Definition of Favourable Conservation Status for Heathland

Defining Favourable Conservation Status Project

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Executive summary

This document sets out Natural England's view on favourable conservation status for heathland in England.

Favourable conservation status is the minimum threshold at which we can be confident that the habitat, and its associated species, are thriving in England and are expected to continue to thrive sustainably in the future.

This definition has been produced following the Natural England approach to defining favourable conservation status described in the guidance document Defining Favourable Conservation Status in England.

Section 1 of this document describes the habitat covered by this definition and its ecosystem context.

Section 2 specifies the units used to describe the three favourable conservation status parameters. These are:

- Natural range and distribution (where the habitat occurs).
- Extent (how much habitat there is).
- The structure and function attributes (habitat quality).

Section 3 outlines the evidence considered when developing the definition. This definition is based on the best available evidence on the ecology of heathland. The evidence covers the current situation, historical changes and possible future changes.

Section 4 sets out the conclusions on the favourable values, that is the value for each of the three parameters when the habitat has achieved favourable conservation status.

This document does not include any action planning, or describe actions, to achieve or maintain favourable conservation status. These will be presented separately, for example within strategy documents.

Summary definition of favourable conservation status

Heathland is found throughout England on nutrient poor, acidic mineral soils and shallow peats (less than 30 cm deep) and is characterised by the presence of ericaceous dwarf shrubs (usually greater than 25% cover). It is a dynamic mosaic of vegetation, and transitions between dry heath, wet heath, mires, acid grassland, bracken and scrub are frequent. The peat archive demonstrates that the development of heathland is a natural process that pre-dates human activity, although in the absence of large herbivores, or some other intervention, natural succession will, at some point, result in open heathland developing into scrub and woodland.

Whilst some fragments are small (10 ha or less), areas of heathland usually occur as part of larger habitat mosaics/ecosystems extending over many square kilometres, which often feature a great diversity of habitats and species. These areas tend be relatively unmodified compared with much of England's landscape, and still support natural environmental gradients, giving rise to a great complexity of conditions.

The extent of heathland has declined by approximately 70% to 80% over the last three or four hundred years, largely through its conversion to agricultural land and built development. Remaining areas of heathland, particularly in the lowlands, have become highly fragmented, with areas divided by roads and separated by intensive agriculture, forestry and built development. The quality of sites is poor, in both uplands and lowlands, often as a result of drainage, inappropriate vegetation management and nutrient enrichment. Heathland supports many threatened species and other species of conservation importance.

For favourable conservation status heathland should be present in 119 National Character Areas, with its extent increased by 135,000 ha to 417,000 ha in order to reverse historical losses, reduce fragmentation and increase connectivity to create functioning ecological networks. This requires an increase in the extent of wet heath of 106,000 ha and of dry heath of 29,000 ha. All areas should be part of a naturally functioning ecosystem and all constituent and associated species should be thriving, with none formally assessed as IUCN Threatened. Heathland is likely to be in a dynamic relationship with associated habitats, changing in response to management and environmental factors.

At favourable conservation status heathland should have sufficient diversity to support the suite of heathland species associated with it, including heterogenous vegetation (structure and composition, including transitions); bare ground with varied characteristics (including substrate, patch size and shape, humidity and juxtaposition with other features) and refuges for species vulnerable to disturbance. Hydrology and soils will be functioning naturally, and air pollution levels will be below the site-relevant Critical Load or habitat Critical Level values. Management, including naturalistic grazing and more specific interventions, where required, will allow dynamism within the landscape.

Table 1 Confidence levels for the favourable values

Favourable conservation status parameter	Favourable value	Confidence in the proposed favourable value
Range and distribution	Maintenance of the current range – present in 119 National Character Areas.	**High**
Extent	An increase in the extent of 135,000 ha to 417,000 ha. Comprising an increase in extent of wet heath of 106,000 ha to 267,000 ha and an increase in dry heath of 29,000 ha to 150,000 ha.	**Moderate**
Structure and function	95% of the favourable area of the habitat should meet the favourable structure and function requirements.	**Moderate**

	95% of the resource should occur in patches greater than 30 ha. All species associated with heathland should be of IUCN Least Concern status at the GB scale.	

As of January 2025, based on a comparison of the favourable values with the current values, heathland is not in favourable conservation status. Note, this conclusion is based solely on the information within this document and not on a formal assessment of status nor on focussed and/or comprehensive monitoring of status.

Contents

About the Defining Favourable Conservation Status project

Natural England's Defining Favourable Conservation Status (DFCS) project is defining the minimum threshold at which habitats and species in England can be considered to be thriving. Our Favourable Conservation Status (FCS) definitions are based on ecological evidence and the expertise of specialists.

Through setting our ambition and aspiration for species and habitats, our definitions will inform decision making and actions to achieve and sustain thriving wildlife.

Our FCS definitions will be embedded into delivery of the 25 Year Environment Plan, through the Nature Recovery Network, biodiversity net gain and environmental land management schemes (ELMS).

Conservation bodies will use them to inform their work, including management planning for the land they own. Businesses will have a clear understanding of how their work impacts nature recovery and how they can help contribute to achieving thriving nature.

By considering the evidence for FCS, decisions will be more confident and strategic, with an understanding of their contribution to, or impact on, the national ambition.

1. Habitat definition and ecosystem context

1.1 Habitat definition

Heathlands occur widely on nutrient poor, acidic mineral soils and shallow peats (less than 30 cm deep) and are characterised by the presence of ericaceous dwarf shrubs (usually greater than 25% cover). They are found throughout England where there are suitable soil conditions.

Areas of heathland in good and favourable condition are typically dominated by a range of dwarf shrubs of varying heights and structures, including heathers *Calluna vulgaris* and *Erica* spp., bilberries *Vaccinium* spp., crowberry *Empetrum nigrum*, gorse species *Ulex gallii* and *U. minor* plus lichens and bryophytes.

Heathland is a plagioclimax community: in the absence of large herbivores or some other management, it undergoes a gradual, natural successional change, from bare or sparsely vegetated ground through grass and dense heath to scrubby heath and, finally, woodland. The pace of successional change and the relationships between these different habitats is dependent on underlying landforms, geology and hydrology and also on past and current management and external factors such as nutrient deposition. Heathland is a natural component of temperate ecosystems, but human agricultural activity widely arrested natural succession to woodland and expanded the area of heathland. Therefore, the present extent and variability of heathland is related to human activities so that most heathland is considered a semi-natural habitat (Hampton 2008). However, it is possible that some areas of heathland in England, in particularly exposed situations, will not undergo natural succession to woodland.

Heathland frequently occurs as a mosaic with a variety of other habitats, depending on environmental conditions and management, including mires and other wetlands, standing and running waters, grasslands, areas of bracken, scrub and stands of scattered and clumped trees. Small areas of these inter-related habitats are often included within the mapping of heathland extent. Heathland with scattered mature trees and patches of scrub may also be identified as wood pasture. Areas with greater than 20% tree canopy cover are classed as woodland.

Heathlands vary in their flora and fauna according to climate, and are also influenced by altitude, aspect, soil conditions (especially base status), hydrology, nutrient availability and vegetation management. There is variation from south to north, and from western (oceanic) to eastern (more continental) types. Sixteen National Vegetation Classification (NVC) communities in Britain meet this definition of heathland but some NVC communities may also occur within other habitat types (see Appendix 1 for a list of NVC communities).

The hydrological conditions, in combination with rainfall, and soils, influence the occurrence of dry and wet heaths. Some heaths in the west and especially south-west of England appear to be more transitional from dry to wet heath in their composition (sometimes referred to as “humid heath”) compared to further north and this is considered to be the result of the more oceanic conditions found in the region (Webb & Vermaat 1990; Bullock & Pakeman 1997; Symes & Day 2003; Webb 1986). The NVC was not divided along hydrological gradients, so humid heaths are usually represented as sub-communities (See Appendix 1 for further detail of the NVC communities).

Naturally dry heaths usually occur on well-drained soils receiving relatively low rainfall. They are characterised by combinations of heather *Calluna vulgaris*, bell heather *Erica cinerea* and gorse *Ulex* species.

Wet and humid heaths occur on substrates such as shallow peat (less than 30 cm deep) or sandy or clay soils with impeded drainage. Wet heath generally has a water table that is close to or at ground level for at least part of the year. It typically includes mixtures of cross-leaved heath *Erica tetralix,* deergrass *Trichophorum germanicum,* heather and purple moor-grass *Molinia caerulea*, with the wettest examples often including carpets of bog-mosses *Sphagnum* spp.

The spatial patterning of wet and dry heath vegetation is naturally dictated by the pathways that water takes through the landscape, with wet heath forming along those pathways and dry heath forming away from them. The lack of an obvious transition between wet and dry heath gives an impression of uniform heather moorland or heathland. However, intimate gradations between wet and dry heath and blanket bog in the uplands, or acid grassland and purple moor-grass and rush pasture in the lowlands, can be seen locally on suitable terrain.

This definition encompasses both the Lowland Heathland and Upland Heathland Habitats of Principal Importance for conserving and enhancing biodiversity (also known as priority habitats) as listed under Section 41 of Natural Environment and Rural Communities (NERC) Act 2006. The distinction between these two priority habitats is broadly made at the upper level of agricultural enclosure in England which approximates to the Moorland Line. However, in practice, there is rarely a clear ecological distinction between the two, as the flora and fauna exhibit a continuum of change from the lowlands to the uplands, influenced by a range of factors, particularly by geology, soils, temperature, rainfall and insolation. This definition thus avoids any reference to an altitudinal distinction and considers all heathland that occurs from near sea level (not including heath with maritime influence) to the start of the alpine or montane zone at approximately 600-750 m altitude. In addition to the exclusion of montane heath, this definition excludes heathlands on coastal sand, shingle and cliffs which show maritime influences, as these are considered in the coastal habitat FCS definitions, and heath-type vegetation growing on peat more than 30 cm deep considered in other FCS definitions, not least that for blanket bog.

In many cases, historic and current management practices have modified heathland and obscured its identity, to the extent it has a major impact on perceptions. Bogs and wet heaths lay down peat which survives as a record of these ecosystems even when their surface vegetation has been modified beyond recognition by anthropogenic activity. For example, some communities of dry heath vegetation found on shallow and deeper peats (particularly examples of those classed as H9, H10, H12 and H18 NVC types (Rodwell 1991)) are generally relatively species-poor, due to aspects of historic management and have most likely replaced M15 and M16 wet heath and M17 and M18 mire communities. Where these communities occur on deep peat, the habitat should be treated as a degraded form of mire rather than as heathland. Similarly, any M15 or M16 wet heath occurring on deep peat (greater than 30 cm in depth) should also be considered as either degraded fen or bog. In a definition of favourable conservation status, which seeks to define thriving habitat, it is not justifiable to classify the habitat purely by its surface vegetation. See also the definition of favourable conservation status for blanket bog.

From a wider European perspective, all heathland within England falls within the scope of four habitats listed on Annex I of the EU Habitats Directive as being important to conserve across Europe. Most heathland falls within the Annex I types European dry heaths (H4030) and Northern Atlantic wet heaths with *Erica tetralix* (H4010). The Cornish heaths on the Lizard Peninsula include all areas of the Dry Atlantic coastal heaths with *Erica vagans* type (H4040) in Britain, whilst the Temperate Atlantic wet heaths with *Erica ciliaris* and *Erica tetralix* type (H4020) is a rare habitat in Britain occurring only in Cornwall, the Somerset/Devon border and Dorset. The Lowland and Upland Heathland priority habitats contain both H4010 and H4030 whereas H4020 and H4040 are included only in the priority habitat Lowland Heathland.

