

# **UK Peatland habitats**

# From broad definitions to contextual descriptions

## **Summary**

- Three main peatland habitat types are typically presented in generalist literature on peatlands: fen, blanket bog and raised bog. However, there is greater peatland diversity than is captured in these broad terms. It is also important to understand peatlands as part of a mosaic of interconnected habitats within the landscape, rather than isolated systems.
- Care should be taken when using peatland-related terminology that is potentially too generalised (e.g. moorland) for an objective of peatland conservation. 'Mire' is another broad term that is typically used in the literature to indicate a range of peatland types which are peat forming, but even within some common habitat classification systems, some peatland types are categorised as non-mire. Peatlands can therefore sometimes be hidden in the descriptions used.
- Accurate definitions and descriptions of peatland habitats are therefore essential

   especially when these are used to inform science and policy. Habitats should
   be described relative to their context of study (e.g. soil science, ecology) whilst
   being mindful of the scale of recording. However, it is good practice to also record
   characteristics that are broader (e.g. information on hydrological units, vegetation, land
   surface parameters and management context) to help subsequent studies make use of
   the data and interpret it accurately.
- Recommendations and links to existing frameworks and descriptors are provided at the end of this briefing to help form a comprehensive description of a peatland site.

### Introduction

Peat and peatlands have been defined and classified based on various characteristics over time, whether based on their formation, peat depth, ecology, hydrology or cultural significance. For the purposes of this briefing, we will call on the broadly accepted, internationally used Ramsar definition of peatland:

"Peat is dead and partially decomposed plant remains that have accumulated in situ under waterlogged conditions. Peatlands are landscapes with a peat deposit that may currently support a vegetation that is peat-forming, may not, or may lack vegetation entirely. The presence of peat or vegetation capable of forming peat is the key characteristic of peatlands."

However, within the broad term of peatland, the abundance and variety of habitat descriptions can cause confusion, posing potential risks when these descriptions are used to inform science and policy. A holistic, interdisciplinary understanding of healthy peatland functioning is essential for accurately assessing the impacts of land management and designing effective restoration strategies. Relying solely on insights from a single discipline – such as greenhouse gas dynamics – risks prioritising one aspect of ecosystem service delivery at the expense of others. Without a thorough grasp of the hydrological, ecological, and other interconnected components of peatland systems, there is a significant risk of mismanagement due to an incomplete understanding of the peatland as an ecosystem.

Furthermore, holistic definitions and descriptions of peatland habitats are critical for evaluating peatland condition, guiding restoration efforts, mapping peatlands and interpreting research outcomes. Incompletely described study sites and the use of generalised terminology (e.g. moorland) can lead to misinterpretation of research findings, which could in turn misinform policy making, leading to inappropriate policy design. This briefing sets out some of the challenges with defining peatland habitats and makes suggestions for how peatlands can be recorded and described, and how to distinguish between some common types of UK peatlands.



Blanket mire mosaic of blanket bog and fen © Richard Lindsay.

# Peatlands and peatland habitats: perspectives of definition

Peat and peatlands have often been defined based on their exploitation potential. For example, the use of minimum peat depth to define a peatland, which excludes areas of shallow peat from land management decisions.<sup>2</sup> A more holistic view is gained through definitions that consider ecology and hydrology, but it is important to note that all definitions come from a 'view' and have bias of perspective.

In a hydrological context, peatlands are commonly divided into just two basic types - water receiving systems, fed predominantly by surface water and/or groundwater (minerotrophic fens), and water shedding systems, fed predominantly by precipitation (ombrotrophic bogs).<sup>3</sup> However, there are many more peatland habitats that can appear strikingly different despite the common underlying process of peat accumulation. In the UK, examples include blanket bogs in the upland hills or raised bogs scattered across the lowlands, fens covered with dense vegetation and different types of tree-covered wet woodlands – see Box 1 below for common characteristics for these habitats in a healthy state.

