peat wetland habitats. Peatland restoration is being achieved via a number of different mechanisms ranging from strategic land purchase and restoration through to assisting land managers gain access to agri-environment subsidies and working with them to ensure that the prescriptions are met and benefits to biodiversity increase.

Theme 2: Delivery for species and communities on lowland wet peat grasslands

Case study: When the RSPB purchased **Greylake** nature reserve in 2003 the area consisted of 100 ha of deep-drained arable land. Over the last nine years, a process of restoration has created a mixture of wet grassland, swamp and fen habitats. Structures have been installed to hold water levels around 80 cm higher than before management began. Monitoring, which started in 1977, shows that the once declining population of Lapwing at Greylake are now starting to recover.

Lawpings on flooded grazing land © David Kjar RSPB

Working in partnership is what farmers do for a living. Whether it is with the soils, water and weather we have or with those that have an interest in their land. This creates new opportunities for us all and helps us to build on all the good work of the last 25 years of ESAs.

Paul Cottington, NFU

X. WORKING IN PARTNERSHIP FOR WETLAND RESTORATION

Anglesey and Llyn Fens LIFE project

The LIFE+ Nature project: Restoring Alkaline and Calcareous Fens within the Corsydd Mon a Llyn (Anglesey and Llyn Fens) SACs in Wales.

Managed by the Countryside Council for Wales and supported by the Welsh Government, the project partnership includes the Environment Agency Wales, Dwr Cymru/Welsh Water and the North Wales Wildlife Trust. The main aim of the Anglesey and Llyn Fens LIFE+ project, North Wales, is to bring 751 ha of fen habitat into favourable or recovering condition. This is through measures aimed at tackling factors affecting their condition, and by delivering more sustainable management. The areas include: two Special Areas of Conservation (SAC), which also form a Ramsar site; a number of SSSI's and National Nature Reserves. Creating strong partnerships with local communities is at the heart of the project — as is commitment to developing opportunities for local businesses and the local economy to thrive.

Mending the fen
Funded by the European Commission LIFE+ programme, which is the main funding for encouraging sites back into favourable condition, the project has 5 Million Euros from 2008 — 2013 to undertake this major wetland restoration project, by tackling the Fens as part of their cultural landscape. This means working with the many communities and catchments that surround the fens, so that everyone gets the best possible outcome.

There are 3 main issues affecting the Fens: water quality, water quantity and dereliction. Critical factors include:

- Management neglect or inappropriate management on and adjacent to sites.
- Nutrient enrichment.
- Drainage
- Successional change (leading to scrub development and other undesirable changes)
- Uncontrolled burning
- Climate change
- Lack of information about the importance of the project sites and the need for wetland conservation management.

Promoting sustainable development
The goal is not only to restore the precious fen habitats, but also to ensure that the local communities benefit from the best use of the fen. Within the catchments, the project is introducing locally targeted Management Agreements, carrying out direct capital works, and aiming to increase connections between habitats, species, people and the fen sites. This includes promoting sustainable, local produce and helping producers with marketing and capital issues. In addition, restoration work helps to realise significant ecosystem benefits, such as reductions in dissolved organic compounds leaching to a drinking water reservoir downstream, and the project team is working in close collaboration with Welsh Water and other partners to achieve this.

Novel Techniques
On the sites, novel bio-mass stripping (removing excess vegetation), and managed grazing to support restoration is being carried out, as well as repairing and restoring ditches, streams and spring heads. This involves buying appropriate land and starting to reverse the neglect and unwanted ecological succession.

An important tactic to ensure that the work is effective in the long-term, is to reintroduce sustainable grazing back onto the Fens. However, before that can happen, the many years of unwanted growth has to be cut and removed, or even burned off. In some cases the drained and compacted soil then has to be taken away. To carry out large-scale cutting, the project is using a modified Pistenbully, which is a specialised piece of machinery from Germany. The cut vegetation is then being used by local farmers as cheap animal bedding, making this a highly sustainable process.

UK PEATLAND RESTORATION — DEMONSTRATING SUCCESS

Fens for the memory
This wetland restoration project works in partnership with the farming and land-owning community, aiming to re-engage the local community with the wetland environment. Historically, the Fens were the lifeblood of the local communities and as part of this, the Isle of Anglesey County Council's Biodiversity team are launching a unique project that aims to put local people back in touch with their neighbouring fen. People who live in or around the sites are being asked to help by recalling some of the unique ways they used the Fen habitat in the past, for example how they benefited from the water, the fen material or even the plants that grew there. In doing this, the project hopes to keep our memory of the fens alive.

Open Day for farmers and landowners at Cors Erddreiniog NNR, showing cuttings of Saw Sedge *Cladium mariscus* in the foreground and the specialised mowing machine (Pistenbully) in the background
© Countryside Council for Wales

You only need to stand in one of these internationally rare wetlands to realise how it fits into the farming landscape around it, and how they both depend on each other.