Heathland is categorised as the F4.1 Wet Heath and F4.2 Dry Heath types of the European Nature Information System (EUNIS) habitat classification (see Table 2). However, these F4.1 and F4.2 types also include the maritime heathlands.

Table 2 The relationships between EUNIS heaths, those listed on Annex I of the EU Habitats Directive, the UK Phase 1 habitat survey classification and heath types identified in the NVC.

EUNIS habitat classification code and name (European Commission and others 2016)	EU Habitats Directive code & name	UK Phase 1 habitat code & name (JNCC 2010)	UK NVC vegetation community code (Rodwell 1991)	UK Section 41 Habitat of Principal Importance
F4.2 Dry heaths	H4030 European dry heaths	D1.1 Dry dwarf shrub heath - acid	H1-4, H8-10, H12, H16, H18, H21	Upland heathland & Lowland heathland
F4.2 Dry heaths	H4030 European dry heaths	D5 Dry heath/acid grassland mosaic	H1-H4, H8-10, H12, H16, H18, H21 / U1-U4	Upland heathland & Lowland heathland

EUNIS habitat classification code and name (European Commission and others 2016)	EU Habitats Directive code & name	UK Phase 1 habitat code & name (JNCC 2010)	UK NVC vegetation community code (Rodwell 1991)	UK Section 41 Habitat of Principal Importance
		D1.2 Dry dwarf shrub heath - basic	H2, H8 / CG2, CG7, CG9	Upland heathland & Lowland heathland
		D3 Lichen/bryophyte heath	H1 / U1a, CG7c	Lowland heathland
	H4040 Dry Atlantic coastal heaths with Erica vagans	D1.2 Dry dwarf shrub heath - basic	H6	Lowland heathland
	H2330 Inland dunes with open *Corynephorus* & *Agrostis* grasslands	H6.6 Dune heath (inland locations)	H11	Lowland heathland
F4.1 Wet heaths	H4010 Northern Atlantic wet heath with Erica tetralix	D2 Wet dwarf shrub heath	H5, M15-16	Upland heathland & Lowland heathland
		D6 Wet heath/acid grassland mosaic	M16, M24-25	Upland heathland & Lowland heathland
	H4020 Temperate Atlantic wet heaths with *Erica ciliaris* & *E. tetralix*	D2 Wet dwarf shrub heath	H3-H4, M16 with Erica ciliaris	Lowland heathland

1.2 Habitat status

European red list of habitats

F4.1 Wet heaths and F4.2 Dry heaths have been assessed as IUCN Vulnerable (Janssen and others 2016).

EU Habitats Directive

All heathland covered by this definition falls within the scope of the four habitat types listed on Annex I of the EU Habitats Directive (H4010, H4020, H4030 or H4040). This confers them status as a habitat of European nature conservation significance.

The fourth UK Habitats Directive Report (JNCC 2019) concluded that the overall conservation status and trend for H4010 Northern Atlantic wet heath with *Erica tetralix* was Bad-deteriorating, it was Bad-improving for H4020 Temperate Atlantic wet heaths with *Erica ciliaris* & *E. tetralix* and H4030 European dry heaths. H4040 Dry Atlantic coastal heaths with *Erica vagans* was Favourable-stable.

Natural Environment and Rural Communities (NERC) Act 2006

Lowland Heathland and Upland Heathland are listed as Habitats of Principal Importance for the conservation and enhancement of biodiversity in England.

1.3 Ecosystem context

British heathland forms part of the Atlantic heathland of mild, humid, western coastal Europe. This is a geographically restricted class of vegetation, with apparently similar types in other continents having little floristic affinity with those in Britain and Ireland. British heathlands are unusual as the country's (hyper)oceanic climate fosters sweeping landscape-scale transitions from dry heath, through wet heath to mire. As in England, Atlantic heathlands on the European mainland have contracted rapidly in range through the same kinds of land-use change (Janssen and others 2016; Fagúndez 2013).

According to the latest figures (JNCC 2019), the UK has about 40% of the heathlands in Europe, England has about 20% of all heathland within the UK and so some 8% of the European total.

In contrast to the homogenous landscapes produced at a local scale by modern farming, heathlands are heterogenous not least because many of the natural environmental gradients such as nutrient availability, base-status and hydrology, that create a diversity of conditions and hence niches, have remained relatively unmodified (Mainstone and others 2018).

Heathland is usually a landscape-scale ecosystem that occurs in association with other habitats. The occurrence of habitat mosaics at all spatial scales is important in providing niches for different stages in the life cycles of characteristic, rare and specialised species.

The presence and numbers of these characteristic species are also important indicators of habitat quality. The interaction with surrounding habitats, for example the 'moorland fringe' including adjacent inbye land or pastures managed at low intensity in the lowlands, is also of importance for many species (Milsom and others 2003; Sharps and others 2015; Silva-Monteiro and others 2021).

Dry heath in the uplands generally occurs in two contexts. The first is on slopes too steep to support or maintain peat, such as on the sides of incised streams or in areas with exposed bedrock. Such situations are widespread and common in the uplands but are often very limited in extent so that they tend not to appear on England-scale habitat maps. The Lake District is an exception, its steep, mountainous terrain permitting a fuller expression of dry heath than on other, more gently contoured English upland massifs. The second context for dry heath is in the rain-shadow of our major uplands, where lower rainfall permits the formation of dry and humid heaths on shallower slopes than would be the case in the west. Thus, there are clusters of humid/dry heath on the Shropshire Hills (rain shadow of Wales), Quantocks (rain shadow of Exmoor), and on the eastern flanks of the Lake District, South Cumbria, the Dark Peak, the North Yorkshire Moors, the Cheviot Hills and, especially, Dartmoor.

Wet heaths occur widely in both the uplands and lowlands because of Britain's cool and wet climate. If drainage is impeded and the water table is consistently high, the conditions occur that lead to the accumulation of peat, creating mires and bogs.

Wet heath is an important habitat for a range of vascular plants and bryophytes with an oceanic or Atlantic distribution in Europe, several of which have an important part of their European and world distribution in the UK (JNCC 2023). The majority (69%) of H4010 Northern Atlantic wet heath with *Erica tetralix* in the European Atlantic biogeographic region is found in the UK (Eionet 2023). Wet heath is widespread in lowland England with large areas in Dorset, the New Forest, the Thames Basin, Cornish lowlands and western England. In the uplands it often fringes mires, both ombrotrophic (rain-fed) - raised and blanket bogs - and minerotrophic (ground or surface water fed) - valley fens/bogs. It is particularly characteristic of the shallower peat fringes of blanket bog in the north and west (for example, Averis 2004) and the drier, upslope parts of mire systems in valley bogs in the south of England (for example, Rose 1953).

Heathland forms transitions to other habitats of European importance including:

- H1220 Perennial vegetation of stony banks
- H1230 Vegetated sea cliffs of the Atlantic and Baltic coasts
- H2140 Decalcified fixed dunes with *Empetrum nigrum*
- H2150 Atlantic decalcified fixed dunes (*Calluno-Ulicetea*)
- H4060 Alpine and Boreal heaths
- H5130 *Juniperus communis* formations on heaths or calcareous grasslands
- H6130 Calaminarian grasslands of the *Violetalia calaminariae*
- H6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*)

- H6410 *Molinia* meadows
- H7130 Blanket bogs
- H7140 Transition mires and quaking bogs
- H7150 Depressions on peat substrates of the *Rhynchosporion*
- H7230 Alkaline fens
- 8240 Limestone pavements
- 91A0 Old sessile oak woods with Ilex and Blechnum in the British Isles
- Various open waters

Other sources: Polunin & Walters 1985; Rodwell 1991.

2. Units and attributes

2.1 Natural range and distribution

National Character Areas (NCAs)

Heathland is an ancient landscape, and its characteristics vary from place to place. National Character Areas follow natural lines in the landscape and are areas that share similar landscape characteristics. They therefore form a good reflection of the relevant geographic variation in heathlands across the country.

2.2 Extent

Hectare.

2.3 Structure and function attributes

Good quality heathland should demonstrate natural ecosystem function and should be resilient, able to recover following natural or anthropogenic damage and support complex food webs and nutrient cycling. All constituent and associated species should be thriving, and none should be GB IUCN Threatened or Near Threatened.

The following attributes are used to describe heathland quality. Ultimately, the structural attributes exhibited by an individual site or location will be determined by the functional attributes of that site.

Function attributes

- Hydrological function. This determines the extent and quality of humid and wet heaths and associated mires.
- Water chemistry and water nutrient status. These are important determinants of the quality of humid and wet heaths and of mires within the wider heathland landscape.
- Soil characteristics. Heathlands are present on naturally acidic and nutrient poor soils and can hold rich carbon stocks, for example in shallow peats. Any changes in these characteristics can have negative impacts.
- Air quality characteristics. Higher concentrations and deposition of air pollutants, in particular atmospheric deposition of nitrogen, can result in undesired vegetation changes.
- Vegetation management. Heathlands are open habitats, maintained by moderate grazing, browsing and cutting. However, where management is too intense this can cause detrimental changes in the vegetation.

Structure attributes

- Species composition. Characteristic species, reflecting the local natural environment and function attributes. Absence of invasive non-native species (INNS).

- Vegetation structure. A diversity of vegetation structure is important for many species. Some plants need bare ground or very short vegetation to germinate; invertebrates and reptiles that need to thermoregulate their body temperature require both open and dense vegetation patches. Some bird and mammal species need old growth heather for shelter and nesting.

- Transitions to, and mosaics with, other habitats. A mosaic of habitats that provides a series of transitional zones between different vegetation communities is important for many species.

- Connectivity. By connecting heathland to other habitats, or other areas of heathland, it may be possible to improve the conditions for characteristic species, particularly those that depend on a mosaic of habitats or are currently at threat of extinction through occurring in small, isolated heathland patches.

- Bare ground. Many heathland species, notably many invertebrates, are associated with bare, sparsely vegetated or disturbed ground. Such areas are essential for nesting (for example, both solitary and colonial Hymenoptera and their associates), hunting and basking. Bare peat, for example from occasional waterlogging, can also be beneficial for some species such as marsh clubmoss. However extensive areas of bare peat and mineral soils may also indicate damage to heathland.

Sources: Thomas and others 2015; Mortimer and others 2000; Mainstone and others 2018.

3. Evidence

All blocks of evidence are assigned one of three confidence levels (High, Moderate, Low), based on the quality of the evidence, its applicability and the level of agreement.

The matrix in Figure 1 is used to assess the confidence level assigned to blocks of evidence. White = High confidence; Light blue = Moderate confidence and Dark blue = Low confidence.

Limited evidence Strong agreement	Medium evidence Strong agreement	Robust evidence Strong agreement
Limited evidence Medium agreement	Medium evidence Medium agreement	Robust evidence Medium agreement
Limited evidence Weak agreement	Medium evidence Weak agreement	Robust evidence Weak agreement

Figure 1 Matrix used to assign confidence to blocks of evidence (after IPCC 2010).

Quality of evidence is defined as follows:

Robust evidence is that which has been reported in peer-reviewed literature, or other reputable literature, from well-designed experiments, surveys or inventories that shows signs of being applicable generally.

Medium evidence is that reported from well-designed experiments, surveys or inventories but from only one or a small number of sites, with uncertainty over its more general applicability, or is correlational or circumstantial evidence.

Limited evidence includes ‘expert opinion’, based on knowledge of ecological factors that plausibly suggest an effect, but there is no circumstantial or direct evidence available.

Agreement is defined as follows:

Strong agreement is consensus across the literature and amongst those with expertise on the habitat or species.

