BODMIN MOOR, EXMOOR AND DARTMOOR

Wooden block construction at The Chains, Exmoor.

Restoration planning, methods and outcomes

Peatland restoration represents an opportunity to make a significant difference to the degrading peatlands of the South West of England. The South West Peatland Partnership is the umbrella name that brings together the local delivery of peatland restoration across the three moors of Bodmin Moor, Dartmoor and Exmoor. Its aim is to work together with a wide range of partners (see back cover) to restore these peatlands and bring about sustainable hydrological management in upland river catchments. The Exmoor Mires Partnership is the culmination of several projects that have run from 1998-to date, whilst the Dartmoor Mires Partnership has had two phases of restoration; a pilot project (2010-2015) and the current phase (2018-2021). The Bodmin Moor Peatland Partnership has been running since 2018.

Restoration work

The overall aim of restoration is to raise water tables, decrease peak flows from storms and increase base flows in dry periods. Blocks (dams) are used to disconnect dendritic erosional features and are placed along ditches and erosional gullies, thereby diverting water out of the ditch and across the land surface or through the peat soil.

The restoration methods used are based on national guidance techniques[1] which have then been adapted to reflect the local requirements and techniques[2] needed. These techniques have evolved over the years through trial and error, and through advice and requests from landowners and farmers.

The decision for the type of block used in an area depends on several factors, such as: the size of the ditch or erosional feature, the gradient of the slope, the volume of water that flows down the ditch and the landscape impact[2]. Blocks installed in the ditches can comprise a combination of peat, wood, stone, bales (made out of purple moor grass (*Molinia caerulea*)) or grey willow (*Sambucus nigra*). The wood for the blocks comes from local plantations, which is then planked to our requirements and left untreated.

Before any restoration takes place, the mires staff carry out a variety of in-depth planning, assessment, research and consultation in order to compile a Restoration Plan for each site representing a best practice approach to peatland restoration. Each plan assesses the positive and negative impacts of the restoration on the ecology, historic environment, landscape, access arrangements, land management practices, and estimates the costs associated of carrying out the restoration works. All appropriate government bodies, landowners, commoners, graziers, tenants and farmers have input into the plans and therefore the restoration that happens on the ground.

Restoration is carried out between August and April, to avoid the ground nesting bird breeding season, using local contractors to deliver the bulk of the work and a pool of volunteers who tackle minor maintenance works. Owing to the delicate nature of peat and to reduce the physical and visual impact on the landscape, specific diggers are used. They have wide tracks to provide greater weight distribution (resulting in ground pressures less than a human footprint), a rotating bucket head in order to reduce the amount the digger moves around, and a toothless bucket to ensure less disturbance, particularly to any historical artefacts hidden in the peat.

To date (January 2020), on Exmoor over 26.03 km^2 (2603 ha) of damaged peatland has had initial ditch blocking works carried out – a total of 25,607 blocks installed in 250 km of drainage ditches. A further 7.5 km^2 (760 ha) is considered unsuitable for restoration. On Dartmoor 1.8 km^2 (180 ha) of degraded blanket bog, characterised by dendric erosional features and bare peat soil, has been restored and rewetted.

Reprofiling steep erosional slopes at Flat Tor Pan, Dartmoor, December 2019.

Restoration in progress within the Spooners monitoring catchment, Spooners, Exmoor.

Willow faggot dam in a steep gully, Hoar Moor, Exmoor, February 2019. Willow was used in this situation to slow flows, trap sediments and create small areas of wet willow woodland. It was part of wider works to reinstate the River Quarme back into its original course, having been diverted in the early twentieth century.

Peat blocks along a drainage ditch showing water stored behind the blocks, Great Buscombe, Exmoor.

Total capital cost of the restoration across the three moors to date (January 2020) is about £4 million. Costs per hectares range from £306/ha^2 to around £5000/ha. This huge variation is dependent on a variety of factors such as the need for unexploded ordinance surveys, how remote a site is, and the range of differing practical interventions required.

The economic benefits of peatland restoration are wide-ranging, both directly from the process of restoration, e.g. sourcing materials locally and employing local contractors to carry out both restoration and monitoring works, and indirectly through the effects of restoration e.g. payments for ecosystem services provided by the peatland generating income to farmers via Higher Level Stewardship schemes for moorland maintenance, restoration and re-wetting.