From an ecological traits perspective, <u>peatland habitats</u> are often defined based on the predominant vegetation – for example, terms such as 'bog woodland' or 'fen carr' are not based on the peatland type but rather the surface vegetation, as bog woodlands are typically rainfall-fed bogs, and fen carr is often a transitional state between a fen and a drier woodland. Descriptions of the vegetation alone (or subsets of the entire vegetation community) can also be problematic.<sup>4</sup> For example, willow carr can grow on alluvial floodplain (non-peat) soils or peat soils: here, the description of vegetation alone does not necessarily give an indication of whether the habitat is peatland or not.

Instead of being isolated habitats, transitions between fens and bogs (as well as other, non-peatland habitats) exist, and all these types can exist side by side, creating complex mosaics of interconnected habitats, supporting a variety of biodiversity. On a landscape scale, all bog systems in their natural state are accompanied by fen systems – the two are either intermixed or fens can be found around the margins of bogs.<sup>3</sup> Large areas of blanket bogs are therefore often a complex network of ombrotrophic bogs and fen units fed by springs and seepages – small habitats that act as hydrological boundaries and refugia for a greater diversity of species. These habitats are all connected – for example, damage or disruption to a small spring flush feature uphill can cause a complete loss of habitat downslope.

#### Peatland habitats can look strikingly different.







Imagine we describe site c as 'fen'. But fen can also look like:

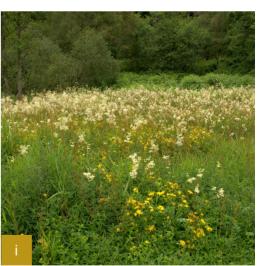












Unless we examine and describe the vegetation, soil, landscape setting, etc. we cannot be sure of what we are looking at, and we cannot be sure that someone else has a similar understanding of what we have observed.

**Figure 1.** a) Blanket bog, © Norrie Russell; b) Fen carr, © Emma Duley; c) Fen meadow, © Tom Barrett; d) Upland valley fen, © lain Diack; e) Reed carr, © Tom Barrett; f) Upland alkaline fen, © lain Diack; g) Reed fen, © Tom Barrett; h) Upland alkaline fen, © lain Diack; i) Tall-herb fen, © Brian Eversham.

# Box 1. Typical characteristics of some common peatland habitat types in the UK in their healthy state





**Figure 2.** The <u>Flow Country</u> is the most extensive and diverse example of an actively accumulating blanket bog in the world, making it the only UNESCO World Heritage Site inscribed purely for its peatland ecosystem qualities. © RSPB (top) and David Brown (bottom).

#### **Blanket bog**

A blanket bog is a peatland that stretches over the landscape both on flat areas and moderately sloping hillsides. Blanket bogs in good condition are often treeless environments with low-lying vegetation consisting of mosses, sedges and dwarf shrubs, interspersed with pools of standing water on flatter areas. Blanket bogs are often found over acidic bedrock where rainfall or atmospheric input exceeds the loss of water, creating a waterlogged environment that allows peat to form.5 Blanket bogs are ombrotrophic which makes them nutrient-poor and acidic. Such conditions favour the growth of bog mosses and a range of specialists unique to these habitats. Sphagnum mosses typically carpet healthy bogs and create an undulating topography with hummocks and hollows. Other typical bog species include cottongrasses (Eriophorum spp.), bladderworts (Utricularia spp.) and sundews (Drosera spp.).

Variation in blanket bog habitats is also seen geographically in response to climatic variation and historic management.<sup>5</sup> Blanket bog habitats in the SW of England differ from those in the NW of Scotland but are still classified as blanket bogs due to soil characteristics and habitat function, despite differences in surface patterning and vegetation composition.

#### **Bog woodland**

Bog woodlands develop naturally on acidic, nutrient-poor peat in ombrotrophic peatlands, and appear as an open woodland with scattered trees across the bog. The dominant tree species are typically Scots pine (*Pinus sylvestris*) and downy birch (*Betula pubescens*).<sup>6</sup> The stunted trees often occur sparsely because the wet surface offers few drier spots and hummocks for them to grow. It is common to see standing and fallen dead trees in bog woodlands, often where the weight of the tree has depressed the peat surface, which has led to waterlogging and death.