Medium agreement is common consensus across the literature and amongst experts but there are some differing papers or reports and/or some differences of opinion.

Weak agreement is little consensus across the literature and amongst experts and, possibly, many different findings and/or opinions.

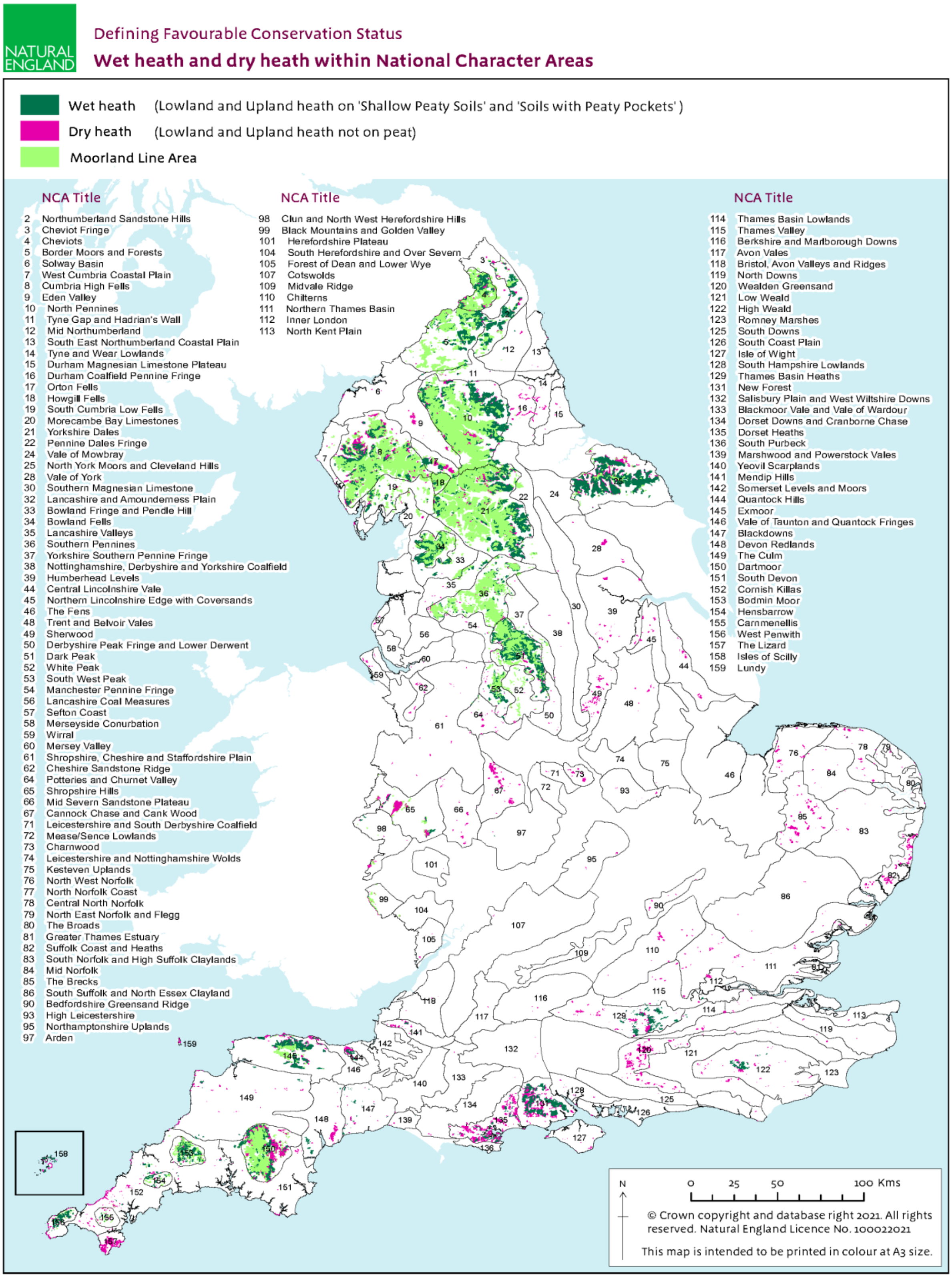
3.1 Current situation

Natural range and distribution

At least 1 ha of Lowland and/or Upland Heathland (as identified on the Priority Habitats Inventory (PHI)) is found within 119 out of a total of 159 English NCAs, 75% of the total (Natural England 2024).

A comparison of the lowland heathland and upland heathland identified on the PHI with the areas of shallow peat and peaty pockets (as a proxy to represent wet heath, peat does not form in dry conditions) identified on the England Peat Status Greenhouse Gas and Carbon Storage Map (EPSGGCSM, Natural England 2010), indicates that wet heath occurs within 59 NCAs and dry heath (not located on peat) within 115 NCAs. Note that some places with dry heath vegetation occur where historic and recent land use (for example drainage, abstraction, peat cutting, burning or heavy grazing) has led to the loss of the original wetter conditions. In the absence of those environmental 'pressures', natural conditions would result in different vegetation, in some places wet heath, but in others it would be blanket bog vegetation or some other type of mire. This shift from the naturally occurring conditions has implications not only for the characteristic plants and animals, but also for various aspects of natural capital values, such as carbon storage and water retention. Equally, some heaths mapped on free-draining soils support humid heaths with very shallow organic soils, and that wet heath can also occur in the absence of peat. The Peat Status Map was largely based on the National Soils Map from Cranfield University and the Superficial Geology data from the British Geological Survey. It incorporated data on peat depth from a range of sources including academic and soil survey publications and Natural England's own survey data. Note that it identifies shallow peat as that less than 40 cm (as opposed to 30 cm used in this definition and elsewhere). As it, therefore, includes some areas that would now be classified as blanket bog it is likely to overstate the extent (but not the overall distribution) of wet heath. A definitive peatland map for England is currently in production which will provide an opportunity to address this issue and review our estimate of heathland extent.

Confidence: High



Map 1 Distribution of wet heath and dry heath in National Character Areas Mapping derived from 1:50,000 scale BGS digital data (Licence 2006/072, British Geological Survey © NERC). National Soils map © Cranfield University (NSRI) 2008/09 BAP Habitat mapping (from OS derived data).

Extent

Data from the PHI, in combination with that from the EPSGGCSM, indicates that there is currently 282,284 ha of heathland in England (Natural England 2024). This figure excludes 55,600 ha of ‘restorable bog’ - heather on peat greater than 40 cm deep, previously mapped as upland heathland. It does, however, include heathland on peat greater than 30 cm deep that would now be classified as blanket bog, so the actual area of heathland will be less than the quoted figure. Heath-type vegetation on deep peat (greater than 30 cm deep), is included in other definitions of favourable conservation status. There may be some changes in area when a more accurate deep peat map is produced. Note also that a small area of the priority habitat mapping for lowland heathland will include maritime heathland. The area of wet heath has been estimated as heath on shallow peat, although it is not restricted to shallow peat and can occur on freely draining soils, where these are wet enough.

Of the total area of heathland, 161,459 ha or 57% constitutes wet heath on shallow peat and peat pockets (Table 3 and Figure 2). Whilst most wet heath (approximately 89%) occurs in the uplands, at least one third of lowland heathland is also wet heath. The remaining area, 120,825 ha, comprises dry heath not found on peat soils.

Table 3 Extent of heathland from Priority Habitats Inventory and England peat status greenhouse gas and carbon storage map.

Current heathland habitat type	Soil type (from peat map)	Previous heathland habitat type	Area (ha)
Wet heath	Shallow peat, Soils with peaty pockets	Upland heathland	144,786
		Lowland heathland	16,673
Dry heath	Mineral soils	Upland heathland	88,132
		Lowland heathland	32,693
Total			**282,284**

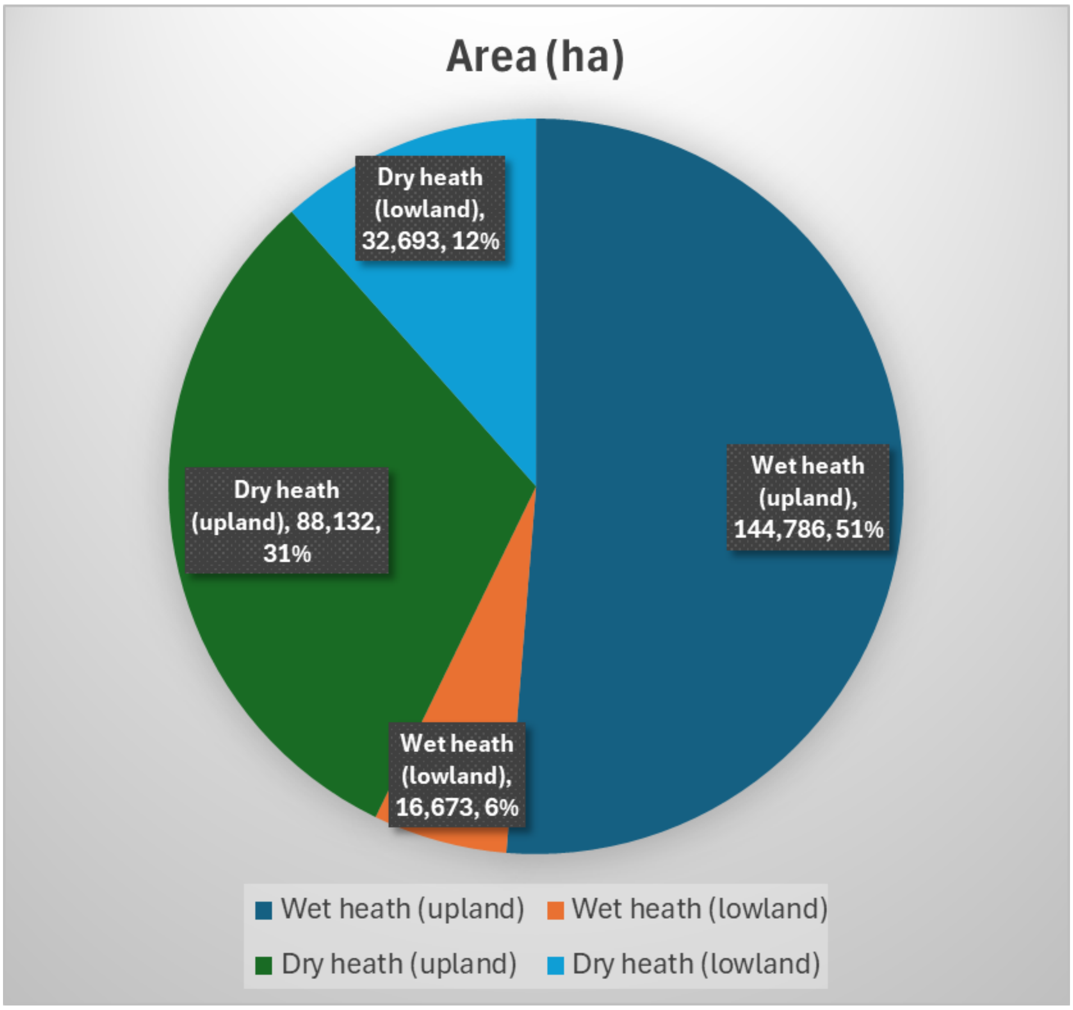


Figure 2 Proportion of different heath types as identified by the Priority Habitats Inventory and England peat status greenhouse gas and carbon storage map.

