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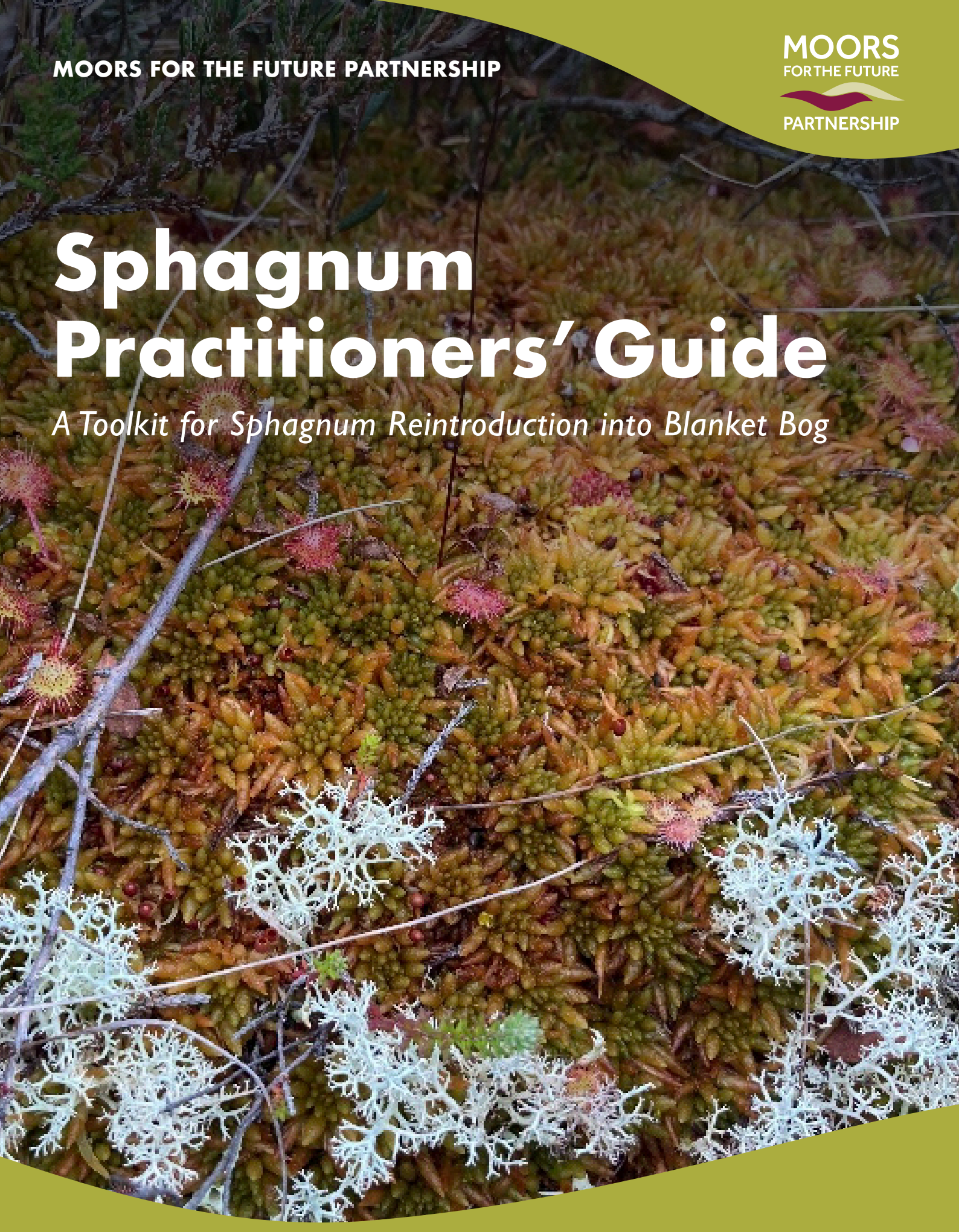
Sphagnum Practitioners' Guide

A Toolkit for Sphagnum Reintroduction into Blanket Bog



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Introduction

The purpose of the Sphagnum Practitioners' Guide is to provide information about the main techniques used to reintroduce sphagnum mosses to degraded peatlands based on work undertaken by Moors for the Future Partnership in the South Pennine Moors Special Area of Conservation (SAC).

This Guide updates the previous version:
A Practitioners Guide to Sphagnum Reintroduction (2015)

Lack of sphagnum cover is a characteristic of degraded blanket bog. Loss of sphagnum is both a consequence of the processes that have damaged our blanket bogs, and a factor in continued deterioration. Increasing sphagnum cover is, therefore, a key part of recovery from degraded peatland to active blanket bog. Success in doing so is dependent on there being suitable conditions for the mosses to thrive at the planting site. As such, this guide covers methods of sphagnum moss reintroduction as well as the antecedent processes and interventions that may be required to create a habitat that favours sphagnum.

As part of a wider restoration plan, sphagnum reintroduction into these blanket bog habitats benefits their resilience to the effects of climate change and their provision of ecosystem services, including:

- Carbon storage and sequestration
- Wildlife and biodiversity
- Economic sustainability (e.g. agriculture and tourism)
- Water provision and quality
- Flood mitigation
- Public health and wellbeing (e.g. recreation)

How to use this Guide

The guidance consists of:

- ***Re-introducing Sphagnum moss Factsheet***

  The Factsheet details the steps needed in preparing a site for sphagnum reintroduction. There are key features to note to best set the landscape up for success when planting sphagnum. Refer to the Factsheet to ensure the necessary steps have been taken into consideration prior to planting.

- ***Sphagnum Planting Guide***

  Use it out on the hill as a step-by-step guide to planting sphagnum plug plants.

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Not all blanket bog locations will be suitable for sphagnum planting. There are fundamental considerations and actions to be taken prior to planting sphagnum to ensure the conditions are appropriate.

Setting achievable goals for long-term success

In order to capture the greatest environmental benefits for each site, a long-term plan is critical. ***The Blanket Bog Land Management Guidance*** (2019), produced by Moors for the Future Partnership on behalf of the Upland Management Group, goes into detail on the outcomes and improvements of blanket bog management. It also builds upon the concept of the 'Six States of Blanket Bog'; a classification system developed by Natural England (Strategy for the Restoration of Blanket Bog, 2015) which characterises UK blanket bog into broad categories, enabling distinctions and prioritisation between these categories, or states.

Changing a site from bare peat (State 2) or dense conifer plantation (State 1) to carpets and hummocks of sphagnum mosses (State 6) is likely to be a longer and substantially more expensive journey than from a less degraded condition, such as heather domination without sphagnum (State 3), or grass or sedge domination (State 4). Refer to the ***Blanket Bog Land Management Guidance*** for more detail.

Efficient use of available resources is fundamental to moving a site as far as possible towards a restored condition, but with sufficient resilience not to slide back at the end of the process. If, for example, a site is in such a poor state that the full budget will need to be allocated to bare peat revegetation and blocking erosion gullies to halt its decline, then it may be advisable for sphagnum reintroduction to wait for the next project. The site may be so degraded that time is required for the initial work to create appropriate growing conditions for desirable key-indicator species like sphagnum mosses. For example, it may take a year or more for sufficient sediment to collect behind stone dams before revegetation can start to occur on that gully's floor. Therefore, planting sphagnum too early could be a costly mistake and/or a lost opportunity if it fails and takes investment away from interventions that could ensure its success in future. It is important that the key stakeholders collectively recognise the starting point.

Diagnosis: identifying specific ecological problems and their root causes

Understanding the site is key to formulating a beneficial and achievable restoration plan. There are several steps to inform this process, including an initial desk study, root cause analysis and consultation with stakeholders.

Desk study

A desk study will benefit from including Geographical Information Systems (GIS) and remote sensing to collate existing information.

An initial desk study should include consultation with people with specialist knowledge of the site. This can provide a useful guiding plan for future meetings and site visits.

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The history of the site

Understanding the historical, social, cultural or traditional circumstances specific to the site can help to influence a restoration plan by indicating the factors that have contributed to its current condition, as well as potential constraints on the types and locations of interventions that would be appropriate. For example, gather what information you can information on:

- Past management techniques
- Past works
- Wildfire history
- Pollution
- Recreational use
- Cultural heritage
- Utilities infrastructure
- Archaeological interest

If a site has had previous works, it is important to identify these to avoid causing disturbance or damage to them, and in case the funding body would consider further work in the same area to be 'double counting' any gains made. However, if the completed work complements the work to be undertaken, for example where areas have been rewetted through past gully blocking or bunding, those areas should be targeted for sphagnum planting.