Survey and monitoring

Biodiversity

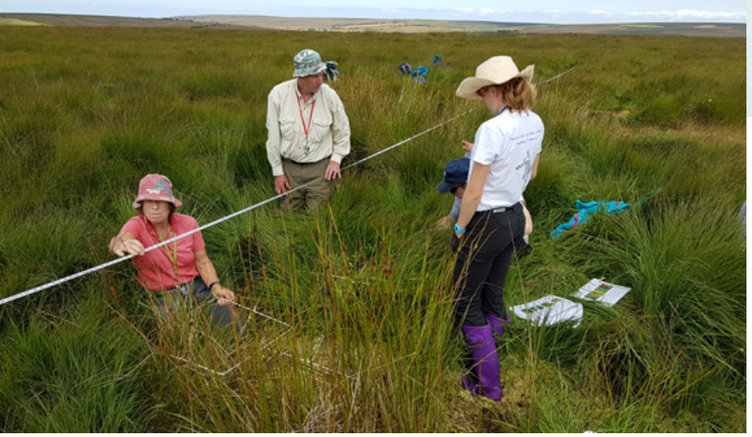
Biodiversity monitoring aims to detect changes (hopefully positive) in the species and habitats associated with healthy, hydrologically functioning peatlands.

The vegetation present is strongly linked to other ecosystem services, such as the production of dissolved organic carbon and the drawdown of gaseous carbon, which are much harder/more costly to monitor. Therefore, if we see bog species like *Sphagnum* mosses and cotton grasses (*Eriophorum* spp.) returning and species like purple moor grass (*Molinia caerulea*) declining, we can infer that there have been changes in the hydrology and ecological functioning of the peatland.

Vegetation monitoring on Exmoor (28 sites) shows an expansion in the distribution of *Sphagnum* 3 years post-restoration. This increase is significant ($p<0.005$) for sites 7 or more years post-restoration. A similar analysis of purple moor grass (*Molinia caerulea*) cover (31 sites) showed no sign of reduction until at least 11 years after restoration[3].

On Dartmoor a significant increase in mire species such as bog cotton-grass (*Eriophorum angustifolium*), *Sphagnum denticulatum, Sphanum cuspidatum* and *Sphagnum papillosum* within 3 years following restoration has been observed. However, a return to favourable blanket bog vegetation is expected to take 10 or more years[4].

Breeding bird assemblages, particularly those species associated with wet peatland habitats, give us an insight into the success of peatland restoration. On Exmoor, breeding snipe (*Gallinago gallinago*) have



Vegetation monitoring along a transect, Squallacombe, Exmoor.

A Mesolithic (7000 to 4000 BCE) hammer stone found at Horsen Farm, Exmoor during mire restoration field work.

Type	Exmoor	Dartmoor
Site surveys (combined walkover and desk-based assessment)	18	7
Palaeoenvironmental Assessments	8	3
Watching Briefs	2	5
Landscape Studies	2	
Geophysical Surveys	7	
Measured, earthwork Surveys	9	
Excavations	7	
Research Reports	5	2
Additional HER entry reports	10	6

Number and type of historic environment assessments carried out as part of peatland restoration

been observed at two restoration sites which previously had none[5,6]. In the context of there being only eight breeding snipe locations on Exmoor in 2011, this is a notable result. Whilst on Dartmoor, snipe (*Gallinago gallinago*) have increased considerably and dunlin (*Calidris alpine*) increased, particularly in the areas that have been restored e.g. Winney's Down and Cowsic Head[7].

The Exehead/ Blackpitts (Exmoor) restored sites have become the best sites in Somerset for black darter (*Sympetrum danae*) and common hawker (*Aeshna juncea*) dragonflies, both upland species which require open water. This success is due to the pools created by the restoration in 2007 – prior to this there was no surface water on the site[8].

Historic Environment

Exmoor and Dartmoor contain a wide range of historic sites and features that often survive well thanks to the less intensive agriculture and development compared to lowland areas. The peat itself often covers archaeological sites and deposits, preserving organic materials and environmental evidence that does not survive in drier conditions. To further inform and mitigate the impact of mire restoration on the historic environment we combine information from walkover surveys and desk-based assessments of existing knowledge into site plans. Where thought necessary, additional work is carried out to ensure the historic environment is both well-recorded and understood. Such work includes palaeoenvironmental studies, geophysical and earthwork surveys, excavations and watching briefs. Many previously unrecorded archaeological features and sites have consequently been identified as a consequence of peatland restoration (over 300 on Exmoor), ranging in date from around 6000BC to the 20th century. The new evidence has included prehistoric standing stones and cairns, nineteenth-century mining works, networks of medieval trackways and Second World War military training features. This data has allowed the existing Historic Environment Records (HER) to be expanded and enhanced.