Confidence: Moderate

Patch size and connectivity

Heathland patches have contracted in size and become fragmented over time, with patches now separated by intensive agriculture, forestry and built development. Loss and fragmentation are more pronounced in the lowlands, with estimated losses of up to 80% of heathland and severe fragmentation of that remaining (Farrell 1993; Rose and others 2000). A fragmentation analysis by Natural England in 2017, using lowland heathland data within the PHI, estimated that more than 30% of the lowland heathland area comprised fragments which were both smaller than 30 ha and relatively remote (more than 500 m) from associated semi-natural habitats (acid grasslands, lowland fen, purple moor-grass pasture, upland heath, lowland raised bog, coastal habitats) (Natural England 2024). Fragmentation of habitat can result in small populations of species which are below minimum viable size and therefore subject to high rates of local or even national extinction over time. Small patches also have higher edge to area ratio and are therefore likely to suffer “edge effects” such as nutrient drift, invasive species, fly tipping etc.

Patch size tends to be large for upland heathland and it generally forms extensive areas of habitat in association with blanket bog. However, although upland heathland occurs in extensive areas, fragmentation in the uplands also occurs.

Confidence: High

Quality of habitat patches

The PHI indicates that approximately 78% of lowland heathland and 72% of upland heathland is currently within Sites of Special Scientific Interest (SSSI) (Natural England 2024).

Relevant structure attributes are periodically monitored on protected sites through Common Standards Monitoring (CSM): extent, bare ground, vegetation structure, vegetation composition (including positive and negative indicators). In contrast, most functional attributes, including hydrology, water quality, air quality and connectivity, are not currently monitored. In October 2022, Natural England's Designated Sites View showed that 45% of lowland dwarf shrub heath and 11% of upland dwarf shrub heath in SSSIs was classed as in favourable condition, and 46% of lowland and 80% of upland dwarf shrub heath was classed as being in an unfavourable but recovering condition.

In a project specifically geared to establishing a measure of upland heathland quality in England, Critchley (2011) found none of a random sample of 99 study sites to be in favourable condition as assessed by CSM (JNCC 2009); the study encompassed both wet and dry heaths and designated and non-designated sites. The difference between this figure and that cited in the preceding paragraph is due to the methodology used, the latter not taking account of management interventions and only having the option of assigning pass or fail against every attribute.

Critchley drew attention to the following structural attributes which were found to be commonly failing:

- Low variety and cover of higher and lower plants indicative of high habitat quality ('axiophytes') for both dry and wet upland heath.
- Poor heather age-class diversity with underrepresentation of late-mature/degenerate heather (dry heath).
- Excessive grassiness and cover of species of enriched soils (wet heath).

Confidence in these data is good, and the results support the notion that a fundamental and characteristic structural and functional element of wet heath, *Sphagnum* spp. have been functionally eliminated in most areas. The poor condition was largely to do with burning and grazing pressures (Critchley 2011).

Condition of lowland heathland sites was found to be better within than outside SSSIs (Hewins and others 2007; Alonso & Hewins 2017). However, all sites were unfavourable, failing at least one attribute target. In particular, the lack of bare ground and structural diversity was marked. Grazed sites appeared better, with grazing having a positive impact on diversity of dwarf shrubs, positive indicator species and tree/scrub cover.

Acidity critical loads were exceeded for 82% of the area of dwarf shrub heath in England over the period 2018-2020 and nutrient nitrogen critical loads were exceeded for 98.5% of heath over the same period. For the UK as a whole, in the period 2017-2019, 19.1% of the area of dwarf shrub heath exceeded the ammonia critical level to protect lichens and bryophytes and 0.9% exceeded the critical level to protect vascular plants (Rowe and others 2022).

Confidence: Moderate

Threatened species

Heathland supports a highly specialised flora and fauna, including many threatened species and other species of conservation importance.

The presence and numbers of these species are important indicators of good habitat quality. Most of them require diversity of structural features including bare ground on mineral soils, mosaics of short and tall vegetation, patches of flowers and tall herbs, trees and scrub, and other features such as temporary water bodies. To ensure thriving populations, heathlands require dynamic processes to sustain a large number and variety of habitat niches (Webb and others 2010).

Some of the species require transitions to, or close association with, other habitats. For example, the potter flower bee *Anthophora retusa* (Endangered, Falk 1991) uses sandy banks to nest, but nectars on ground ivy *Glechoma hederacea* – a plant not found within typical heathland vegetation but characteristic of heathland edges. Twite (assessed as GB IUCN Endangered) nest on moorland edges, usually under small patches of bracken or in tall heather, but feed on small seeds from hay meadows close to the edge of heathland (Brown and others 1995). Black grouse (GB IUCN Vulnerable) typically use the transition between scrub/woodland and more open heathland but also adjacent wet pastures and hay meadows for feeding (Starling-Westerberg 2001). Roos and others (2016) show how chicks in particular need wetter, taller, more *Sphagnum*-rich vegetation.

The following paragraphs identify some of those threatened species. Red list status assessments using IUCN criteria are indicated in brackets.

Plants and lichens

Many characteristic species including *Calluna vulgaris*, *Erica* spp., and *Drosera rotundifolia* are now Near Threatened in England. The Botanical Society of Britain and Ireland has created a list of positive indicators for various habitats (Trippier and others 2022). Using heath, bog and acid grassland broad habitats to represent the wider heathland mosaic, over half of all the characteristic vascular plants are on the England Vascular Plant Red List, and 40 of those are also on the GB Vascular Plant Red List (Dines and others 2005; Stroh and others 2014). See Appendix 2 for the complete list.

The bryophytes assemblage occurring on heathland is not as diverse as that occurring in some other habitats, but notable species include *Riccia bifurca*, a Nationally Rare liverwort, and assessed as Endangered in the 2023 bryophytes Red List for Britain

(Callaghan 2023). It is confined to the Lizard peninsula in Cornwall where it occurs in damp or wet hollows in heathland, on damp slopes and on tracks across heathland and clifftops. Reduced use of heathland tracks has led to declines in populations, caused by the encroachment of taller vascular plants including gorse (Blockeel and others 2014). *Dicranum spurium* is a Nationally Scarce moss that occurs in heathland, usually where there is some shelter and often in the transition zone between wet and dry heath. Populations in England have declined more than those in Scotland. Factors responsible for this decline are considered to include heathland fires, invasion of heaths by woody species, overgrazing, nitrogen deposition, ammonia pollution and drainage (Porley 2013).

Terricolous lichens are a distinctive component of heathlands characterised by the genus *Cladonia* with other characteristic species from, for example, *Cetraria* and *Pycnathelia*. Rich and diverse assemblages are found on high-quality heaths in good condition where grazing or burning maintain open areas with well-lit conditions on the ground. *Cladonia peziziformis* is a Critically Endangered lichen of mildly-enriched heathland which, as a pioneer species, requires disturbance from heavy grazing to maintain open conditions and prevent its exclusion. The Near Threatened *Cladonia phyllophora* is a species of montane heathland and high-quality lowland heathland.

Birds

Many of the breeding bird species commonly associated with heathland and the wider heath mosaic are identified as threatened in the second IUCN Red List assessment for Great Britain (Stanbury and others 2021) including: black grouse (Vulnerable), curlew (Endangered), hen harrier (Endangered), merlin (Endangered), nightingale (Vulnerable), pied flycatcher (Near Threatened), redshank (Vulnerable), ring ouzel (Near Threatened), short-eared owl (Endangered), snipe (Vulnerable), stone-curlew (Vulnerable), twite (Endangered), wheatear (Endangered) and whinchat (Near Threatened).

Reptiles and amphibians

Sand lizard *Lacerta agilis* (Endangered), smooth snake *Coronella austriaca* (Endangered); Natterjack toad *Epidalea calamita* (Endangered) and adder *Vipera berus* (Vulnerable in England) are all closely associated with heathland.

Invertebrate assemblages

Heathlands are extremely important habitats for specialised invertebrates, but their value can be enhanced where they form habitat mosaics and transitions with other semi-natural habitats. The Pantheon database (Heaver and others 2017; Webb and others 2018) classifies invertebrate assemblages in England. It recognises a large suite of 440 species reliant on dry, hot soil conditions, typically found on bare ground in early successional habitats. This is the ‘Specific Assemblage Type’ F111: ‘Bare sand and chalk’, which is well represented on (but not exclusive to) heathland. It comprises around 30% beetles, 20% bees, wasps and ants, and more than 10% each of true flies and spiders; the remaining 20% includes true bugs, butterflies and moths, molluscs and grasshoppers and crickets.

The other principal Specific Assemblage Type found on heathland is F003: ‘Scrub heath and moorland’ (Webb and others 2018). It is characteristic of nutrient-poor, acid soils where herbaceous or dwarf shrub vegetation is dominant, although trees and taller shrubs can be an important component of the overall habitat. It occurs on both damp and dry soils and is widespread in the uplands. F003 also has a large suite of 344 species, comprising around 30% beetles, 15% each of spiders, butterflies and moths, and true flies; the remaining 20% includes true bugs and bees, wasps and ants.

The F111 and F003 assemblages can occur together in a habitat mosaic. They may be monitored as features of those SSSI containing heathland, where targets for species richness act as thresholds for favourable condition. The F003 ‘scrub heath and moorland’ component may persist when grazing and active management of lowland heath are discontinued, leading to the disappearance of the early successional F111 assemblage.

While the above Specific Assemblage Types of invertebrates are linked to particular biophysical gradients, invertebrates also depend on structural components of the habitat, known as ‘surfaces’ (Appendix 13, JNCC 2008). Surfaces on dry heath are bare ground; cover of lichens and bryophytes; very short grass or pioneer heather; taller grass or building phase heather; tussocky grasses, sparse bracken and mature heather; young scrub to 2.5 m; and mature scrub and trees above 2.5 m. Other, fine scale, ‘preferred features’ for invertebrates on dry heath include paths and tracks with mild erosion; scrub margins; flowery areas, including those on adjacent habitat; vertical erosion ‘clifflets’; glades in scrub and heathy woodland; sand pits and turf cuttings; isolated small trees; and areas of rabbit warren, scrapes and burrows (Appendix 13, JNCC 2008). The structural surfaces of wet heath are: Early successional, including peats and lichen and bryophyte cover; short ‘grass’ swards; ericaceous shrub layer; medium shrub layer (for example, gorse, bog myrtle); taller scrub (for example, sallows); and mature scrub and trees.

The ‘preferred features’ of wet heath include scrub margins; pools and their margins; areas of bare wet peat or sand; concentrations of cross-leaved heath *Erica tetralix*; Sphagnum tussocks, lawns and sumps; transitions to dry heath; and flowery areas, including those on adjacent habitat.

3.2 Historical variation in the above parameters

Heathlands are a natural component of temperate ecosystems with interactions between species formed over millions of years by abiotic factors such as climate and soil conditions (for example soil acidity, low nutrient status and waterlogged conditions). These conditions along with grazing by large herbivores have arrested succession to woodland to maintain the open dwarf shrub community.

The extent of heathland in prehistoric times has been much debated. Current thinking suggests that natural assemblages of free-roaming grazing animals in prehistoric landscapes sufficiently influenced vegetation structure to enable the formation of areas of open habitat, including heathland (Wallis De Vries, Bakker & Van Wieren 1998; Vera

2000). The peat archive demonstrates that the development of heathland is a natural process that pre-dates human activity (Barton and others 1995; Birks 1972; Tallis 1964).

Heathland today has been heavily modified by intensive human exploitation for both farming and industry from about 6,000 years ago. All sorts of materials were extracted (Howkins 1997) including sand, gravel, taking of turf or peat for fuel (turbary) and taking trees, firewood or bracken (estovers), as well as providing grazing for livestock. This has influenced the amount, composition and distribution of this habitat. Heathlands reached their maximum extent in the Neolithic when they replaced cleared forests on suitable soils throughout Britain (Godwin 1975).