Early engagement with Historic Environment Record officials is critical to determine if archaeology is present on site and, if so, agree appropriate measures to protect it. It is important to factor this in early in order to protect the historic environment, but also because the protection measures may mean project timescales and the restoration tools will have to adapt accordingly.

Current management and social pressures on the site

Any restoration plan needs to account for current land management, uses and users. These may include:

- Legal and administrative frameworks – land ownership, tenancies, agri-environment schemes, statutory designations
- Management
- Local interest groups
- Recreational use

Examples of restoration plan adaptation to these factors include making sure any new fences do not restrict or complicate regular farm tasks, for example, gathering livestock. Alternatively, rewetting schemes need to consider access to areas in regular use and not hinder their use.

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Landscape characteristics of the site

Assessment of the hydrology, topography and aspect of the restoration site will indicate where rewetting interventions are likely to be most successful (generally on shallower slopes) or where conditions may already be suitable for sphagnum reintroduction (where water accumulates or on cooler north-facing slopes). It is possible to model how water moves through the landscape, where it accumulates and steepness of slope by using GIS software and LiDAR data.

Ecological features of the site

To understand what a degraded blanket bog needs to move closer to State 6, understanding what is already there is critical. Similarly, measures will need to be taken to ensure that any work proposed will not negatively affect rare or protected species already found on the site.

Good sources of information on these aspects are recent survey data for flora, fauna and peat depth, or Natural England (NE) Advisers and Condition Assessments. While some aspects of this information are helpful, rather than essential, it is essential that any new project makes its own checks for protected species.

Wildfire

In the case of fire pressures on the site, the site's wildfire history and current condition must be considered in tandem. Review the frequency, location and severity of previous fire events, taking into account likely future trends and the resilience of the current environment. This will help you to identify areas at greatest risk of ignition and areas at greatest risk of severe environmental damage. The focus of the restoration plan can then be tailored towards breaking the link between areas at high risk of ignition and areas at greatest risk of severe damage.

Ignition and fuel type

Higher fire risk areas are often in easily accessible places close to population centres or gathering points (Dixon and Chandler, 2019). In these locations, rewetting work and vegetation management are useful techniques to prioritise. A Wildfire Ignition Map has been produced using data on moorland wildfires across the Peak District and South Pennine moors that is available to view online. Areas containing fine fuel types, such as dry grasses and sedges, are at greatest risk of ignition and spread. Areas containing coarse fuel types, such as woody material over 6mm in diameter or dry peat, tend to be at greatest risk suffering severe environmental damage in the event of a wildfire.

While all plants can burn, water held in the environment reduces the risk of damage, both when it is in the peat and in the plants. A higher water table makes the peat less likely to ignite. Wetter, preferably waterlogged, growing conditions favour mosses and in particular sphagnum moss, which holds more water for longer than other plant species.

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Invasive species

Invasive plant species pose a significant risk to conservation projects, but removing invasive alien species can be costly. Early identification allows consideration of the cost and time required to remedy it.

Recognising the need for extreme action early in a programme of work has a significant influence on the success of a project. For example, if rhododendron is not effectively removed from a site, the regrowth and ensuing recolonization has the potential to dominate areas recently stabilised with brash, seed, lime and fertiliser. A successful plan requires both funding and permissions that often span a long period; it can take ten years or more to successfully eradicate rhododendron.

Root cause analysis

Once the desk study has gathered what information it can about the place and its people, the next steps in formulating a coherent and achievable plan will involve time spent on site, confirming or updating the desk survey information according to what can be seen on the ground, and discussions with key stakeholders. The purpose of this is to identify the apparent symptoms of ecological problems (erosion, lack of plant diversity, etc.), link back to the most likely root causes of those problems (historical industrial pollution, over-grazing, low water table, etc.) and introduce restoration options to stakeholders. The result of a successful root cause analysis is a restoration plan that treats the symptoms while also addressing their causes. For example, it will revegetate eroding bare peat (a symptom) and slow the flow of water down the hill (a cause) to prevent the symptom returning.

Record your rationale and any agreements and decisions with stakeholders as they are made.

Consider three types of ecological pressures when assessing the characteristics of vegetation on site: competition, stress and disturbance. [Based upon Grime's CSR Theory (Grime J.P. (1988) *The C-S-R model of primary plant strategies*.)]

Competition

Where one species gains dominance over another/others beyond what might be expected in a more natural habitat (often the result of a change in site conditions influenced by human activity). Examples include introduced invasive species like rhododendron and conifers, but native species – Calluna vulgaris ('Calluna') and Molinia caerulea ('Molinia'), in particular – may dominate habitats beyond what is deemed desirable. Domination by these two blanket bog natives is likely to have resulted from a combination of factors that you may not be able to pinpoint (a history of fire, nitrogen deposition, historical overgrazing, low water table). What is likely to be obvious, however, is that the conditions currently do not support active blanket bog species assemblages, including sphagnum, which form in a low disturbance, low nutrient, low pH and low-flow (waterlogged) environment. With that, you can surmise that either the current conditions are too dry, water is flowing off the hill too quickly, nutrient status is too high, pH is too high/low, or all four.

Before planting sphagnum, it is important that the right growing conditions are created so that it can compete effectively. Therefore, removing non-native invasive species and introducing measures to control other over-dominant species, on a bog, often means rewetting and slowing the flow of water.

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Stress

Stress occurs where the environmental conditions are approaching or beyond the tolerance limit of plant species or communities – for example, they cannot meet all of their nutrient or water requirements. Stress reduces a species' ability to compete with other species better suited to the conditions. Whilst this can cause problems, it is also an essential mechanism for managing and maintaining vegetation assemblages. Bare peat is the result of stress levels exceeding the limits for all plant species. Common sources of stress for blanket bog species in the South Pennine Moors SAC are pollution and a low water table.

Many bogs have experienced historic pollution that has lowered pH levels in the already acidic peat. This limits the ability of plants to uptake nutrients. Raising the pH with lime and applying fertiliser has been shown to assist restoration in these cases, especially when nurse crops of grass seed are used to revegetate bare peat. Soil tests before planting sphagnum will reveal whether there is a need for work of this type.

Blanket bog is naturally a waterlogged habitat, but degraded blanket bogs are often drier than they should be. Waterlogging controls, balances and manages this habitat and its species. Recreating waterlogged conditions can cause stress to some species, like Calluna or Molinia, and favour others, like sphagnum, increasing the ability of sphagnum mosses to survive and compete, just as Calluna thrives and may become dominant in drier conditions.

Disturbance

Disturbance is a physical effect that has an effect on the flora, soil and geology of a site. Sources of disturbance may include grazing, cutting, trampling, fire, erosion by water and wind, or damage from vehicles' wheels or tracks. Sphagnum seems to compete much better in low-flow, low disturbance, waterlogged environments. Slowing the flow and rewetting the site is a key preparatory step when planting sphagnum, even if this means not actually planting any sphagnum until the next funding opportunity. In all but the most degraded of sites, there is remnant sphagnum to be found. Rewetting the habitat alone, can tip the balance of conditions in favour of sphagnum and lead to natural recolonization.

Organisational stakeholders and consultees

Ideas for a site focused purely on it's ecological needs have to be balanced with the stakeholders' needs.

Stakeholder mapping

Each site will have its own unique list of stakeholders. Among the list of stakeholders will be individuals or organisations whose good will and consent is essential for proposals to proceed to delivery. These are the key stakeholders.

Key stakeholders will closely assess your proposals and plans. Investing time early on in the process to develop relationships with the key stakeholders, and understand the relationship dynamics between them, will aid the process of obtaining consensus and agreements and facilitate smooth communication.

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The stakeholder list across different sites can vary substantially, with each site having its own unique community. As an example, this may include:

- Landowners (which may include some of the list below)
- Tenants
- Holders of shooting rights
- Commoners
- Utility companies
- Local authorities, including National Parks
- Councils (Parish, District or County)
- Natural England
- Forestry Commission
- Local interest, recreational groups and individuals
- Local residents
- Archaeologist groups

Working with stakeholders

Provide stakeholders with accurate information, tailored to their own needs, including preferred communication channels. This permits stakeholders with a strong influence on the work to make decisions clearly and effectively, including, but not be limited to:

- **What?** – the restoration proposal
- **How?** – for example, explaining that stone dams will involve stone deliveries and helicopter use
- **Why?** – potential benefits of the restoration plan versus the cost of doing nothing. Benefits will differ between stakeholders, so a rationale should be tailored accordingly. Include evidence and information from a range of sources. These may include scientific papers or acknowledged expert advice but, critically, the sources must be seen and trusted by all stakeholders. Use examples from other projects or sites. It may be useful to provide evidence as to why this plan has been selected, demonstrating other examples of where similar interventions have been delivered, showing the cost and effect of the work.