Justin Hanson, Project Manager

Welsh Black cattle grazing the fen at Cors Nant Isaf after hand-cutting of vegetation
© Countryside Council for Wales

6. Glossary

Blanket bog
Peat bog which forms in areas with a cool, wet oceanic climate which means soils are continually wet across the landscape, allowing peat to form a ‘blanket’, even on slopes of up to 30 degrees.

Dwarf shrubs
Moorland plants such as common or ling heather (*Calluna vulgaris*); Bell heather (*Erica cinerea*); Cross-leaved heath (*Erica tetralix*); Bilberry or Blaeberry (*Vaccinium myrtillus*); Cowberry (*Vaccinium vitis-idaea*); Bearberry (*Arctostapylos uva-ursi*); Crowberry (*Empetrum nigrum*).

Geojute
Netting made from unbleached jute fibres. It is used to provide short-term stabilisation of soils and prevent erosion in revegetation projects.

Geotextiles
A generic name used for natural netting materials used in revegetation such as Geojute.

Grip
Another name for a drain.

Heather bales
Bales of heather used to slow down drainage to raise the water table and encourage the formation of bog pools.

Heather brash
Heather cuttings which spread on bare peat which reduce weathering from wind and rain, contain heather seed, and provide a medium for other plants to root into.

Lagg fen
An area encircling a raised bog where water draining from the bog meets surrounding mineral soils.

Raised bog
Develops primarily, but not exclusively, in lowland areas where impeded drainage and resultant waterlogging provides anaerobic conditions which slow down the decomposition of plant material which in turn leads to an accumulation of peat. Continued accrual of peat elevates the bog surface above regional groundwater levels to form a gently-curving dome from which the term 'raised' bog is derived. The thickness of the peat mantle varies considerably but can exceed 12 metres.

Sphagnum
A genus of mosses which includes a number of species which grow in peat bogs, and which form peat when they decompose in anaerobic, waterlogged conditions. There are thirty-four species which occur in the UK, grouped into six ‘sections’. Of these *Section Sphagnum* with five species contains the real peat bog specialists which are the main peat formers. These are *Sphagnum affine*; *S. austinii*; *S. magellanicum*; *S. palustre*; and *S. papillosum*. *Sphagnum* mosses are very sensitive to atmospheric pollution.

Turbidity
A measure of the amount of suspended solids in water.


Sphagnum tenellum © Andy Amphlett

7. Acronyms and abbreviations

The following in a list of the acronyms and abbreviations frequently used in this report.

CAP
Common Agricultural Policy, a system of European Union agricultural programmes and subsidies

ha
Hectares.

LNR
Local Nature Reserve.

NGO
Non-governmental organisation.

NNR
National Nature Reserve, a national conservation designation, NNRs comprise the ‘jewels in the crown’ of protected areas in Great Britain.

NPA
National Park Authority.

RSPB
Royal Society for the Protection of Birds.

SAC
Special Area of Conservation designated under the EU Habitats Directive.

SPA
Special Protection Area designated under the EU Birds Directive.

SSSI
Site of Special Scientific Interest. SSSIs are a national designation which protect a representative series of the best sites for species and habitats in Great Britain. In Northern Ireland they are called ASSI – Areas of Special Scientific Interest.


Sphagnum papilosum © Norrie Russell

8. Acknowledgements

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We are very grateful to Tom Edwards for proof reading the text.

Sundew, a carnivorous plant © Norman Russell

9. Supporters and Partners

Anglesey & Llyn Fens LIFE, *North Wales*
The Anglesey & Llyn fens LIFE Team
http://www.ccgc.gov.uk/landscape--wildlife/protecting-our-landscape/special-landscapes--sites/the-life-programme/anglesey-and-llyn-fens-life.aspx

Blawhorn Moss, *Central Scotland,*
Andrew McBride
This is an SNH Project and we would like to thank Blackridge Primary School who have supported us along the way. The following link will take you to a video of the restoration at this site.
http://www.snh.gov.uk/planning-and-development/renewable-energy/onshore-wind/peat-restoration-video/
Site leaflet
http://www.snh.gov.uk/publications-data-and-research/publications/search-the-catalogue/publication-detail/?id=339

Dove Stone, *Peak District National Park*,
Dave O'Hara
We would like to thank the following funders for their support of restoration work: Royal Society for the Protection of Birds and United Utilities. With thanks for grant funding from Grantscape and Natural England
http://www.rspb.org.uk/reserves/guide/d/dovestone/index.aspx

Exmoor Mires, *Exmoor National Park*
David Smith
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http://www.exmoormires.org.uk/

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Falklands Conservation, Falklands Government, Queen's University Belfast and UKFIT
http://www.falklandsconservation.com