Rotherham (2008) has noted that in the early medieval period, more peat was removed from the South Pennines than from the entire Norfolk Broads and this scale of exploitation may well have been more widespread. Where wet heathland occurred on shallow peat, this widespread exploitation of peat and turf, and the consequential drainage and shrinkage of the peat mass to a fraction of its former extent, would have variously caused the conversion of wet heath to pasture, rough grassland or, in some cases, dry heath. This has greatly modified the resource, reducing total area, changing the habitat types and fragmenting patches.

Several other factors have caused shifts from mire to heath and from heathland to grassland or arable. Draining, liming and fertilising all enabled significant increases in stock numbers and have converted large areas of heathland to grassland (Dudley 2011) so that many areas that were once heathland are now dominated by mat-grass *Nardus stricta,* bents *Agrostis* spp. or fescues *Festuca* spp. (Davies 2010; Dudley 2011). In the uplands the introduction of hardier sheep breeds in the 18th century (which allowed winter grazing), government subsidies following the Second World War for moorland drainage and European subsidies resulting in a 30% increase in the numbers of sheep between the 1970s and 1990s (Holden and others 2007) all contributed to these changes. Overgrazing in the uplands in the late 20th century, especially as offtake of relatively nutritious heather shoots in the (dormant) winter season, damaged heathland structure and function over many years, increased graminoid dominance and continued to cause losses and a decline in quality of heathlands (Crofts and others 1996). This was driven by headage payments to hill farmers - these ending in approximately 2005 (Condliffe 2009; DEFRA 2013). Even in the uplands, the replacement of heathland by grassland is already likely to have been considerable even by medieval times (Pennington 1997). Significant losses of heathland to agriculture took place from the 17th to 19th centuries and may have peaked in the 18th century during the enclosures. In the 20th century, improvements in irrigation technology led to the conversion of dry lowland heaths to arable agriculture (Farrell 1993).

Since the Second World War heathland in the lowlands has also suffered major losses and fragmentation due to urban development, mineral workings and clay extraction. Major road construction has both reduced the extent of heathland and created smaller patches which are usually harder to manage; for instance, the M3 motorway across Chobham Common.

Heathland has also been lost by the creation of golf courses (Farrell 1993). For example, 505 ha of heathland was converted to golf courses in the Suffolk Sandlings, mainly in late 1800s and early 1900s. Although golf courses may still retain some characteristic heath in the 'roughs', heavy trampling, frequent mowing and the use of fertilisers and pesticides in other areas will eliminate dwarf shrubs and specialist invertebrates and almost continuous disturbance will deter many breeding birds (Armstrong 1973).

Large losses to afforestation, in both uplands and lowlands, took place in the period approximately between 1930 and the 1980s. This resulted in at least a 20% loss of upland heathland to commercial conifer plantations in England and Wales. In the lowlands, in the period between 1900 and 1980, 11,758 ha of heathland was afforested in the Brecks alone (Thompson and others 1995; Farrell 1993; Fagúndez 2013; Diaz and others 2013). Many of the coniferous forests planted on heathlands have retained low nutrient status and a viable heathland seedbank so still support remnants of heathland and associated fauna in open areas such as forest rides and, importantly, provide a considerable area which could be made available for heathland restoration (Walker and others 2004).

From the 19th century, management favouring red deer and red grouse production to enable hunting for sport encouraged more intensive burning in the uplands. Water loss through drainage was exacerbated by burning management (Tapper 1992), intensifying from the mid-1990s as participation in driven grouse shooting increased. Different heathland species take different times to recover their pre-burn population levels and, by gearing burn frequency solely to the requirements of a single species, other species with longer recovery times, or dependent on more mature heather, become chronically compromised sometimes to the point of local extinction (Rowe 1983). Burning also leads to changes in species composition and structure of shallow peatlands including wet heath, typically with periods of graminoid and then dwarf shrub dominance (Glaves and others 2013). Use of heathland for grouse shooting, has resulted in changes in distribution and abundance of key heathland species both through habitat management and direct management of individual species - both legal and illegal - bringing about significant distortions in the relative abundance and sometimes distribution of key heathland species (Newborn & Foster 2002; Drewitt 2020).

Fire is not regarded as a natural process in the UK, these are not fire-dependent ecosystems, with a few species which show opportunistic fire-related adaptations. Frequent burning may prevent restoration of natural function (IUCN 2020) and the aspiration should be to find natural processes to replace this management. On dry heath, on mineral soils, careful burning (following the Heather and Grass Burning Code (DEFRA 2007) is a recognised management tool. Managed burning on dry heath has been used as an expedient means of maintaining open habitat, but there are other more naturalistic approaches to creating bare ground and early successional habitat. Ideally any burning will be on a long rotation and used in combination with other methods to mimic natural process eg. grazing by large herbivores. Drainage and rotational burning on wet heath is now recognised as being especially damaging to habitat function and remains a particular problem especially where this has led to the dominance of purple moor-grass at the expense of the heathland plant communities (Glaves and others 2013). Unmanaged and accidental fires are an ongoing concern, but particularly in the face of climate change and increased frequency of drought conditions which are likely to increase their frequency, extent and intensity. Uncontrolled fires may impact soils, especially where there is peat, and large fires can be hugely damaging to reptiles and amphibians as well as other species within the ecosystem. Most such burns are started by human action, either arson or accident (Glaves and others 2020).

Atmospheric acid deposition, which peaked in the early 1980s, has had a wide range of impacts on heathlands, including soil and vegetation. The major acidifying pollutant has been sulphur dioxide, emitted from fossil fuel combustion and deposited as acid rain. The impact of acidification on heathland varies, depending on the initial vegetation, soil buffering capacity and management practices. Acid deposition has been linked to major changes in vegetation including widespread loss of lichens and *Sphagnum* species (Ferguson and others 1970; Stevens and others 2020). Acidic deposition leads to a decline in soil pH, increasing the solubility of heavy metals in the soil which cause decreased plant growth, changes in plant communities, changes to soil communities and soil processes (Holden and others 2007).

Atmospheric nitrogen deposition leading to soil nutrient enrichment has been linked to shifts from dwarf shrub-dominated habitats to grass-dominated habitats, with purple moor-grass in humid and wet heaths and wavy hair-grass *Deschampsia flexuosa* in dry heaths becoming dominant, sometimes in combination with the impact of heather beetle *Lochmaea suturalis* (Heil & Aerts 1993). Higher nitrogen levels have been linked to increased damage from the native heather beetle which can result in loss of heather, particularly where purple moor-grass or other dense graminoids are abundant which may prevent regeneration from the seedbank (Gillingham and others 2016a, b), resulting in conversion of heathland to grassland or species-poor mire (Taboada and others 2016). Field and others (2014) used a coordinated approach to look at species richness and plant composition across Britain in five widespread semi-natural habitats, including both lowland and upland heathland, in sites stratified along gradients of climate and pollution. In all cases, there was reduced species richness and changed species composition associated with higher nitrogen deposition, with remarkable consistency in relative species loss across ecosystem types. Diversity of mosses, lichens, forbs and graminoids all fell with nitrogen deposition in different habitats, whilst the cover of graminoids generally increased (Field and others 2014). Most losses are likely to have happened decades ago, so current systems are poorer representations of past habitats (Byfield & Pearman 1995, Stevens and others 2006).

The abandonment of agricultural management on remaining fragments of heathland in the lowlands, combined with a reduced rabbit population due to myxomatosis, has led to a reduction in heterogeneity at small and large scales, and a consequent loss of niches for associated species. Agricultural management is often assumed to mean just grazing, but in the past it included the harvesting of wood fuel, crushed gorse for fodder and bracken for bedding or thatch. There is evidence that the remaining lowland heathlands today have less bare ground and more biomass than they did historically (prior to the 20th century) and tend to be in the more mature stages of the heather cycle. At the same time, there has been an increase of secondary woodland, bracken and gorse. This means that many species that required short vegetation and bare ground have disappeared or decreased significantly (Farrell 1993; Byfield & Pearman 1995; Rose and others 2000; Webb and others 2010; Stroh and others 2014) and communities are likely to be impoverished.

One quarter of all lowland heathlands in England are Common Land. While these have developed in the same way as other heathlands, in many cases the traditional management was discontinued decades ago due to economic and social changes.

Heathlands are popular recreational areas within England that enable the public to have a close connection with nature. However, this can lead to littering, trampling, erosion and nutrient pollution of the soil and water from dog waste (Taylor and others 2005). Dogs accessing ponds can create considerable disturbance which may affect the immature life stages of amphibians and the insecticides with which many dogs are treated are known to have a negative impact on freshwater invertebrates. Studies have shown that disturbance from humans and dogs affects characteristic breeding heathland birds, including changes in nest distribution, lower breeding densities and reduced breeding success (Underhill-Day & Liley 2007; Warren and others 2009). Disturbance and damage by dogs have been noted as one of the reasons for adder population declines in England, and there have been incidences of public hostility towards adders and other snakes due to perceived risks towards them, their children or pets (Edgar and others 2010). The use of vehicles and motorbikes on heathland can damage fragile habitats, as well as cause disturbance and erosion of tracks and paths. This is combined with indirect impacts for example, difficulties of grazing sites with high recreational use and increased unmanaged fire risk. Recreational use is a major source of ignition for unmanaged fires (Albertson and others 2010; Glaves and others 2020).

In the uplands there has been a loss of heathland mosaic around the upland fringes (Milsom and others 2003) to agricultural intensification. This has almost certainly fragmented heathland and disconnected it from other semi-natural habitats.

The trend of loss of heathland appears to be changing, as major losses to other land uses have slowed in the last few decades (driven in part by changes in livestock payments since the 1990s) and there have been some gains. Whilst some of these gains will be down to restoration under agri-environment schemes it is likely that increased accuracy of mapping is also a factor. Overall, however, recent gains have not come close to making good the significant historical losses. Data show that, whereas the trends in quantity are stable for the last 50 years for wet heaths, the quality of both habitats and the quantity of dry heath have declined in the same period (European Commission and others 2016).

Natural range and distribution

As far as is known, the range and distribution of heathland is still the same, that is, no heathland type has disappeared from any NCA, and all the relevant ecological and geographical variation is still present**.**

Confidence: Moderate

Extent

There have been significant losses of heathland throughout England, although the exact scale of these losses, particularly in the uplands, is inadequately documented. An approximation is certainly possible, however, particularly at regional scales.

Farrell (1993) reported significant regional lowland heathland losses from the 1800s to the mid-1980s, with an average loss of 80%, for six major heathland areas, largely by conversion to arable or improved grassland, afforestation, lack of appropriate management and development. There were over 145,000 ha in 1800, but since the data didn’t include significant areas of heathland such as in Sussex, Cornwall (except The Lizard), Devon, etc, it is likely that the 19th century figure was over 200,000 ha suggesting a loss of nearly 150,000 ha (75%) of heathland from lowland England. Circa 75% of rough ground in Cornwall, which almost certainly equates to the heathland mosaic in the wider sense, has been lost since about 1550 (Dudley 2011).

Based on an analysis of pollen within lake sediment cores from across upland Britain and Ireland, Stevenson & Thompson (1993) found that heather cover had declined in about 90% of sites over the last 200 years. Major losses commenced during the seventeenth to nineteenth centuries and were greatest in regions with high grazing pressures from sheep. Since the 1940s an estimated 20% of upland heathland present in England and Wales has been lost due to afforestation, agricultural reclamation, high grazing pressures and bracken *Pteridium aquilinum* expansion (Thompson and others 1995). In the Peak District, Anderson and Yalden (1981) estimated losses of 36% of heathland over the period 1913-81. A loss of 36% of upland heather between the 1940s and 1980s was also recorded in Cumbria (NCC 1990). A comparison of air photo analysis of sample areas found a decline in upland heath across England between 1947 and 1980 of 22% (NCC 1990). The average measured total losses of heather from five case studies (NCC 1990) in Somerset (one study) and Cumbria (four studies) are lower - at around 18% (range 13%-27%) - between the early 1940s and the 1980s.