Take into consideration that these discussions take time (often over a period of days), and longer to think it over (week or months).

- **Financial costs and liabilities** – consider the ways any work may affect stakeholders. What is the direct or indirect effect on stakeholders during works (increased road traffic in a rural area, helicopter noise throughout the day, footpath closures, new fences, etc).
- **Timescales** – date, time and duration of the work.

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A tailored approach will allow stakeholders to understand the risks and/ or effect of the work, specific to them. This will help to avoid any issues during the work that could halt the works at increased costs and risks.

Engaging stakeholders is an important part of formulating a restoration plan, and will benefit the plan and delivery in the long term; helping with ongoing support long after an initial consultation project. However, this engagement can be time-intensive and costly. If it is not possible to engage fully with stakeholders, ensure clarity in what is being proposed.

Identifying acceptable risks

Based on the information provided as outlined above, stakeholders will be able to work out the individual risks to them, and which risks they find unacceptable. These unacceptable risks require early identification so they can shape the toolkit, outcomes and prescriptions for that site.

Prescription

Based on your diagnosis, create a sequenced or layered plan (with an identified budget) of measures to specifically address problems arising from the Root Cause Analysis.

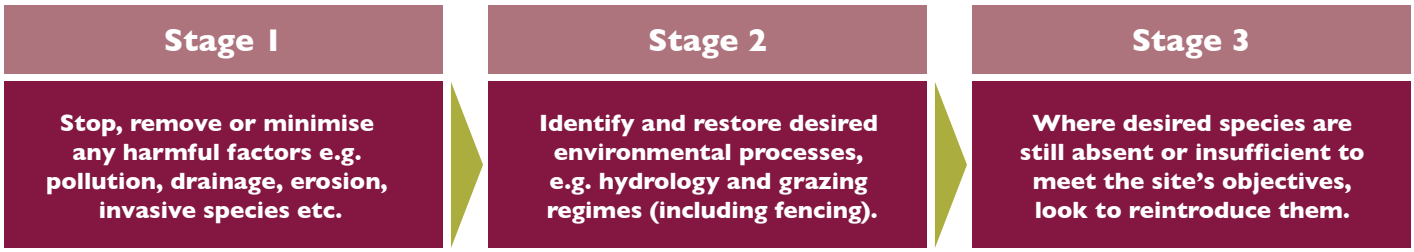

Figure 1: *Flow-path diagram of the three stages of blanket bog restoration.*

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Blanket Bog Toolkit

When making a plan for a site, there are many techniques and materials to consider. ***The Blanket Bog Land Management Guidance*** details the decision-making process and outlines the blanket bog toolkit. Further information on toolkit methodologies can be found by searching 'Factsheet' at ***www.moorsforthefuture.org.uk***. Looking to the widest selection of techniques, consider which tools could be useful in addressing the root causes of issues on site and are acceptable to stakeholders. The decision tree given in Figure 4 can help you to decide which tools may need to be included in your restoration plan, ending with sphagnum reintroduction. A selection of complementary and additional information on techniques that are key to the reintroduction of sphagnum is described in this section.

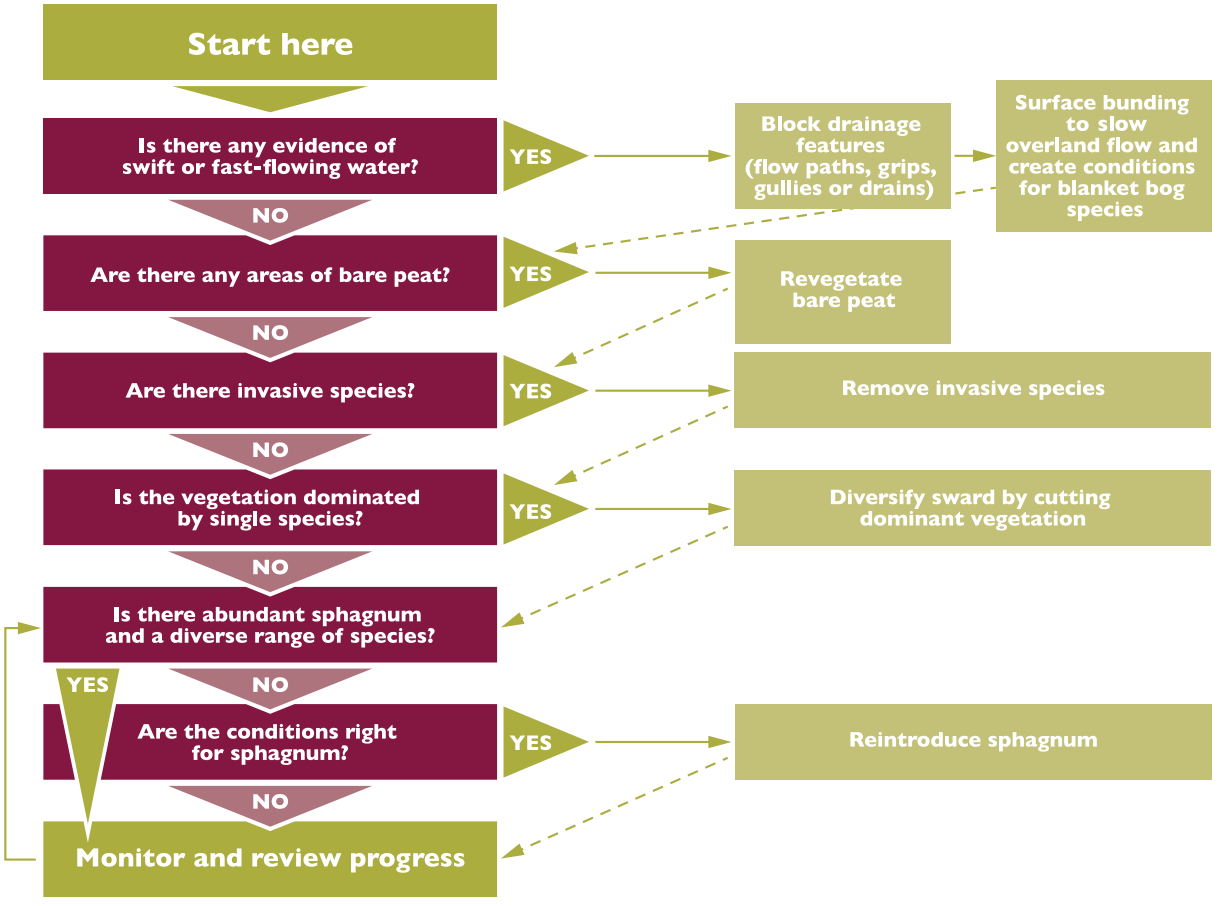

Figure 2: *Flow-path diagram or decision tree for preparing a site for sphagnum reintroduction or diversification.*

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Rewetting

Rewetting refers to restoring the hydrological behaviour of a blanket bog by slowing the flow of water through the landscape, across the surface and below it, in order to recharge and maintain a water table just below the surface of the peat. Surface water flow can be slowed or interrupted by blocking channels (grips, gullies or drains) or by surface bunding.

Block grips, gullies and drains

A range of materials and techniques can be used to create dams including peat, stone, timber, plastic sheeting, heather bale and coir roll.

Each individual gully/grip and location within can vary widely, from its dimensions to the peat depth to the vegetation growing within it. Figure 3 presents an example of how an appropriate dam type can be selected at a given location based on information taken at that location.