The slow growth rate and sparse coverage of trees due to the lack of nutrients in peat does not allow them to dry out the habitat or interfere with the accumulation of peat.<sup>6</sup> In true bog woodlands, this stable ecological relationship maintains the trees as well as the typical low-lying bog vegetation (e.g., Sphagnum mosses, sedges (*Cyperaceae*) and bilberries (*Vaccinium*)) that carpets the undergrowth. This habitat is rare in the UK, with old growth bog woodland mainly limited to Scotland.<sup>6</sup>





**Figure 3.** Abernethy bog woodland (top, © Emma Hinchliffe) and Inshriach bog woodland (bottom, © Helen Harper) in Scotland.

#### Raised bog

Raised bogs are localised, often isolated domes of peat rising several meters above surrounding land. Raised bogs are ombrotrophic, waterlogged, nutrient poor and acidic, with few plant species adapted to such conditions. Cranberry (*Vaccinium oxycoccos*), bog rosemary (*Andromeda polifolia*) and cottongrasses (*Eriophorum* spp.) often grow among Sphagnum mosses on a raised bog, which create a unique surface topography of hummocks and bog pools. Carnivorous sundews (*Drosera* spp.), bladderworts (*Utricularia* spp.) and other bog specialists can also be found here.

Raised bogs are often a climax community, following succession from water bodies through fens to an ecologically stable raised bog, and can be further divided into distinct types based on their formation and location.<sup>3</sup> Raised bogs are often surrounded by **laggs** - wet areas that receive their water from adjacent uplands as well as the domed centre of the raised bog itself. Laggs have a higher nutrient content and are identifiable by vegetation typical to fens, such as tall sedges.



Figure 4. Peeswit Moss raised bog. © Emma Hinchliffe.

#### Fen

Fens (Fig. 1) are minerotrophic peatlands that receive their water from both precipitation and groundwater. Depending on the underlying geology, the groundwater feeding fens can be mineral-rich, and have a range of nutrient statuses varying from poor to eutrophic.7 Contact with groundwater makes fens less acidic than bogs; however, fens are still slightly acidic environments. Fens are diverse, and their appearance is driven by both their nutrient content and the acidity of the water. They are also transitional habitats, and some lowland fens would develop into wet woodlands or raised bogs over time, if left alone. Fens exhibit a rich diversity of species and support around a third of all native plant species in the UK, as well as half of all dragonfly species, a range of aquatic beetles and thousands of other invertebrate species.8

**Base-rich fens**, typically found in lowlands, are associated with calcareous water (pH 5 or higher)

which has been in contact with a base-rich rock such as limestone. These fens have a rich plant life, featuring reeds and sedges, and a variety of other flowering plants including orchids. Base-rich fens can also be found in the uplands. However, **upland fens and flushes** are often small in extent, occur on shallow peat and are dominated by lower-stature vegetation, with rich diversity of flowering plants. Base-poor fens on the other hand are associated with acidic water (pH 5 or lower) which has been in contact with sandstone or granite. These fens occur mainly in the uplands and resemble bogs, with *Sphagnum*, cottongrasses and heather growing on the surface.

#### Fen carr

Fen carrs are a type of wet woodland. They are naturally wooded, minerotrophic peatlands fed by mineral-rich groundwater and surface water. Fen carrs often occur in mosaic with other habitats, particularly drier woodlands and fens, and the boundaries between these habitats can be sharp or gradual, often changing over time in response to changes in hydrological conditions. Fen carrs have significant capacity for carbon sequestration, both in the form of peat and in the biomass of trees. Fen carrs have significant capacity for carbon sequestration, both in the form of peat and in

The rich vegetation of fen carrs is made up of dominant tree species, such as willow (*Salix* spp.), alder (*Alnus* spp.) and birch (*Betula* spp.) and a herbaceous understory. These habitats can appear dense and tangled, with a shaded understory consisting of rich vegetation of shrubs as well as ferns, sedges, mosses and liverworts interspersed with pools of standing water. Carrs also support a rich invertebrate community. Fen carrs can be found in East Anglia, Shropshire and Cheshire. Shropshire and Cheshire.