Flow Country, *Northern Scotland*
Neil Cowe, Norman Russell
The main funding of work in the Flows has been supported by many organisations, trusts etc, including EU Life, the Tubney Trust, HLF, Scottish Natural Heritage, Caithness and Sutherland Enterprise and the RSPB membership via programmes such as the Flow Country Partners scheme, successful membership appeals etc — coming on the back of the major public campaign waged against forestry policy at the time, with the Flows at its heart. The Scottish Government has also provided funds for peatland research and restoration in the Flow Country.
http://www.rspb.org.uk/supporting/campaigns/flowcountry/

Friends of Langlands Moss (FOLM),
Southern Scotland
Maureen Potter
http://www.folm-ek.org/

Great Fen, *Cambridgeshire*
Chris Gerrard
The Great Fen is delivered by the Environment Agency, Huntingdonshire District Council and Middle Level Commissioners
http://www.greatfen.org.uk

Humberhead Peatlands, *Yorkshire*
Tim Kohler, Julian Small
Natural England
http://www.naturalengland.org.uk/ourwork/conservation/designatedareas/nnr/1006766.aspx

Keighley Moor, *South Pennines*
Andrew Walker
http://www.yorkshirewater.com/your-water-services/local-improvements/improvements-in-your-area/west-yorkshire/keighley-moor.aspx

Lancashire Mossland, *Lancashire*
Chris Miller
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http://www.lancswt.org.uk

LIFE Active Blanket Bogs in Wales
Jude Lane, Mike Morris
The National Trust, RSPB, Natura, Countryside Council for Wales, Environment Agency Wales, Welsh Assembly Government, Forestry Commission Wales.
http://www.blanketbogswales.org/

Malham Tarn, *Yorkshire Dales National Park*
Martin Davies
http://www.nationaltrust.org.uk/malham-tarn-estate/

Marble Arch Caves, *Cuilcagh Mountains, Northern Ireland*
Michelle Shannon, Richard Watson
http://www.marblearchcaves.net

May Moss, *North York Moors National Park*
Brian Walker
Forestry Commission and SITA Trust

Migneint, *Snowdonia National Park*
Katherine Hearn
http://www.nationaltrust.org.uk/ysbyty-ifan/
http://www.blanketbogswales.org/

Moors for the Future Partnership, *Peak District and South Pennines*
Louise Turner
EU LIFE-Nature
http://www.moorsforthefuture.org.uk

North Pennies AONB Partnership's Peatland Programme, *North Pennines*
Paul Leadbitter
http://www.northpennines.org.uk

Pumlumon, *Mid-Wales*
Liz Lewis-Reddy
Countryside Council for Wales, Biffaward , Environment Agency, Forestry Commission, Glasu, J. Paul Getty JNR Charitable Trust, LEADER, PRP, Powys, The Wildlife Trust, The Welsh Assembly Government, The Waterloo Foundation
http://www.montwt.co.uk/pumlumon.html

Redwood Moss, *Central Scotland*
Alan Anderson, Jonathan Hughes, Jenny Schwarz and Julian Warman
The site is managed by SWT under an agreement with the Balerno Commoners
Support gratefully received from Scottish Natural Heritage and Waste Recycling Environmental Ltd
http://scottishwildlifetrust.org.uk/reserve/red-moss-of-balerno/
A BBC interview on Red Moss can be seen here
http://news.bbc.co.uk/1/hi/scotland/8582584.stm

ScottishPower Renewables, *Scotland*
Peter Robson
http://www.scottishpowerrenewables.com

Somerset Levels and Moors, *Somerset*
Steve Dury
Environment Agency, FWAG SW, NFU, Natural England Royal Society for the Protection of Birds, Somerset Wildlife Trust, Somerset County Council, Somerset Drainage Boards Consortium
http://www.waveproject.eu
http://www.somersetwildlife.org/brue_valley.html
http://www.somersetdrainageboards.gov.uk/html/conservation.html
http://www.somerset.gov.uk/irj/public/services/directory/service?rid=/wpccontent/Sites/SCC/Web%20Pages/Services/Services/Environment/Somerset%20Levels%20and%20Moors%20policy

United Utilities, SCaMP, *North-West England*
Philip Austin
Forestry Commission, Natural England, OfWat, Royal Society for the Protection of Birds
http://www.unitedutilities.com

Yorkshire Peat Partnership, *Pennines*
Tim Thom
http://www.yppartnership.org.uk
http://www.facebook.com/YorkshirePeatPartnership
Twitter: http://twitter.com/#!/ypp_peat

Restoration, research and celebration

Conservation through collaboration

Peatland restoration for enjoyment

This booklet and associated material can be downloaded from

http://www.iucn-uk-peatlandprogramme.org

The International Union for the Conservation of Nature (IUCN) is a global organization, providing an influential and authoritative voice for nature conservation. The IUCN National Committee UK Peatland Programme promotes peatland restoration in the UK and advocates the multiple benefits of peatlands through partnerships, strong science, sound policy and effective practice.

IUCN National Committee United Kingdom

Peatland Programme