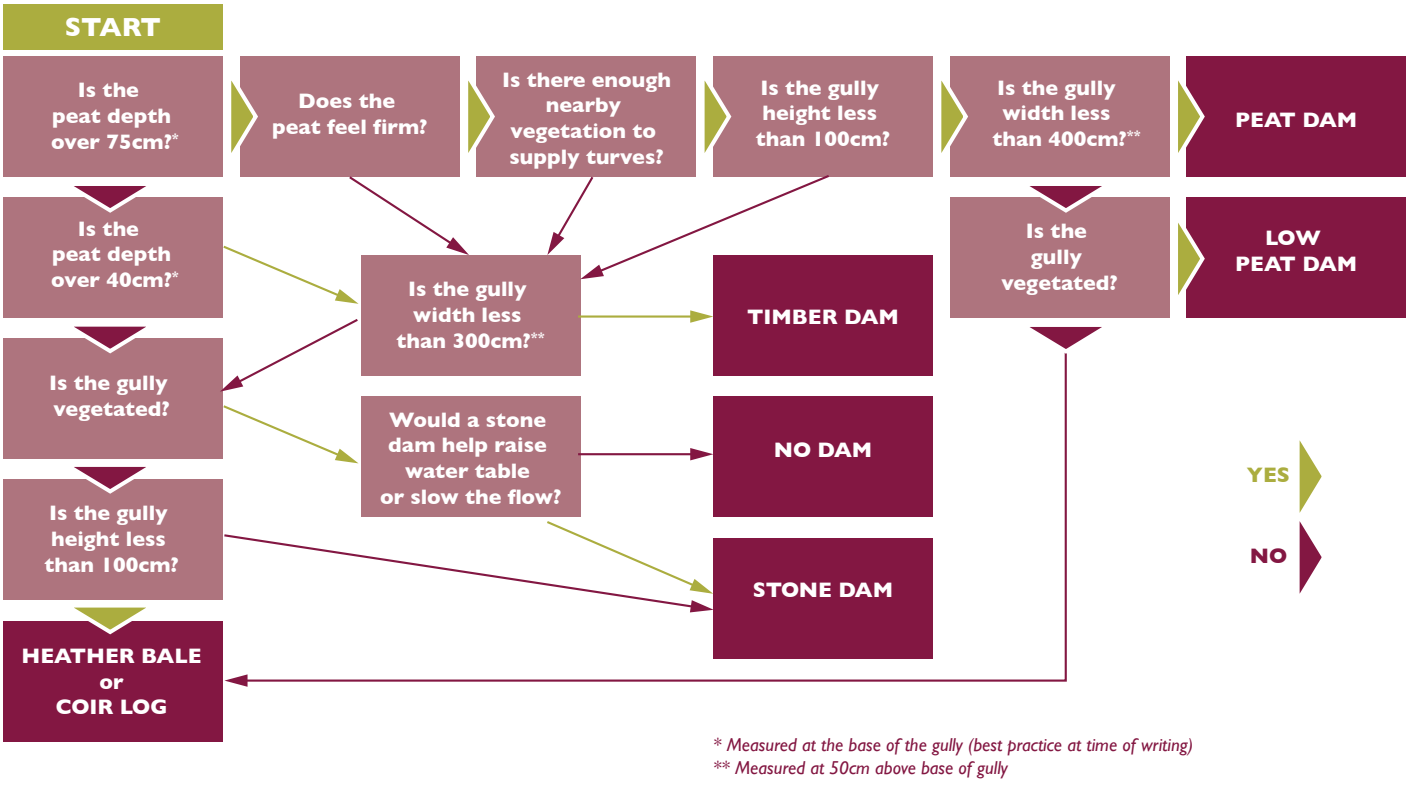

Figure 3: *Flow path diagram or decision tree for gully blocking.*

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Peat bunding

Peat bunds are impermeable dam features constructed on the bog surface, rather than within a channel. They are intended to slow the flow of water over and through the degraded peat, holding the water for longer and, in doing so, rewetting the peat. Specifically, peat bunds have been designed to help a degraded or absent acrotelm – the blanket of vegetated life which should cover and protect our peatlands – to recover by permanently changing the growing conditions to favour blanket bog species assemblages. Their use could mean huge areas of degraded upland peat, which have so far been beyond the reach of restoration work using dams in channels, could be effectively rewetted. From this, there are many potential benefits:

- Wildfire resilience
- Molinia and Calluna diversification
- Natural flood management
- Rapid and species-diverse sphagnum recolonization.

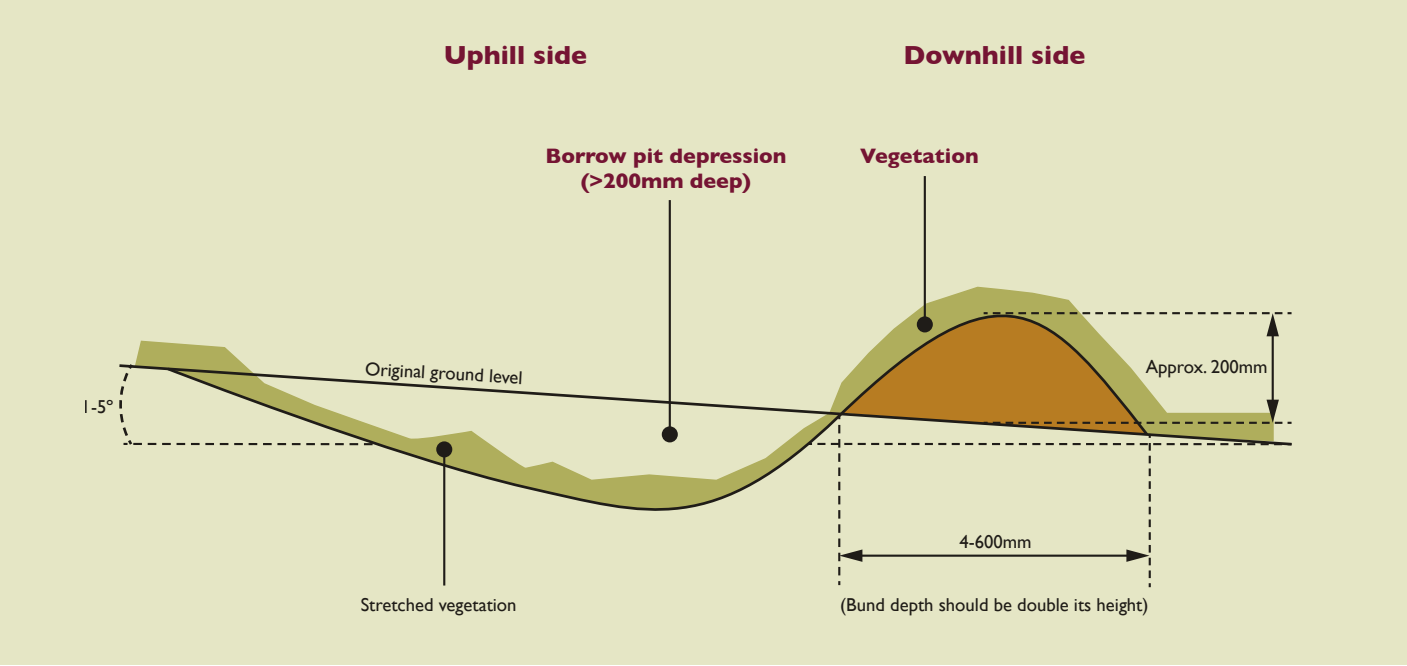

Figure 4: *Cross-section of a peat bund.*

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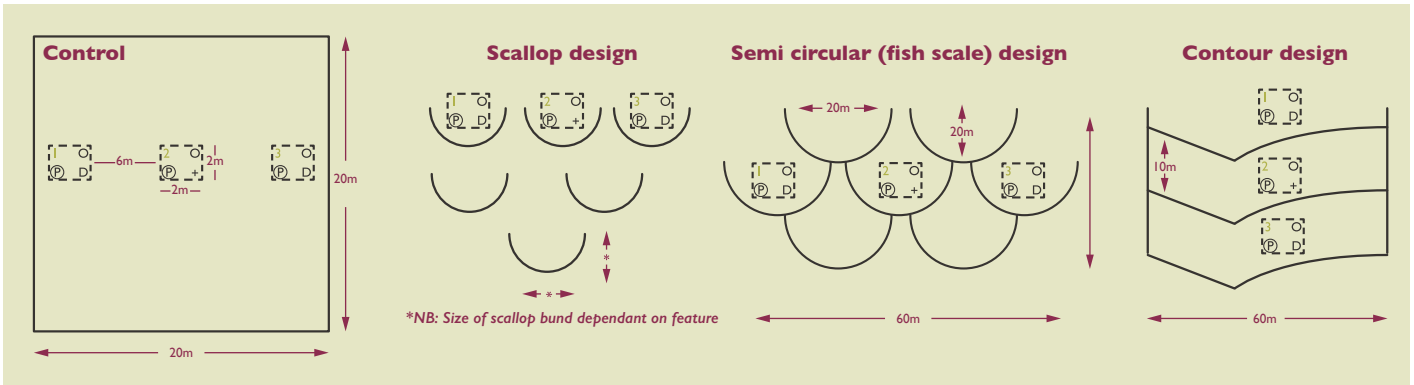
Figure 5: *A constructed peat bund.*

In order to maximise the capture of water, bunds are recommended for ground of up to a maximum of 6 degrees of slope. The shallower the slope, the more area is rewetted behind the raised feature. It is also recommended that the peat is sufficiently deep to enable the excavator driver to find sufficient amounts of good, cohesive peat, with which to construct watertight bunds. To date, MFFP's peat bunding has been limited to 'deep' peat of more than 40 cm depth.