**Figure 5.** Fen carr in Goss Moor NNR (top, © Emma Duley) and Wakehurst (bottom, © Alice Milner).

# Peatland condition adds a further variable

These brief descriptions set out parameters that broadly characterise each peatland habitat in its healthy state; this list of habitats is, of course, not exhaustive. Degraded peatland habitats, however, can look strikingly different from healthy peatlands. Degraded and drained peatlands often display signs of erosion and fragmentation, and the scarcity of bog vegetation can leave sections of peat exposed on the surface.4 A diversity of Sphagnum moss that is characteristic of healthy raised bogs and blanket bogs is scarce or absent, and grasses and shrubs such as purple moor grass (Molinia caerulea), common heather (Calluna vulgaris) and hare's tail cottongrass (Eriophorum vaginatum) begin to dominate the drier surface.4 The hummock/pool topography characteristic of bogs is lost, and over time, degraded bogs can begin to resemble heathlands, or wet grasslands where habitat management includes grazing. In more extreme cases, the vegetation is completely absent, and bare peat is exposed on the surface.

### **Problems with terminology**

'Peatland' and 'peat' as terms can be problematic as they have no singular accepted scientific definition. However, to make decisions where peat or peatlands are concerned, a definition of some form is likely required. This has meant that definitions are often made as the result of a policy need. In the UK, this has led to the application of depth-based definitions to delineate 'deep' and 'shallow'





**Figure 6.** Peatlands damaged through peat cutting (top, © Nick Littlewood) and heavy grazing and drainage (bottom, © Penny Anderson).

peat.<sup>2</sup> These are applied variably both within and across the UK countries with depths of between 30-50 cm used for different applications. Uneven definitions risk leading to perverse outcomes on the broader peatland mosaic, confusion amongst land users and managers and accusations of unfair treatment.

The IUCN UK Peatland Programme is seeking to address this problem with the proposal of <u>IUCN motion 003</u>, which was accepted as a resolution at the IUCN World Conservation Congress in 2025. The motion seeks to support the development of a scientifically underpinned and agreed definition of peatland and peat to support decision-making and understanding.

Overlap in definitions and the multiple uses of some terminology related to peatlands can cause further confusion. Moorland is an overarching term that is widely used to describe open upland landscapes, but this term does not describe a single habitat: it embraces upland heath and upland grassland as well as blanket bog and other habitats. The first two habitats are not wetlands and are quite distinct in their functioning from blanket bog; they also do not always store comparable quantities of carbon and often occur over mineral soils (although these habitats could eventually form deep peat). When blanket bog is damaged it can superficially resemble either dry upland heath or upland grassland, but the processes which led to its formation remain those of a wetland, i.e., waterlogged conditions and peatland vegetation led to the creation of the underlying peat soil. Generalised "moorland" management may therefore fail to account for the characteristics of peatlands and cause further degradation; instead, the different components of moorland landscape and their requirements should be recognised. The term moorland is a cultural concept rather than a habitat description<sup>12</sup> and should therefore be used with caution in research, management and policy.

Another challenging term is **mire**, as it is often used in different contexts in different ways - typically in Europe, as it is not as widely recognised internationally. Mire is an ecosystem that supports peat-forming vegetation. <sup>13,14</sup> By this definition, healthy, peat-forming peatlands are mires, but peatlands damaged by the removal of vegetation are no longer peat-forming and cannot be described as mires. Mire is a useful 'catch-all' term to indicate active peat formation and is commonly used in the literature, even in relation to global peatland classification.