Peat soils associated with acidic, nutrient-poor soils usually indicate where formerly wet heaths lay, and considerable areas now lie outwith the current limits of heathland. An analysis of the England Peat Status Map (Natural England 2010) shows that there are over 500,000 ha of land on shallow peat and peaty pockets that is not currently identified as heathland but may have the potential to be wet heath. This is nearly three times the current extent of wet heath, suggesting a loss of about two thirds of wet heath.

It is likely that much dry heath has been lost from the upland fringes through agricultural intensification and forestry.

Confidence: Moderate

Patch size and connectivity

Farrell (1993), Webb (1986) and Rose and others (2000) demonstrated that at the same time as the area of lowland heathland decreased, the size of the remaining patches also decreased, resulting in increased fragmentation and loss of connectivity leading to likely long-term loss of biodiversity.

Within the uplands, heathland may cover extensive areas and fragmentation may appear less of an issue than in the lowlands, as many heathland areas are defined by topography, being separated by valleys and lower lying areas. However, there has been a separation of these heathland areas from the surrounding wider mosaic of semi-natural habitats including heathland in the lowlands, wood pasture and mires.

Confidence: Moderate

Quality of habitat patches

The quality of heathlands has been adversely affected by activities such as drainage and burning, particularly on peat soils, overgrazing, under-grazing and air pollution, also by recreational disturbance and predator control, although the relative impact of individual factors varies across the country and has changed over time.

From a survey of sample 1 km squares, Bardgett, Marsden & Howard (1995) found that 24% of heather in England showed growth forms associated with overgrazing, neglect and other inappropriate management (damaged heather). The proportion of damaged heather varied regionally and was highest in south-west England (38%) and the West Midlands (30% - which included areas of Wales). The proportion of damaged heather was approximately 20% in north-west and north-east England and the North Yorkshire Moors. Thompson and others (1995) estimated that 50% of heather within upland heathland in England and Wales was in poor or suppressed condition liable to further reductions and damage due to overgrazing. However, the numbers of sheep and other livestock in the uplands are currently lower than was the case a few decades ago as a result of a series of UK Government and European Union policy changes and initiatives (Silcock and others 2012). These included overgrazing cross-compliance controls attached to livestock support schemes from 1992 and agri-environment schemes first introduced on moorland from 1988 and especially from 1993/94 (Condliffe 2009, 2006).

In recent years there has been some decline in the amount of sulphur deposited. There was a 4.7% reduction in the area of dwarf shrub heath exceeding acidity critical loads from the period 2009-11 to 2018-2020, and the magnitude of the exceedance declined by 28%. However, over the same time there was only a reduction of 0.4% in the area exceeding nutrient nitrogen critical loads, but the magnitude of the exceedance declined by 11%. For the UK as a whole, the area of dwarf shrub heath exceeding the ammonia critical levels increased from the period 2009-2011 to the period 2017-2019. The increase was by 28% of area for the critical level for lichens and bryophytes and the area exceeding the critical level for vascular plants nearly doubled (Rowe and others 2022).

Confidence: Moderate

3.3 The future for the habitat and its conservation

Ongoing pressures from urban development (particularly in the lowlands), afforestation and agricultural intensification continue to impact heathland through continued fragmentation and disconnection with surrounding habitats. Past damage carries a legacy into the future and climate change will likely pose a threat. The effects of past drainage on wet heaths are still felt, with the added risk that dry peats are more prone to ignition and loss in the event of a fire. Rewetting, by reversing past drainage of all habitats, but especially areas which currently appear as dry or wet heath on degraded peatland, offers huge opportunities to restore wet heath, bog and mire (England Peat Action Plan 2021), and could help offset risks from climate change, for example drought or wildfire. Recreational disturbance and illegal predator control continue to affect the conservation status of several key species. However, some of the historical pressures cited in the previous section, particularly overgrazing in the uplands and sulphur deposition have lessened significantly.

Recreational disturbance is a growing concern. There is mounting evidence of both increasing recreational access and of its impacts on heathlands.

Lowland heathland is severely fragmented (Rose and others 2000); the effects of this on isolated populations can take decades to manifest. Reconnecting the upland and lowland heathland mosaic will be very important for restoring some species losses but also allowing the movement of species in response to a range of climate change scenarios.

Reactive nitrogen deposition is now considered one of the main threats to ecosystems of high conservation value across the globe (Wallis de Vries 2017; Soons and others 2017). Virtually all English heathland exceeds critical loads for nutrient nitrogen (Rowe and others 2022; Caporn & Emmett 2010), slightly less for acidification, though both pollutants are declining. Several studies show that acidification, rather than eutrophication, is a more important factor for species loss in heathland (Roem and others 2002; Maskell and others 2010; Bobbink & Hettelingh 2011). Strandberg and others (2012) connected this phenomenon specifically to the loss of cross-leaved heath, arguably the key wet heath species. Stevens (2016) suggests that even with declining nitrogen levels vegetation recovery is likely to be slow, due to species losses and local extinctions happening decades ago, and that it may reach an alternative stable state which requires active techniques to revert to original condition.

The Climate Change Adaptation Manual (NE & RSPB 2019) assessed the sensitivity to climate change of heathland as Medium, with potential increases in recreational pressure, wildfires, drought, bracken expansion, heather beetle attack and loss of peat the flagged issues. Climate change is likely to favour the growth of grasses leading to the loss of heathland-characteristic plant species which will be detrimental for some associated animal species. Climate change may also lead to shifts in the range of species. Key species currently at the northern end of their range in England such as the smooth snake and sand lizard may extend their range as the climate becomes milder. The habitat is not expected to be lost from any NCA as a result of climate change, but a marked shift in the community composition of English heathlands is to be expected. Addressing existing pressures on heathland (such as fragmentation, isolation, management, hydrology) are likely to be key climate change adaptation responses in many cases.

Grazing management remains important to maintain the heath mosaic and prevent succession to secondary woodland. In some places this could be undermined by local opposition to grazing or its reintroduction due to the implications on recreation (dog walking) and perceived conflicts with priority species (ground-nesting birds, reptiles).

Natural range and distribution

Maintenance of the current range is required to maintain the variety of conditions that provide for the diversity associated with heathland. Some NCAs with small fragments of heath may not add much to the national resource, although their presence may be of local significance, can add to local diversity and be sites from which the habitat can expand.

Extent

An increase in the extent of heathland is required to increase patch size, reduce fragmentation and counter the impacts of the large historical losses and the continuing decline in many heathland species. An increase in area would give scope to restore natural function at a large scale and re-establish ecotones across heathlands, allowing the full range of associated species to thrive and increasing resilience to climate change (Natural England & RSPB 2019; Mainstone and others 2018). In lowland areas, the emphasis when increasing extent should aim to reduce fragmentation by increasing overall patch size and linking up the remaining fragments. In the uplands the emphasis should be around restoring the heathland mosaic.

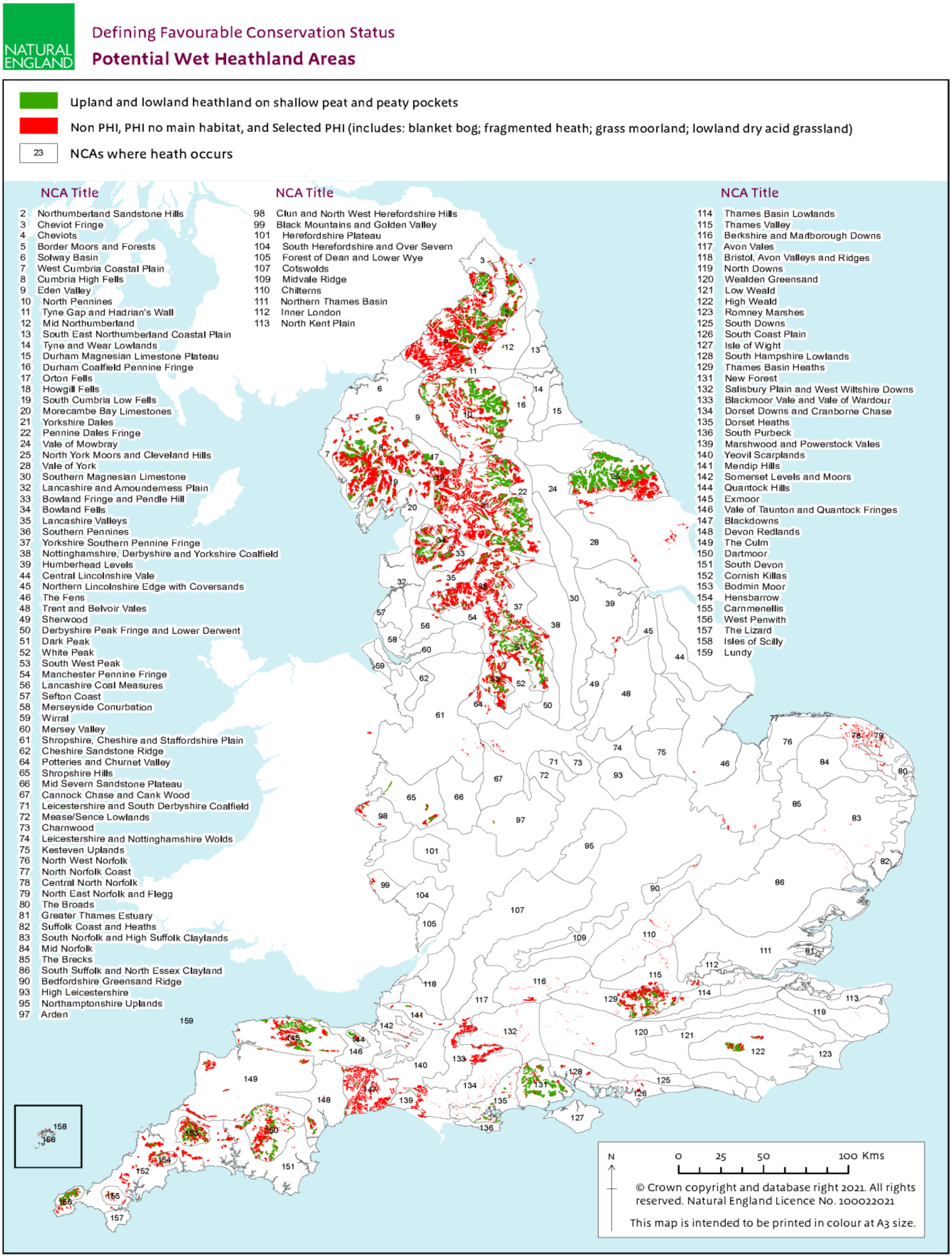
There are four possible options for determining a favourable extent:

1. The use of habitat potential mapping. Habitat Potential maps produced by UKCEH for Natural England indicate that there are 1,431,108 ha with potential to host dry acid heaths and grassland within England and 1,183,668 ha with potential for damp and wet acid heaths and grasslands. These maps are based on a number of environmental variables including climate and soil conditions. The figures include the current areas of heathland as well as areas of other habitats, for example acid grassland and oak woodland. The heathland potential area will therefore overlap with the potential areas for these other habitats. The areas identified may also include areas of built development which form an immovable constraint to the recreation of heathland. Therefore, these figures give an indication of the maximum theoretical potential for heathland extent but are best regarded as greater than a favourable extent for heathland.
2. Use of the England peat status greenhouse gas and carbon storage map to determine the potential for wet heath and increase dry heath by the same proportion. Shallow peat soils associated with acidic, nutrient-poor soils can be used to indicate the extent of former wet heath. The England peat status greenhouse gas and carbon storage map shows that there are 506,000 ha (figure

rounded) of shallow peat and soils with peaty pockets that is either fragmented heath (less than 25% cover of ericaceous shrubs), not a PHI habitat or is classified as grass moorland, lowland dry acid grassland or no main habitat on the PHI. This area has the potential to be wet heath and is over three times the existing extent of wet heath. Adding this latter figure to the current area of wet heath would give a favourable area of wet heath of 670,000 ha. Increasing the extent of dry heath by the same proportion gives a favourable area of dry heath of 210,000 ha (figure rounded up). This gives a total favourable extent of heathland of 880,000 ha which requires an increase in the extent of heathland of approximately 649,000 ha. However, this is likely to underestimate the favourable extent of dry heath as historically it would have been much easier to convert to alternative land uses than wet heath so was perhaps disproportionately impacted by losses. The potential area for dry heathland, identified under Option 1, is larger than the potential for damp and wet heaths which tends to support this possibility. The potential area for wet heath includes peat between 30 and 40 cm deep which would now be classed as blanket bog. Additionally, some of these wet peats may historically have encompassed other habitats such as wet woodland. Therefore, the figure for wet heath is an over-estimate and represents the full potential for wet heath and the full potential may not be required to ensure thriving heathland biodiversity.