Peat bunding on blanket bog is in its infancy as a technique. At the time of writing, only isolated 'scallops' (like a simple upturned smile) have been used in notable numbers. These scallops, alongside 'fishscale' and 'contour' bunds are being trialled.



KEY:
+ Automated dipwell
Ⓟ Peat Anchor
O Quadrat Stake
⬚ Quadrat boundary
D Manual dipwell
1 2 3 Survery plot number

Figure 6: *The different bund types trialled by Moors for the Future Partnership.*

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Re-profiling

Steep edges of bare peat, found on some channel sides and peat 'haggs', are unlikely to revegetate naturally. They will continue to erode unless the slope is reduced to less than 45 degrees. Reducing the slope to below 45 degrees using an excavator can improve revegetation prospects, which could be done using vegetation turves within reach of the excavator, geotextiles or heather brash with lime, seed and fertiliser. More exposed and eroding sites may consider using these techniques in combination. Native plug plants, such as cotton grass, will increase long-term stability and ongoing revegetation, though plug plants alone do not have an equal initial stabilising impact to either geotextiles or brash.

Figure 7: *This image shows sphagnum plugs in bare peat, in August 2019.*

Figure 8: *This image shows the same location as above, only in November 2021. Those plugs in bare peat have not survived well and most have now eroded away.*

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Removal of invasive species

It is not recommended to proceed with any reintroductions while alien invasive species persist on site. The following methods for their removal can be effective:

Physical removal

This can be done through mechanical means, such as with excavators, or by hand. Removal of species such as rhododendron and Sitka spruce using mechanical techniques, such as stump turning and felling, flailing or rolling (effective for bracken) should be considered.

Chemicals

Sometimes it is necessary to use herbicides, for example Asulox for bracken control or Glyphosate for rhododendron control. In all cases, full compliance with the legal restrictions and best practice are required when using chemicals like herbicide on designated or protected sites and in proximity to waterbodies.

Cutting for diversification of swards

Changes in conditions and historical management practices may have led to the over-dominance of some species to the detriment of others. It may be possible in the longer term to reduce the dominance by altering the hydrological behaviour of the site through gully blocking and bunding, but diversification through cutting is also an option.

Cutting dominant species such as Calluna vulgaris (Common heather) and Molinia caerulea (Purple moor grass) can also have positive effects on wildfire risk. This is achieved through strategic cutting of fire-breaks and cutting close to traditional, high-risk ignition points.

Heather

Cutting is an effective method of reducing heather domination. Cuts in suitable locations open up the canopy, making more light available to moorland plants already established underneath and encouraging growth. Removing the canopy can be enough to create suitable conditions for reintroducing sphagnum. Refer to the ***Heather Cutting factsheet***.

Molinia

Cutting Molinia has proved to be less successful than cutting heather for the goal of diversification because its vigorous growth rate does not allow time for competing species to establish. Repeat cutting or other ongoing management will therefore be necessary to keep on top of the sward. However, a study published in 2021, ***Diversification of Molinia-dominated blanket bogs using Sphagnum propagules,*** concluded that introduced sphagnum can establish in and help to diversify Molinia-dominated swards.

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Reintroduction of native bog species (including sphagnum and trees)

Where natural regeneration alone is not possible or too slow, intervention may be necessary, but always address the causes of a species' loss before considering reintroducing it.

Sphagnum

Refer to Part 3, where sphagnum is covered in depth.

Trees

The following factsheets are useful when considering native broadleaf woodland creation on moorland fringes or natural regeneration:

Clough Woodland: Benefits for My Land

Clough Woodland: Planting New Woodland

Clough Woodland: Grants & Support

In addition, some Partners have trialled the use of live willow as part of restoration:

- The National Trust at Marsden Moor have installed live willow dams in steep channels on the peat margins.

The RSPB at Dove Stone are trialling live willow pegs to stabilise the peat edge (see Richard Lindsay's 'Over the Top – how far should we go' ***'Blancmange'*** theory (Lindsay, 2019)).

PART 2
Planning effective sphagnum planting

Once you have made use of the available Blanket Bog Land Management Guidance – Decision-making toolkit (*here*) to restore the site or are otherwise confident that suitable conditions exist on site for sphagnum reintroduction, planning the delivery of planting can begin.

Surveying and mapping

Using information gained from your desk study, identify target areas to visit on the ground and survey (ground-truth). On-site surveys should focus on the target areas but, if time allows, also look at areas not identified to confirm their unsuitability. It is important to understand that the desk-based work has limited reliability so, where possible, check conditions on the ground rather than rely on assumptions.

Sub-habitats

Target areas can be split into three defined types of habitat: bog, fen and pool. The characteristics of these habitats are outlined below. Each of these broad habitat types should be planted with appropriate species or mixes of species. That is, with species adapted to or associated with the habitat type. During the ground-truthing process, map out these distinct areas carefully.

Bog

These can be identified as areas of peat which receive all (or most) of their water from the atmosphere around them (e.g. rain, fog, mist, snow), with little or no ground water flow as these locations tend to be on top of hills and higher ground. Characteristic species include S. medium, S. capillifolium and S. papillosum, Bog rosemary (Andromeda polifolia) and Sundews (Drosera sp.).

Fen

Fen, or flush areas can be found across all states of blanket bogs. These fens are characterised by water which flows, in part, from other areas of the landscape, frequently bringing nutrients to these otherwise nutrient-poor places. In essence, fens are the wetter features fed by drains and gullies, but are densely vegetated in places with rushes and sedges and can contain numerous sphagnum species associated with wetter areas, such as S. fallax, S. pallustre, S, fimbriatum, S. denticulatum and S. cuspidatum. Vegetated gullies and blocked gullies that are revegetating can also be considered as fen.

Pool

Pools here are defined as those locations where standing water is held through most or all of the year. These permanent or semi-permanent pools are a distinct habitat with benefits not only for blanket bog species, but also more generalised pond life, such as dragonflies and pond skaters.

As seen in the section on rewetting, some grip/gully-blocking techniques create permanent or semi-permanent pools. It is recommended that pools identified in a desk-based study are ground-truthed to ensure they are suitable for planting and appropriate sphagnum species are introduced. In 2020, Moors for the Future Partnership developed and trialled a new sphagnum Pool Mix ***(see Pool Mix)*** to target these pools.

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Planning effective sphagnum planting

Locating species already present

Sphagnum identification in the field is difficult (even for bryologists), but knowing what species, if any, are present on site, where and at what quantities can be useful for developing plans for sphagnum reintroduction and diversification. This knowledge can indicate:

- Whether there are areas with sufficient quantities of wild sphagnum to be harvested and replanted in other areas. For further details, see ***Harvested Sphagnum***.
- The suitability of the habitat for other, similar, types of sphagnum.
- What species are missing that should be present.

There are various sphagnum ID materials suitable for beginners, including a printable MoorMoss Sphagnum Guide and the ***FSC Field Guide***.

Budget and other constraints

Budget allocation will need to be balanced between delivery tasks. Having a clear budget will guide decisions on funds allocated to ground-truthing, purchasing/harvesting sphagnum to plant, transporting and planting sphagnum, and planting density (quantity of sphagnum per unit area). It is also important to manage the expectations of funders with regard to the changes that they can expect to see on a site during a given period based on the budget and planting density.

Time limits in regards to spending the budget must be factored in, bearing in mind what restrictions may be in place during certain times of the year preventing work, such as breeding bird restrictions between April and August, and frost heave in the winter.

Selecting desirable species

As well as assessing the habitat types and species presence on your site, it is important to understand that this is a snapshot. In order to reintroduce the most appropriate species to restore a site, there must be an understanding of past conditions and uses.

What species were present historically?

This should be discussed with Natural England, researchers and organisations that may have previously collected and analysed peat cores from the site or area.

Which species are best suited for the site now?

A balanced approach looking at the site's past, present and restoration objectives will enable an assessment of what species should be returned that can survive and thrive in current conditions.

Natural England advisors will understand what species would best suit a site based on past and present conditions, as well as being able to consider future objectives and what is achievable for the site.

PART 2
Planning effective sphagnum planting

Choosing propagule type(s)

Propagule type refers to the form of plant material used for reintroduction. There are different options available depending on available budget, timescales and what is already available either on-site or elsewhere. The propagule types that MFFP has used to date for sphagnum reintroduction are described and their advantages and disadvantages compared in the ***Kinder Scout Sphagnum Trials: 2018 Update Report*** (Crouch, 2018) and ***Kinder Scout Sphagnum Trials: 2020 Update Report***.