Vegetation classification systems such as the UK-specific National Vegetation Classification use the term 'mire' as a phytosociological definition with a focus on plant communities, but also include both 'swamp' and 'heath' communities within the 'mire' family classification. Moreover, not all 'M' classes indicating mire communities in the NVC are congruent with active peat formation, e.g., M23 (*Juncus effusus/acutiflorus – Galium palustre* rush-pasture) and

M25 (*Molinia caerulea – Potentilla erecta* mire), whilst other peatland types are categorised as non-mire, e.g., 'S' habitats (such as S4 *Phragmites australis*) which are "swamp" or some 'W' habitats such as wet woodland (e.g., W5 *Alnus glutinosa – Carex paniculata* woodland).¹⁵ Whilst helpful for those interested in vegetation communities, the NVC use of the term 'mire' does not necessarily align with

other uses of this term, particularly when talking about intact versus degraded hydrology and peat formation (e.g., the <u>Peat Bog Condition matrix</u>). This example highlights the difficulty in placing arbitrary boundaries around natural systems. A definition will likely never be 'the truth' but a representation of collective effort to place clarity of understanding around a topic.

## A habitat description toolbox

There are already several tools and frameworks which exist for describing habitats, including peatlands. Some examples of these are given in the table below.

Table 1. Existing tools and frameworks useful for describing habitats

Table 1. Existing tools and frameworks useful for describing habitats.							
Tools and frameworks	Description	Useful links	Advantages	Limitations			
Functional wetland typology	Simple wetland classification system	Functional wetland typology	Offers a simple classification system which is accessible to non-specialists.	Field survey manual developed is no longer available online. Only applicable to Scottish context.			
UK Habitat Classification (UKHab)	Standardised method for mapping and describing habitats in the UK.	UK Habitat Classification	Provides a clear set of habitat categories and codes for ecologists, ensuring consistency. Includes finer distinctions (different types of bogs).	Detailed system that may require training. Relatively new; guidance and interpretation are still evolving.			
National Vegetation Classification (NVC)	Terrestrial habitat classification describing plant communities of Britain.	NVC   JNCC Blanket bog Bog woodland Raised bog Alkaline fens	Widely recognised; provides high- resolution classification and reflects species composition.	Focus on plant communities at a point in time; does not capture seasonal variation.  Misleading use of the term 'mire'.			
The Peat Bog Condition Matrix	Supplements the JNCC Common Standards Monitoring scheme for raised bog and blanket bog.	Handbook for the Peat Bog Condition Matrix	Provides a simple 'traffic light' approach to indicating the condition of the various identifiable sectors of ground.	Only applicable to blanket bogs and raised bogs.			
Von Post Humification Scale	Describes the degree of decomposition (humification) in peat.	Von Post Humification Scale	Helps to assess peat condition. Useful in hydrological modelling. Easy to use on the field.	Subjective - depends on the observer and can be influenced by moisture content and sampling method.  Does not account for chemical composition or bulk density.  Not suitable for some fen types (e.g. tall-herb fen, fen carr).			
Wetland Water Supply Mechanisms (WetMECs)	Classification system used to understand and categorize how water is supplied to wetlands.	Wetland functional mechanisms	Provides a robust framework for understanding wetland dynamics and facilitates classification of wetland habitats.	Developed for lowland wetlands in England and Wales; direct applicability elsewhere may be limited.			
Eco-hydrological Guidelines for Blanket Bog (in progress)	Set of eco-hydrological guidelines which can be applied to all areas of UK once complete.	SWE EcoHydro Report	Aims to provide the foundation for a robust upland mire habitat classification.	In development and not currently published for the whole of UK; limited to blanket bogs.			
Peatland Code	Classification for the purpose of habitat condition acting as a proxy for carbon emissions.	Peatland Code Field Protocol	Simple categorisation of bogs and fens alongside description of condition. Considers physical features such as drains, bare peat areas, modified habitat.	For some purposes, the categories within the Code will be an oversimplified way of describing the habitat as the method was designed to be a greenhouse gas proxy indicator.			
EUNIS	Comprehensive pan- European system for habitat identification.	EUNIS habitat classification — European Environment Agency	Hierarchical classification covers all types of habitats from natural to artificial. Common framework across Europe.	Can be complex to apply, often needs extensive field data.			