3. Use of data from Natural England’s National Habitat Network Maps for lowland heathland and upland heathland (Natural England 2020), in combination with the habitat potential maps in Option 1, to provide figures for the increase in extent required to achieve functioning ecological networks. This is the figure required to create a connected network of habitat incorporating existing habitat patches. This would indicate an increase of approximately 106,000 ha in wet heath and 29,000 ha in dry heath, giving a total increase in extent of 135,000 ha. However, this mapping is based on the PHI and does not account for areas classified as heathland that should be classified as bog. The removal of deep peat from the dataset would generate a different distribution of habitat patches which would generate a different network. Therefore, these figures are only indicative of the increase needed to achieve a functioning ecological network.
4. Use of the guidance within Defining Favourable Conservation Status in England (Mousley and van Vliet 2021). This method uses a “rule-of-thumb” to derive a figure for restoring a proportion of the historical loss of the habitat. When applied to the restoration of heathland, this indicates an ambition to restore 90-100% of the historical loss (based on the current status of the habitat as Vulnerable, a high number of associated threatened species and the potential for restoration being ‘good’). Assuming an overall loss of heathland of 75% (see Section 3.2), gives an increase in extent of approximately 642,000-713,000 ha. However, the historical loss of heathland may represent a loss from an artificially high maximum as agricultural practices would, initially, have favoured heathland over other vegetation types that could potentially have occurred in these places. Therefore, this figure is likely to over-estimate the favourable extent of heathland.

None of the above options enables the identification of a favourable extent with any degree of certainty. However, Option 3 is the extent required for a functioning ecological network and is justifiable given our knowledge of historical losses and the likely negative impacts of decreased patch size and connectivity. The area expansion figures in the other options represent the full potential of the habitat, which would probably yield multiple benefits to society under a banner of restoring ecosystem services, but favourable conservation status may not require the full potential to be realised. Therefore, the increase in extent in option 3 will be used to define the favourable extent.



Map 2 Extent of shallow peat and peaty pockets within NCAs indicating potential for wet heath Mapping derived from 1:50,000 scale BGS digital data (Licence 2006/072, British Geological Survey © NERC). National Soils map © Cranfield University (NSRI) 2008/09 BAP Habitat mapping (from OS derived data).

Confidence: Low

Patch size and connectivity

De Vries (1994), Webb & Thomas (1994) suggested the minimum area of lowland heathland to be functionally viable to support its characteristic species (invertebrates in those studies) as around 30 ha. Below that size, species, particularly those with lower powers of dispersal, tend to go extinct. At the same time, generalist species from edge habitats will invade the small fragments (Webb & Hopkins 1984). The relative importance of patch size is affected by the connectivity of habitat patches, how easily species are able to move through intervening areas, as well as the mobility of species (Crick and others 2020). The impact of smaller patch size is more significant for species with poor mobility (Marini and others 2010; van Noordwijk and others 2015) but less so for generalist species or in areas with greater habitat connectivity (Gavish and others 2012; Rosch and others 2013) or heterogeneity (Hatfield & LeBuhn 2007; Öckinger and others 2012).

The 'stepping-stone' distance - the distance between unconnected areas of semi-natural habitat that allows more mobile species to move through the landscape - is estimated to be around 1 km for lowland heathland (Catchpole 2008). A number of large-scale sites comprising individually connected heathlands are needed for sustainable populations of wide-ranging species and to ensure that the full range of ecological niches for these species can be provided within the heathland landscape. An optimum size of heathland landscape (covering multiple habitats) is indicated by a size of greater than 200 ha (Heutz & Paelinckx (ed.) 2005). However, NCC (1990) stated that areas in excess of 250-300 ha are needed if the bird assemblage is to be as naturally diverse as possible.

To achieve a favourable conservation status an increase in heathland patch size to greater than 30 ha is desirable for long-term viability of the habitat together with an increase in the number of large-scale sites, comprising connected heathlands in a mosaic of other habitats. An increase in connectivity will support habitat patches less than 30 ha in size and is also likely to help the habitat to adapt to climate change. Note that patches less than 30 ha need protection in the landscape as they can still act as important refugia and sources from which to restore a wider landscape, particularly where the surrounding matrix is favourable (Baum and others 2004).

Confidence: Moderate

Quality of habitat patches

At local scale, a diverse vegetation structure, including bare ground and mosaics with other habitats, should be seen as desirable characteristics of the habitat.

H9 heaths are often the least diverse of all UK heaths and are widely regarded as a form heavily impoverished by anthropogenic activity. At least some H18 heath has been derived from burning and grazing and some may be degraded blanket bog (Shimwell 1973; Rodwell 1991; Averis and others 2004). These would be restored to another heath or heath-scrub community in the process of attaining favourable conservation status.

Similarly, when considering restoration of natural ecosystem function (Mainstone and others 2018) some species-poor acid grasslands (including the U2 *Deschampsia flexuosa,* U3 *Agrostis curtisii,* U4 *Festuca ovina-Agrostis capillaris-Galium saxatile,* U5 *Nardus stricta-Galium saxatile,* U6 *Juncus squarrosus-Festuca ovina*, and U20 *Pteridium aquilinum-Galium saxatile* communities) - many, if not all, of which are degradation products of damaging activities on more complex habitats - should be considered for restoration to other habitats including heathland.

Sources: Janssen and others (2016); Webb and others (2010).

Confidence: Moderate - High

3.4 Constraints to expansion or restoration

There are few immovable constraints to the restoration of heathland. There are significant areas with appropriate soils and landform, heathland seedbanks can remain present and viable in the soils even under some different land uses, and there is considerable experience of successful heathland restoration. However, it would not be possible to restore the full historical extent as former heathland areas within south-east England, in particular, are now under London, Bournemouth and other large towns. This large-scale built development is an immovable constraint to the restoration of the full historical extent.

It is technically feasible and possible to restore undermanaged, neglected heathland (acidic, low nutrient sites with invading scrub & bracken) by introducing appropriate management, which is likely to include a combination of hydrological restoration and scrub or bracken management along with cutting and grazing to restore age structure (Shellswell and others 2016). These interventions also have the capacity to be damaging to archaeological features and some species so clear site objectives and assessments to take account of archaeology (Hawley and others 2008) and individual species' requirements are necessary to identify the balance of management types and intensities (Offer, Edwards & Edgar 2003). For example, species like nightjar and nightingale require a scrub component in the landscape, and intense or ill-timed grazing and scrub/bracken management could harm reptile populations. In some cases, individual species may need to be re-introduced for example through seed or plug plants.

When there has been a historic change of land use, restoring the extent of heathland may be straightforward: removing the trees when restoring a conifer plantation to heathland, or stopping nutrient inputs when converting arable land (Walker and others 2004). However, restoring a favourable structure and function is likely to be more difficult, depending on the nature of the land use change. For example, restoring a first cycle conifer plantation to heathland is likely to succeed as the soil structure and nutrient composition will have changed little (Pywell and others 2002). Heather is also known to have a large, buried seedbank which can provide a potential pool of propagules for natural regeneration after ground disturbance. First rotation plantation may be restored from the soil seed bank, thereafter seed may need to be supplemented (Donath and others 2007). Similarly, there is considerable experience of restoring dry heath after mineral extraction (RSPB n.d.).

However, if the heathland was converted to arable land, with significant changes in the buried seedbank, soil structure and nutrient loads, restoration is more challenging. It can be done but it is expensive, resource intensive and has mixed results to date, particularly with higher residual fertility (Glen and others 2016; Shellswell and others 2016).

Dry heath restoration is probably better investigated and better documented. Encouraging progress was found over seven years at a site in the Peak District involving several species of dwarf-shrub. Perhaps less well understood are the implications for habitat restoration from ongoing nitrogen inputs from air pollution (Britton and others 2003; Stevens and others 2020).

Many heathland species benefit from conditions associated with early successional stages, meaning that the benefits of restoration can be seen relatively soon, though it may take longer to restore the full suite of habitats and species (Lewis 2015). Also, although initial results may be favourable, this does not always last, so repeat treatments may be required, and all restoration methods require an ongoing commitment to management.

Successful restoration of wet heath is less-well understood. Mountford and others (2005) undertook a preliminary characterisation of wet heath ecohydrology, but several studies have concluded that varying success in heathland restoration was due to the underlying biogeochemical processes being poorly understood (De Graaf and others 2009; Pywell & Bullock 2011; Baar 2010; Box and others 2011). This highlights the need above all to understand how to re-wet thin peat soils and provide conditions which allows for peat formation. In common with most habitats, where the vegetation has become dominated by a dense grass sward, it can be difficult for other species to establish, unless other measures are taken e.g. to create bare ground or add seed. Restoration of wet heath can be successful if there is sufficient water of the right quality and pH (Symes & Day 2003).

The development of heathlands with greater structural diversity and a greater extent of scrub may support fewer breeding waders but there would be gains in other groups. Mortimer and others (2000) identify two upland scrub types (northern and western upland scrub) of particular importance to breeding warblers and chats, of which three species are now birds of conservation concern (Eaton and others 2015). There would also be scope for improving the status of juniper scrub. In addition, there is the potential to benefit the extent and variety of upland oakwoods by allowing the expression of seres and progressing favourable conservation status for these two types should be intimately linked.

Other sources: Symes & Day 2003

Confidence: High

4. Conclusions

4.1 Favourable range and distribution

The presence of heathland depends mainly on soil characteristics, climatic conditions and management. The current presence and distribution of heathland in National Character Areas reflects the geographic variation desirable across the country. The current range (present in 119 NCAs) is believed to be the same as the historical range, although with a lower extent and some changes in the characteristic species. To achieve a favourable conservation status, heathland should remain represented in each of these NCAs.

4.2 Favourable extent

To achieve favourable conservation status the current extent of heathland needs to increase by 135,000 ha to 417,000 ha in order to reverse historical loss and fragmentation and to increase connectivity of patches to create a coherent and functioning ecological network.

This represents an increase in wet heath of 106,000 ha to give a favourable extent of wet heath of 267,000 ha and an increase in dry heath of 29,000 ha to give a favourable extent of dry heath of 218,000 ha. All figures are rounded.