Propagule types broadly fall into two categories: harvested 'wild' sphagnum and propagated sphagnum.

Harvested sphagnum

Harvesting and replanting wild sphagnum (also known as sphagnum translocation) can be done within a site where enough sphagnum of the appropriate species is available, or between sites where that is not the case. Based on site visits, determine whether there are sufficient quantities of sphagnum of the target species to harvest, whether from the restoration site or off site. Each individual patch needs to cover a minimum of 1m^2 to be harvestable (Benson et al, 2019).

Harvesting any sphagnum species from a SSSI requires consent from Natural England. In order to aid the consenting process, please use the harvesting methodology included in this Guide when applying for consent and keep to the agreed methodology to ensure that the donor site recovers. Where sphagnum material is being moved from one site to another, further biosecurity measures will need to be in place to ensure that no unwanted pests, diseases or invasive species and introduced to the recipient site along with the sphagnum.

Other factors to consider for harvested sphagnum

Cost

- Harvesting cost – people required, bags, rates
- Transport costs (on-site) – moving material from the harvest area to planting area by helicopter or low ground-pressure vehicles (which are either expensive or time-consuming)
- Transport (off-site) – removal from harvesting site, transport between sites, transport to the planting site by helicopter or low ground-pressure vehicles.

Quality assurance

Are the harvesters experienced enough to identify and harvest your preferred species?

Economies of scale

Cost per unit will reduce as the quantities transported increase. For small projects, other methods of sphagnum reintroduction may offer higher value for money.

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Combined approach

If there are sufficient quantities to make it financially viable but there not enough to plant the whole site, a combination may be considered by topping up with propagated sphagnum.

Permission to harvest

As mentioned previously, harvesting sphagnum from a SSSI requires NE consent. If the harvesting site is separate from the planting site, you will require two consents instead of one.

Propagated sphagnum

Propagated sphagnum enables a bespoke mix of species to be produced and reintroduced at large quantities, low cost and with reduced biosecurity risks. Propagule types that MFFP have trialled and/or used extensively fall into three categories: beads, gel and plugs.

Beads

Previously available as BeadaMoss®, this propagule type was the first to be trialled and is no longer commercially available. It has been covered in the original report, ***A Practitioners Guide to Sphagnum Reintroduction*** (2015) and the Kinder Scout Sphagnum Trials reports.
More than 5 years after planting different propagule types on re-vegetated bare peat, beads showed limited success.

Gel

Sold as BeadaGel®, this propagule was developed to overcome the issue of the small fragments in BeadaMoss®. The gel contains longer strands of propagated sphagnum suspended in a liquid solution. It is applied by spraying the application area and the gel provides a degree of protection during application, reducing desiccation of the sphagnum. However, at the time of writing, there is not a viable method to spread it cost-effectively over large areas in the uplands.

Plugs

Sold as BeadaHumok®, plugs are small clumps of whole sphagnum plants. They can be grown in large quantities, can be carried to site without the need for a helicopter, are easy to plant and, if planted well, survive and thrive with an impressive growth rate.

The Kinder Scout Sphagnum Trials: 2020 Update Report found plugs, along with harvested sphagnum handfuls ('clumps') to be the most successful propagule trialled, over beads or gel. Further, it reported that comprehensive sphagnum cover can be achieved in a minimum of 68 months when plug planting is delivered at a density of approximately 10 plugs per m^2 on undulating ground in re-vegetated areas. Single-species plugs have also been shown to be successful when planted closely packed together (touching) in a 6 x 6 configuration in areas with some vegetation cover (See ***Monitoring single-species Sphagnum plug growth on blanket bog: 2021***).

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Sphagnum plugs can be grown to order to contain only the required species and at the relative quantities wanted. MFFP uses mixed-species plugs in restoration projects. Table 1 shows the preferred species mixes.

Moorland Mix		Chunky Mix		Pool Mix	
Species	**% in mix**	**Species**	**% in mix**	**Species**	**% in mix**
S. fallax	10%	S. papillosum	25% (+/-5%)	S. cuspidatum	30
S. palustre	20%	S. capillifolium	25% (+/-5%)	S. denticulatum	25
S. papillosum	20%	S. medium	25% (+/-5%)	S. fallax	15
S. capillifolium	10%	S. palustre	15% (+/-5%)	S. medium	10
S. cuspidatum	5%	S. subnitens	10% (+/-5%)	S. palustre	10
S. fimbriatum	5%	S. palustre	15% (+/-5%)	S. medium	10
S. subnitens	5%			S. papillosum	10
S. denticulatum	5%				
S. squarrosum	5%				
S. medium	10%				
S. tenellum	5%				

Table 1: *MFFP's sphagnum plug mixes.*

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Why mixed-species plugs?

The rationale for using a mix of species is based on practicality and risk. Sphagnum plugs are often planted as part of large-scale projects where tens or hundreds of thousands of individual plugs are planted over many hectares of land. It is not possible at this scale to ensure that every plug is planted into the ideal situation for each species. Using plugs that contain different species adapted to slightly different niches means that, once planted in a given location, the chances are the conditions will suit one or some of the species contained in the plug, even if they are not ideal for others. Plug mixes tend to contain one or more species that can tolerate a range of conditions as insurance against failure of other more sensitive species.

Moorland Mix

The Partnership's original species mix used in all propagules was the 'Moorland Mix'. It is an 'all-rounder' containing 11 species, although the preferred proportions of each species have changed since it was originally developed.

Gully transect surveys on Kinder Scout have shown that there were effects of topography on plug-derived S. capillifolium, S. cuspidatum, S. fallax and S. palustre introduced in the original Moorland Mix (see ***Benson et al, 2021***); the sphagnum species grew differently according to where they were, but plug and species survival rates were consistently high. These sphagnum reintroduction studies have shown that there can be more confidence in the survival rates of each individual species when planted as a community of species, and thus there can be less reliance on the more generalist survivor, Sphagnum fallax. As a result, the proportion of this species has been reduced in favour of those that were previously present only at very low proportions.

Chunky Mix

This plug mix removes the majority of the flush/fen species contained in the Moorland Mix and focuses more on hummock-forming species, some of which are key peat-formers and more drought tolerant, making them better suited to drier degraded areas outside of flushes. Often on degraded sites, these are the species that are missing, whereas flush/fen species may be abundant.

Pool Mix

The Pool Mix was developed by the Partnership as a response to the success of past and ongoing rewetting efforts. The pools created through gully blocking and bunding, along with natural pools already on the moor, are a habitat quite distinct from bog and fen. The resulting plug is intended to be planted into and around the margins of pools. It contains species that are aquatic, semi-aquatic or associated with pool margins; these include a large proportion of S. cuspidatum and S. denticulatum. Trials of Pool Mix plugs began in 2020.

SSSI consents

Consent is required from Natural England for sphagnum work on sites designated as Sites of Special Scientific Interest (SSSI). Once you know your planting locations, methods, timescales and species to be introduced, you can apply for consent to undertake the work.
Please make use of the methodologies included in this guide in doing so
(note that not all propagule methodologies are included).

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Collected below are methodologies that have been repeatedly consented by Natural England for use on SSSIs and used within successful projects by Moors for the Future Partnership.

Harvested sphagnum clumps

This section covers the methodology for collecting and planting handfuls of sphagnum sourced from wild populations.

On- and off-site translocation guide

Since 2014, the RSPB, at their Dove Stone reserve in the Peak District National Park, on land owned by United Utilities and managed jointly by United Utilities and the RSPB, has developed a sustainable technique for harvesting live whole sphagnum plants from a range of sites. To begin with, sphagnum was harvested from off-site non-SSSI areas, as well as on-site flush species (S. fallax and S. fimbriatum) with consent from Natural England. Subsequently, some large-scale harvesting has taken place from sites in Scotland and Wales (non-SSSI).

The priority for all harvesting is to be sustainable and non-damaging to the harvest site. A pilot study on Dove Stone yielded evidence to suggest that S. palustre recovers sufficiently within 5 years from a 10% harvesting rate to allow further harvesting of clumps (see Harvesting Sphagnum from donor sites: pilot study report (Benson et al, 2019).