# Recommendations for comprehensive peatland descriptions

Most of the existing tools and frameworks set out above cover a specific aspect or feature of a peatland. They should be used with this in mind, whilst bringing in additional descriptive data, if possible. There is value in recording attributes which may seem irrelevant or tangential to record for a particular study or purpose, but which can be invaluable in connecting the disparate peatland data we do have and contributing to more powerful collective research. These recorded details may also be key for someone else interpreting the description.

When describing a specific 'peatland' as opposed to 'peatlands' in general, there are other factors which can be important to record systematically. In the checklist below, we suggest what needs to be recorded and defined when describing a peatland.

- Vegetation
- Soil type, depth and underlying geology
- · Hydrological units
- Land surface parameters (slope, aspect, elevation)
- Climatic parameters (mean annual temperature and precipitation)
- Present and historic land use management
- Context of the location

As peatlands often occur in a mosaic, it is also important to describe patterning and context of the location, i.e. what surrounds it, and what it is connected to. For example, considering the influence of connected landscape in terms of water movement (e.g., flowpaths and water inputs to the peatland). It is also crucial to be transparent about methods used, and it is good practice to make the <u>data available</u>.

The table below illustrates a few examples of published studies that all conducted their work in the Moor House National Nature Reserve in the North Pennines. Whilst working in the same study area, it is evident that different papers will often focus more on describing parameters that may be more relevant to the topic that they are investigating. It is nevertheless good practice to record characteristics that are broader to allow comparative studies, as the authors in the table below have done to varying degrees. This practice helps subsequent studies make use of the data.

In addition to the suggested parameters above, the scale of **study** is also a factor to consider. When studying peatlands at the microtope scale (e.g., for understanding microorganism dynamics) it might only seem pertinent to record the ecology of the 1m<sup>2</sup> guadrat being sampled. However, larger scale factors such as aspect, hydrology, soil depth and management can also be important influencing factors to record. Similarly, broad descriptions of landscape scale factors are not always helpful for understanding small scale dynamics. Habitat descriptions should thus also be mindful of the scale of recording. To advance peatland research, we need funding mechanisms that recognise the importance of detailed recording and foster collaboration across disciplines, as limited time and resources often constrain researchers. Partnerships with experts and engagement with local communities is encouraged to make research more collaborative and informed.

**Table 2.** The inclusion of suggested parameters in study site descriptions of some published studies describing blanket bog sites in the Moor House National Nature Reserve in the North Pennines.

	The effects of burning and sheep-grazing on water table depth and soil water quality in a upland peat. <i>Worral</i> et al. (2007) <sup>16</sup>	Wind-splash erosion of bare peat on UK upland moorlands. <i>Warburton</i> (2003) <sup>17</sup>	Piping and pipeflow in a deep peat catchment.  Holden and Burt (2002) <sup>18</sup>	Removal of mesh track on an upland blanket peatland leads to chang- es in vegetation com- position and structure. <i>Williams-Mounsey et al.</i> (2023) <sup>19</sup>
Vegetation	<b>✓</b>	<b>✓</b>	<b>✓</b>	<b>//</b>
Soil type, depth and underlying geology	<b>✓</b>	<b>//</b>	<b>//</b>	<b>✓</b>
Hydrological units	<b>//</b>	_	<b>//</b>	<b>✓</b>
Land surface parameters (slope, aspect, elevation)	<b>✓</b>	<b>✓</b>	<b>//</b>	<b>✓</b>
Mean annual temperature and precipitation	<b>//</b>	<b>//</b>	<b>//</b>	<b>//</b>
Context of the location	<b>//</b>	<b>✓</b>	<b>//</b>	<b>//</b>
Present and historic land use management	<b>✓</b>	_	<b>✓</b>	<b>//</b>

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Laxford Mire © Tim Allot.

The International Union for the Conservation of Nature (IUCN) UK Peatland Programme exists to promote peatland restoration in the UK and advocates the multiple benefits of peatlands through partnerships, strong science, sound policy and effective practice.