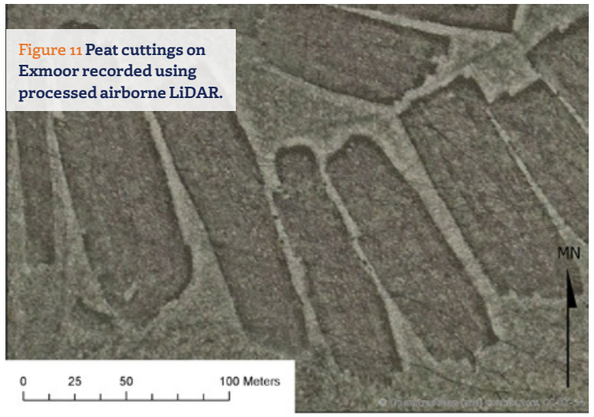


Figure 11 **Peat cuttings on Exmoor recorded using processed airborne LiDAR.**

In some cases, we have carried out additional case studies that go beyond individual sites and represent new research into aspects of the historic environment that may be impacted by mire restoration. This includes investigations into domestic and industrial peat cutting on both moors, the form and dating of deserted field systems on Codsend Moor (Exmoor) and the soils of Exmoor before the formation of peat. One such study identified tephra – volcanic dust deposits that can precisely date peat deposits and the evidence of environmental change held within them – for the first time in the South West[9].

Figure 10 **Fixed point photography from Roostichen, Exmoor; pre-restoration (2006), immediately post-restoration (2006) and 13 years post-restoration (2019).**

Landscape

Peatland restoration aims to bring about landscape change. In order to demonstrate and monitor landscape change associated with restoration fixed point photography is used (Figure 10). There are now over 60 pre- and post-restoration locations across Exmoor and Dartmoor.

Comparing aerial imagery dating from the 1940s to present day images enables us to map and analyse how that landscape was, is, and has changed through time. At the same time, this captures modern day archaeology in the form of our restoration work. Airborne LiDAR (Light Detection and Ranging) and Unmanned Aerial Vehicle (UAV) photogrammetric surveys record our landscapes in another dimension at up to centimetre accuracy. These surveys clarify features such as individual peat cuttings (Figure 11) which are often hard to distinguish by human eye on the ground.

Communication and Education

Communicating all the work and research undertaken is a vital element of the partnership, as is learning from those who manage and work on the peatlands. Involving local individuals, community groups, the farmers who manage the land and partner organisations has enabled successful landscape peatland conservation to happen on the ground. A programme of education, events and publications have been delivered in order that the numerous people who work in and visit these landscapes can gain a greater understanding and experience of peatlands. For example, the '*Bogtastic*' CLOWNS Play Bus and the '*Bogtastic*' Summer Festival, has engaged with over 4000 people.

Volunteers are actively involved in a wide range of activities within the project including running, leading and organising educational walks, talks and events; practical work such as small-scale ditch blocking; survey and research; publicity work and office work. Over 1000 days of volunteering have been carried out on the project.

Enjoying the 'Bogstacle Course' at Bogtastic.

REFERENCES

The appendices are available to view at **www.exeter.ac.uk/creww/research/casestudies/miresproject**

1. Thom, T. *et al. Conserving Bogs the Managment Handbook.* (Stationery Office, UK, for Scottish Natural Heritage, 1997).
2. Grand-Clement, E. *et al.* New approaches to the restoration of shallow marginal peatlands. *J. Environ. Mange.* **161**, 417-430 (2015).
3. Hand, A. *Analysis of Botanical Survey Data 2018 Exmoor Mires Partnership.* (2019).
4. Lunt, P. *Dartmoor Mires Project Vegetation Survey Data Analysis 2018.* (2018).
5. Boyce, D. C. *A survey of waders and other birds on mires in Exmoor National Park, 2011-12. RSPB South-west Region Report to South West Water.* (2012).
6. Ballance, D. K. *Exmoor bird monitoring project.* (2016).
7. Townend C., R., E. & Booker H. *Dartmoor Mires Project breeding bird survey 2018: Distribution and Population Breeding of Dunlin and other bird species on Dartmoor Blanket Bog.* (2018).
8. Boyce, D.C. Inveterate Survey and Monitoring on Exmoor Mire Project Restoration Sites, 2009-2014. (2015).
9. Bray, L. S. *The Past and The Peat: Archaeology and peatland restoration on Exmoor.* (Exmoor National Park Authority, 2015).