Figure 9: *RSPB staff and volunteers harvesting S. fimbriatum from a S. fimbriatum/S. fallax-rich flushy gully at RSPB Dove Stone.*

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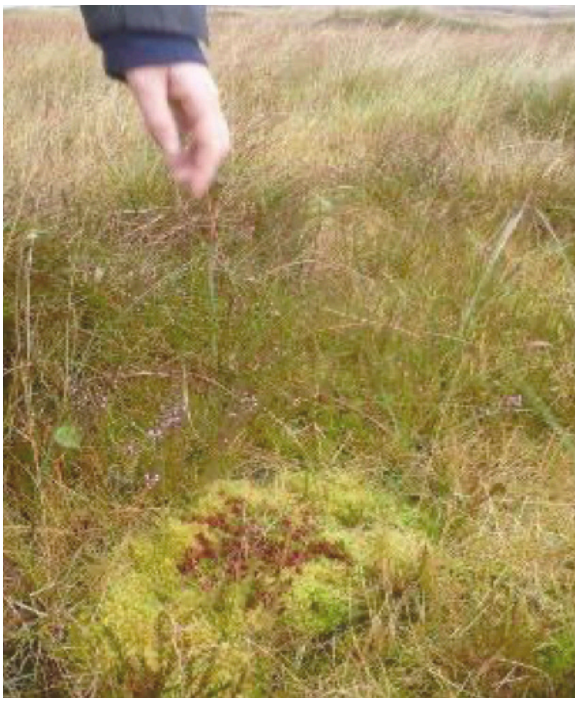

Figure 10: *Sphagnum from Geltsdale planted at RSPB Dove Stone. Established and growing well two years on.*

Harvesting sphagnum

Refer to ***A Practitioners guide to Sphagnum Reintroduction*** (2015), Case Study 6.3

Figure 11: *S. fimbriatum flush area before harvesting at a rate of 10 handfuls per square metre.*

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Figure 12: *S. fimbriatum flush area after harvesting at a rate of 10 handfuls per square metre. Very wet areas recover extremely quickly in our experience so will support the higher rate of harvesting (10 handfuls compared to 5 handfuls).*

The harvested handfuls are carefully formed into an individual 'bunch' and placed into a polypropylene bag (30 handfuls per bag). Keeping each handful separate is important. Doing so will aid planting efficiency as the original "bunch" will be easier to plant and may establish more quickly.

Figure 13: *An area of S. fimbriatum harvested in 2012 at a rate of 5–10 handfuls per square metre.*

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Figure 14: *The same area of S. fimbriatum in 2013, showing full recovery after 1 year. It can now be harvested again.*

Figure 15:*. A handful taken from a drier area of S. fimbriatum. The hole needs to be patted back together after harvesting to reduce the risk of the clump drying out, and to increase the rate of recovery.*

Holes should be patted back together when harvesting hummock-forming species as well. Where possible, handfuls should be harvested from the edge of hummocks, to reduce the risk of the hummock drying out.

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Planting harvested sphagnum

Figure 16: *Planting S. papillosum.*

- Take a handful from the bag.
- Hold it tightly and make it into a mini- 'proto-hummock'.
- All the brown, dead material underneath the living capitula will be planted into the peat, as if it were roots.
- The living capitula will be above the peat.
- All sphagnum species can be planted in this way, except for S. cuspidatum, which should just be placed in the pool (around the edges but in permanent water if the pool is very large, to protect against wave action).

Figure 17: *Make a divot in the peat using either your foot, or a large dibber (e.g. shovel handle). It is key that a hole is formed, and not a dent in the peat surface.*

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- Sphagnum should be planted into a habitat that closely resembles the original habitat:
- Flush species harvested from fen/ flush areas should be replanted into similar, very wet places, such as behind dams and sphagnum-free vegetated gullies, and into seepage lines, where there is a constant flow of water (though not enough to wash it away).
- Aquatic species should be placed into, or planted along the edges of permanent pools.

Figure 18: *Hummock and other 'chunky' sphagnum species should be planted into wet, vegetated areas that are sedge and/or dwarf-shrub dominated.*

- The Partnership has found that sphagnum established best when planted into wet, vegetated peat (look out for low/wet microhabitats).
- It is key that they are planted into the shade from existing vegetation, especially to protect them from long-term exposure to direct sun and wind.
- On the edge of pans, gullies etc. be conscious of sun/wind by planting to southern and western edges.
- Once sphagnum is established into wet areas, it will grow out into drier areas by itself.

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Figure 19: *Make sure that the divot goes through the vegetation and into the peat. Plant the sphagnum as a proto-hummock.*

- Make sure the capitula are tightly packed together.
- Make sure all the dead, brown material is below the peat surface.
- It is important to plant the dead material for several reasons: it anchors the sphagnum into the peat; it keeps the proto-hummock tightly packed; if the peat dries out in the summer, it will wick moisture from under the surface of the peat and keep the sphagnum growing.

Figure 20: *Sphagnum harvested from Bowland and planted at RSPB Dove Stone, two years after planting. Healthy, established and growing well.*

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Sphagnum plugs

This section covers the methodology for storing and planting propagated sphagnum plugs.

Plug storage and care guidelines

Sphagnum plugs can be delivered just at the time of planting. However, if they need to be stored on site, it is best to follow these guidelines:

- Sphagnum plugs should be kept in a cool, sheltered location with some natural sunlight (not in direct sunlight but also not in the dark).
- Sphagnum plugs should not be allowed to freeze. Storing outside, especially at the planting site, is not recommended during freezing temperatures.
- Sphagnum plugs should be kept moist (whitening of plant branches indicates drying out) so it is recommended to keep them stored in the plastic bags that they are delivered in. This should prevent the need to water them. If it does become necessary to water them (for example, if the plastic bags are torn), then rain water (only) should be used. Tap water will kill them.
- Sphagnum plug bundles should be stored and transported with care to avoid being squashed by the weight of other plants on top; this is key during transportation to the planting site in rucksacks, etc.

Delivery to planting site

Due to their small size and low weight, a person can carry the plugs required for a day's planting in a large rucksack. Care must be taken not to damage/squash the bundles whilst carrying.

Where to plant (general for ALL plug types)

Sphagnum plugs should be planted in the flattest, wettest areas. Cotton grass beds and revegetated peat pans are ideal. The ground should be wet and spongy, even during dry spells. The photo below shows an ideal planting area. The planting density is reliant on the agreed number of plugs per hectare for your work. However, the suitable areas within a hectare will be limited so planting could occur as frequently as 1 plug every metre. Each site will differ, therefore it is important that planting isn't regimented e.g. 1 plug per square metre, with plugs planted in a rigid grid system resulting in plugs being planted in unsuitable areas; it's preferable to plant more densely in suitable areas and ignore those that risk the sphagnum plug not surviving.

Figure 21: *A plug planted in a suitably wet and vegetated habitat*

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Sphagnum plugs require shelter from the wind and direct sunlight. Therefore, they should be planted into areas of existing vegetation. Here, the plug will benefit from the shade and shelter of existing vegetation, as well as the more stable humidity. Do not plant in open, bare peat spaces, especially peat pans. Plugs can be planted on the borders of bare peat areas, but still need to be in the shaded areas protected from the sun and wind, as well as avoiding any areas where fluctuations in sediment-rich water could deposit sediment over the plug, preventing photosynthesis.

The photo below shows vegetation cover required for planting. Due consideration needs to be made of the density of the intact vegetation, as it needs to provide sufficient shelter for the plugs without the risk of blocking out the light to the plug.

Figure 22: *A plug planted under existing vegetation cover.*

Sphagnum should not be planted directly in stream or gully channels, but could be placed on the edges of channels ensuring that they will not be directly in fast running water or areas where deposition of eroded peat will cover the plugs.

Figure 23: *Plugs planted along the edge of a water channel.*

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Where there are gully blocks, plant the plugs at the water's edge in locations where the plug is sheltered from any significant water flow. An agreed number of plugs should be planted at each gully block.

Figure 24: *Plugs planted behind a gully block (plastic piling dam).*

How to plant (general for ALL plug types)

This guide should apply to the planting of all types of plugs, irrespective of the type of mix (see the following section for a specific guide to the different mixes).

Sphagnum plugs will be delivered in bundles of 20 sphagnum plugs wrapped together in one bundle with cling film. A bag will contain 20 x bundles/400 plugs. This is based on how they are delivered from Micropropagation Services Ltd. Other producers may differ.

Figure 25: *Sphagnum bundle of 20 plugs securely wrapped in clear film. The bundle should be moist and vibrant green.*

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The mix type and species names will be shown on the bag. This could include any of the mixes previously covered, or a bespoke mix. Some sites may have a specific mix developed for that site, based on site history and current requirements.

Planting density

This should be specified to whoever is managing the work, be it in-house or contracted.
All planters should be aware of the number of plugs to be planted in an area. Please note, this is a guide. The planting density will vary across the site depending on the suitability of the planting areas, and as an average depending on your budget. However, it is useful to have an average guide to ensure areas are well covered and for project reporting purposes. As we have covered, planting at higher densities has been shown to result in comprehensive sphagnum coverage within 68 months. Alongside further research looking at the ***impact of conservation work using aerial imagery*** from an unmanned aerial vehicle (UAV) that has shown sphagnum grows and establishes at a faster rate in larger clumps, it would be reasonable to suggest that, when a project allows, planting more densely will benefit restoration trajectories.

What to look for

- Plant in an area that feels wet underfoot. Areas dominated by heather, bilberry and crowberry can be dry, especially on slightly higher ground.
- Preferably, an area with common cotton grass present (a good indicator of a wet area).
- Small, sheltered spaces (micro-habitats) in between existing vegetation (newly planted plugs require shelter from the drying wind and sun to get established).
- Where there have been cuts in the vegetation (areas that have had either heather, cotton grass or Molinia cut prior to planting). These areas can be planted if the conditions covered here apply.

Figure 26: *Ideal vegetation cover for Sphagnum sp. (wet area with cotton grass providing shelter but allowing enough light to get through).*

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What to avoid

- Bare peat and peat pans. Sphagnum plugs need shelter (rather than space) from surrounding vegetation to establish. Therefore, do not plant into an area of bare peat and, in the case of peat pans, where the water level regularly changes and sediment can cover the plugs (an example is shown in Figure 27). However, planting into the edges of these areas is acceptable if protected from the sun and wind (therefore the south and western edges can be suitable) and away from any risk of being submerged for too long a period, an example is shown in Figure 28.

Figure 27: *Bare peat and peat pans are not appropriate areas for sphagnum planting.*

Figure 28: *Peat pans are acceptable to plant into if plugs are protected from sun and wind.*

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- Standing water. Only a few species tolerate regular inundation well. Therefore, it is best to avoid planting directly into standing water, as shown in Figure 29, with all mixes apart from the Pool Mix, or single species of S. cuspidatum or S. denticulatum (see Single Species Guide below).

Figure 29: *Gully block pools are only suitable for planting into with Pool Mix, or single species e.g. S. cuspidatum.*

- Gullies with regular running water. Only plant on the edges.
- Directly behind gully blocks. These areas are regularly under water and sediment may be an issue for mixes other than Pool Mix. Only plant other mixes along the edge of the waterline further away from the block. Pool Mix can be planted lower down to below the water level and along peat dam walls where water flows out or downstream (the sphagnum will help prevent scouring).

Figure 30: *Plugs planted along edge of water line behind a gully block.*

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Figure 31: *Close-up of plugs planted in water draw-down zone behind gully blocks.*

Figure 32: *Close-up of plugs planted in water draw-down zone behind gully blocks.*

- Top gully edges where the water table is low; these areas will remain very dry during times of little rain.

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Figure 33: *An area of thick vegetation unsuitable for planting.*

Refer to the Sphagnum Planting Guide for detail on the planting method for sphagnum plugs.

A guide to planting different mixes

Moorland Mix

A mix of 11 species, including both flush and hummock (or 'chunky') species. This mix has recently been updated to include a higher proportion of species like S. medium, S. squarrosum, S. denticulatum, S. cuspidatum and S. tenellum.

As this is a 'generalist' mix, following the guidelines above, one or some of the species present will thrive and grow. This type of mix is ideal for a site with variation in micro-habitats and lacking in any sphagnum species in general. This is especially the case for large areas of newly revegetated areas of bare peat including a lot of blocked erosion gullies, where planting more specialist mixes would be complicated.

Chunky Mix

A mixture of five species: S. papillosum, S. capillifolium, S. medium, S. palustre and S. subnitens, designed to promote faster hummock growth where planting conditions are sufficiently favourable, or at least less degraded. This mix is targeted toward areas that are in unfavourable condition, but are largely vegetated and not actively eroding. These areas are more hydrologically intact, although surface flow and periodic drying is an issue. They may have patches of sphagnum present, in particular flush species in the wetter flushes and gullies. In order to move these areas into more favourable condition, diversification is key. In particular, the introduction of sphagnum species associated with functioning blanket bogs because of their ability to form peat layers. When assessing condition, Natural England takes into account the type of sphagnum species present on site, as opposed to general sphagnum presence.

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Pool Mix

A mix of five species that consists of aquatic and semi-aquatic species (S. cuspidatum and S. denticulatum) and some hummock species. This mix was developed to optimise sphagnum establishment and growth in pools and wetter areas; common features where hydrological restoration work has taken place.

Single species

Where specific species are needed for diversification, and where a bespoke mix is not available, planting (and mixing) single species can work. The types include:

- Flush species, e.g. S. fallax and S. fimbriatum – prefer wetter, flush areas with high water flow rates, such as gullies.
- Hummock or chunky species, e.g. S. medium, S. papillosum, S. capillifolium – still require wet areas, but can tolerate the drier tops. Suitable for planting in larger, flatter cotton grass-dominated areas.
- S. cuspidatum – this is a species of sphagnum that thrives in pools. It should always be planted or placed in/on the edge of semi-permanent pools, such as behind gully blocks (plastic piling or peat dams) or peat bunds.

Related documents to view

This Practitioners' Guide is part of a suite of documents to guide you through the process of planting sphagnum. Please refer to the ***Re-introducing Sphagnum Moss Factsheet***, and view the ***Sphagnum Planting Guide*** when you are ready to plant the sphagnum into the ground. Both are available to view online: **www.moorsforthefuture.org.uk**

APPENDIX/ USEFUL RESOURCES

(2015) A Practitioners Guide to Sphagnum Reintroduction. Edale: Moors for the Future Partnership.

(2015) Strategy for the Restoration of Blanket Bog in England. London: Natural England.

(2020) Monitoring the impact of blanket bog conservation using aerial imagery. Edale: Moors for the Future Partnership.

(2022) Factsheet: Re-introducing Sphagnum Moss. Edale: Moors for the Future Partnership.

(2022) Sphagnum Planting Guide. Edale: Moors for the Future Partnership.

Benson, J. L., Crouch, T. and Chandler, D. (2021) Monitoring single-species Sphagnum plug growth on blanket bog. Edale: Moors for the Future Partnership

Benson, J. L., Crouch, T., Chandler, D. and Walker, J. (2019) Harvesting Sphagnum from donor sites: pilot study report. Edale: Moors for the Future Partnership

Benson, J.L., Crouch, T., Spencer, T. and Pilkington, M. (2021) Monitoring Sphagnum growth from propagules applied to re-vegetated degraded blanket bog; Kinder Scout Sphagnum Trials: 2020 Update Report. Edale: Moors for the Future Partnership.

Crouch, T. (2018) Kinder Scout Sphagnum Trials: 2018 Update Report. Edale: Moors for the Future Partnership.

Dixon, S.G. and Chandler, D. (2019) Producing a risk of sustained ignition map for the Peak District National Park. Edale: Moors for the Future Partnership.

O'Reilly, O'Reilly and Tratt (2012) Sphagnum mosses guide (Shrewsbury: Field Studies Council)

Pilkington, M., Walker, J., Fry, C., Eades, P., Meade, R., Pollett, N., Rogers, T., Helliwell, T., Chandler, D., Fawcett, E. and Keatley, E. (2021) Diversification of Molinia-dominated blanket bogs using Sphagnum propagules. London: British Ecological Society.

Titterton, P. (2021) MoorLIFE 2020: D4 – Final Wildfire Database Report: A guide to the methodology used in creation of the wildfire database and an analysis of trends associated with key variables. Edale: Moors for the Future Partnership.

Upland Management Group (2019) Blanket Bog Land Management Guidance – Frequently asked questions. Edale: Moors for the Future Partnership.

Bund trials – Preliminary results – https://www.moorsforthefuture.org.uk/our-work/our-projects/moorlife2020/conservation-works/moorlife-2020-bunds-trial

Factsheet: Clough Woodland: Benefits for my land. Edale: Moors for the Future Partnership.

Factsheet: Clough Woodland: Grants & support. Edale: Moors for the Future Partnership.

Factsheet: Clough Woodland: Planting new woodland. Edale: Moors for the Future Partnership.

Factsheet: Heather Cutting. Edale: Moors for the Future Partnership.Factsheet: MoorMoss Sphagnum Guide. Edale: Moors for the Future Partnership.

MoorLIFE 2020

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