4.3 Favourable structure and function attributes

To achieve favourable conservation status at least 95% of the favourable area of the habitat should meet the structure and function requirements described below.

Function attributes

- Hydrological function, water chemistry and water nutrient status should reflect local natural environmental conditions.
- Soils should have a low nutrient status, be undisturbed, unpolluted and their characteristics should reflect local natural environmental conditions.
- Concentrations and deposition of air pollutants are at levels that enable the ecosystem to function naturally. Sources of atmospheric pollution should be at or below the site-relevant Critical Load or habitat Critical Level values.
- Appropriate management that restores or mimics natural grazing and browsing processes will be in place and adapted as required to ensure that the other structure and function requirements are delivered, reflecting the local characteristics of each heathland.

Structure attributes

- The full suite of characteristic heathland species, reflecting the local natural environment and function attributes, are present. Development of the full range of vegetation types characteristic of the local natural environment. Invasive non-native species are either rare or absent.
- A diverse heathland vegetation structure, including a high cover of dwarf shrubs of varying ages, patches of shrubs and scrub of different age classes, areas of flowers and tall herbs acting as foodplants and some limited bare ground to create regeneration niches and supporting habitat for specialist invertebrates, vascular plants, bryophytes, lichens and fungi.
- Natural pattern of vegetation zonation, transitions and mosaics.
- Contiguous or connected areas of suitable habitats.

Patch size and connectivity

95% of the resource should occur in patches greater than 30 ha.

Threatened species

All species partially or wholly dependent on this habitat should be Least Concern, when assessed using IUCN criteria (or considered to be Least Concern if not formally assessed), as regards to this habitat.

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Appendix 1 Heathland National Vegetation Classification types (Rodwell 1991)

National Vegetation Classification community type	**Summary description**
H1 *Calluna vulgaris – Festuca ovina* heath	H1 is confined to base-poor, impoverished sandy soils in semi-continental lowlands of eastern England, for example Breckland on the Norfolk-Suffolk border. Some occurs very locally but widely in the uplands though it has rarely been specifically identified. It is generally overwhelmingly dominated by *Calluna vulgaris*, sometimes with an abundance of lichens.
H2 *Calluna vulgaris – Ulex minor* heath	Occurs on dry acid soils in the lowlands of south-east and central southern England with a less extreme temperature range and higher rainfall than H1. It is typically dominated by mixtures of *Calluna vulgaris, U. minor* and *E. cinerea*. H2c *Calluna vulgaris-Ulex minor* heath, *Molinia caerulea* sub-community is the more humid of the sub-communities with *Molinia caerulea* and *Erica tetralix* constant and frequent.
H3 *Ulex minor – Agrostis curtisii* heath	Occurs on slightly damp soils in south-east England in Dorset and the New Forest, where *U. gallii* is replaced by dwarf gorse *U. minor.* Both H3a *Ulex minor-Agrostis curtisii* heath, typical sub-community and H3 b *Ulex minor-Agrostis curtisii* heath, *Cladonia* spp. sub-community are more humid, with *Molinia caerulea* and *Erica tetralix* constant and frequent in both.
H4 *Ulex gallii – Agrostis curtisii* heath	Occurs on moist, acid soils in the mild, oceanic climate of south-west England. It is characterised by frequent *Agrostis curtisii* and *Ulex gallii*, alongside *Calluna vulgaris*, *Erica cinerea* and cross-leaved heath *E. tetralix*. The rare Dorset heath *E. ciliaris* may occur in this community and M16 wet heath. Cornish heath *E. vagans* is associated with ultrabasic serpentine rocks in this community on the Lizard.

National Vegetation Classification community type	Summary description
	H4 are generally more humid heaths, though H4c *Ulex gallii-Agrostis curtisii heath, Erica tetralix* sub-community, is the wettest sub-community with *Molinia caerulea* and *Erica tetralix* constant and frequent.
H5 *Erica vagans – Schoenus nigricans* heath	Found on wet, base-rich but calcium-poor mineral soils and shallow peats on the Lizard in Cornwall. It is characterised by constant *Erica vagans* and *Schoenus nigricans*, along with *Molinia caerulea*, and *Erica tetralix* Both H5a *Erica vagans-Schoenus nigricans* heath, typical sub-community and H5b *Erica vagans-Schoenus nigricans heath, Eleocharis multicaulis* sub-community are humid, with *Molinia caerulea* and *Erica tetralix* constant and frequent.
H6 *Erica vagans – Ulex europaeus* heath	Found on free-draining brown earths, usually base-rich but calcium-poor and fairly oligotrophic soils on the Lizard in Cornwall. Characterised by *Erica vagans* and *Ulex europaeus*, often with *Ulex gallii* and *Erica cinerea*. H6d *Erica vagans-Ulex europaeus heath, Molinia caerulea* sub-community is the humid sub-community, with *Molinia caerulea* and *Erica tetralix* constant and frequent.
H8 *Calluna vulgaris – Ulex gallii* heath	Occurs on free-draining, acid to neutral soils at low to moderate altitudes in warm oceanic parts of southern Britain, characterised by abundant *Calluna vulgaris*, *U. gallii* and *E. cinerea.*
H9 *Calluna vulgaris – Deschampsia flexuosa* heath	Occurs on acidic, impoverished soils at low to moderate elevations in the less oceanic areas of north-east England and the Midlands. These heaths are often extensive species-poor heaths with an overwhelming dominance of *Calluna* and frequent wavy hair-grass *Deschampsia flexuosa.* Often results from frequent burning and grazing combined with the impacts of heavy atmospheric pollution. H9e *Calluna vulgaris-Deschampsia flexuosa* heath, *Molinia caerulea* sub-community is most humid, with *Molinia caerulea* and *Erica tetralix* constant and frequent.

National Vegetation Classification community type	Summary description
H10 *Calluna vulgaris – Erica cinerea* heath	H10 occurs on acid to neutral, free-draining soils in the cooler oceanic climate further north, where *E. cinerea* and *Calluna vulgaris* are abundant together and *U. gallii* becomes scarce especially on more southerly-facing slopes. *E. cinerea* becomes dominant in the hyper-oceanic fringes of the north-west.
H11 *Calluna vulgaris – Carex arenaria* heath	Only locations inland. H11 is generally localised and found on stabilised, acidic sands on dunes and plains. It is generally species-poor, often dominated by *Calluna vulgaris*.
H12 *Calluna vulgaris – Vaccinium myrtillus* heath	Found on acid to neutral, free-draining mineral soils in colder, wetter climate below the montane zone, above the Moorland Line. Characterised by *Calluna vulgaris* and *Vaccinium myrtillus.*
H16 *Calluna vulgaris - Arctostaphylos uva-ursi* heath	Occurs on acid to neutral soils at moderate altitude in cold continental climate, mainly in Scotland although some is reported from the Lakes and North Pennines. Only sub-montane habitat would be included within this definition
H18 *Vaccinium myrtillus - Deschampsia flexuosa* heath	H18 is found on moist but free-draining acid to neutral soils on steeper slopes at moderate altitudes. Only sub-montane habitat would be included within this definition. Often on sheltered north facing slopes with snow-lie. At lower altitudes at least some H18 has been derived from burning and grazing and some may be degraded blanket bog.
H21 *Calluna vulgaris - Vaccinium myrtillus - Sphagnum capillifolium* heath	H21 is found on patches of humic soils on shaded north-west to east facing slopes. Mostly found in Scotland, though patches are found in English uplands. Most of this should be considered as humid heath, with frequent *Sphagnum* spp. a distinctive component
M15 *Scirpus cespitosus-Erica tetralix* wet heath and	Found on shallow, acid, nutrient-poor peats and peaty mineral soils, kept moist for much of the year and often seasonally waterlogged. They typically occur in wet depressions and seepage areas, often in hydrotopographic zonations between drier heath and valley mire (for example, Rose 1953), and at

National Vegetation Classification community type	Summary description
M16 *Erica tetralix-Sphagnum compactum* wet heath	higher altitudes on more rapidly draining slopes around blanket bog massifs. The south-west of England has a ‘damp’, oceanic heath that often intergrades from H4/H8 heaths into M15 wet heath.

Appendix 2 Vascular plants identified as positive indicators for heath, bog and acid grassland broad habitats

Derived from BSBI Botanical Heatmapping species lists (Trippier and others 2022), with red list status from England and GB Vascular Plant Red Lists (Dines and others 2005; Stroh and others 2014). CR Critically Endangered, EN Endangered, VU Vulnerable, NT Near Threatened, LC Least concern, DD Data deficient.

Taxa	GB red list status	England red list status
Ajuga pyramidalis	VU	CR
Alchemilla glomerulans	VU	EN
Andromeda polifolia	LC	NT
Antennaria dioica	LC	VU
Arabis glabra	EN	EN
Arctostaphylos uva-ursi	LC	NT
Artemisia campestris	VU	EN
Betula nana	LC	CR
Calluna vulgaris	LC	NT
Carex echinata	LC	NT
Carex limosa	LC	EN
Carex magellanica	LC	NT
Carex pauciflora	LC	NT
Centaurium scilloides	EN	EN
Cerastium arvense	LC	NT
Chamaemelum nobile	VU	VU
Cicendia filiformis	VU	VU
Cornus suecica	NT	NT
Cryptogramma crispa	LC	VU
Cuscuta epithymum	VU	VU
Deschampsia setacea	LC	VU
Diphasiastrum complanatum	NT	CR
Drosera anglica	NT	EN
Drosera intermedia	LC	VU
Drosera rotundifolia	LC	NT
Erica cinerea	LC	NT
Erica tetralix	LC	NT
Erica vagans	LC	NT
Eriophorum angustifolium	LC	VU
Euphrasia anglica	EN	EN
Euphrasia confusa	DD	VU
Euphrasia micrantha	DD	EN
Euphrasia nemorosa	LC	NT
Euphrasia tetraquetra	LC	NT
Euphrasia vigursii	EN	EN
Genista anglica	NT	VU

Genista pilosa	NT	NT
Gentiana pneumonanthe	LC	NT
Gladiolus illyricus	LC	NT
Gnaphalium sylvaticum	EN	EN
Hypochaeris glabra	VU	VU
Jasione montana	LC	VU
Juncus capitatus	VU	EN
Juniperus communis	LC	NT
Lathyrus linifolius	LC	NT
Lobelia urens	VU	VU
Lotus angustissimus	NT	NT
Lycopodiella inundata	EN	EN
Lycopodium annotinum	LC	VU
Lycopodium clavatum	LC	VU
Medicago minima	VU	VU
Moenchia erecta	LC	VU
Myrica gale	LC	NT
Nardus stricta	LC	NT
Ophioglossum lusitanicum	VU	VU
Orobanche rapum-genistae	NT	VU
Orthilia secunda	LC	NT
Pedicularis sylvatica	LC	VU
Petrorhagia prolifera	EN	EN
Pinguicula vulgaris	LC	VU
Platanthera bifolia	VU	EN
Polygala serpyllifolia	LC	NT
Potentilla argentea	NT	NT
Potentilla erecta	LC	NT
Pseudorchis albida	VU	VU
Pulicaria vulgaris	VU	VU
Pyrola media	VU	EN
Radiola linoides	NT	VU
Rhynchospora alba	LC	NT
Sagina subulata	LC	NT
Salix repens	LC	NT
Scleranthus annuus	EN	EN
Scleranthus perennis	EN	EN
Silene conica	VU	EN
Silene otites	EN	EN
Solidago virgaurea	LC	NT
Teesdalia nudicaulis	NT	NT
Utricularia minor	LC	VU
Veronica verna	EN	EN
Viola canina	NT	VU
Viola lactea	VU	EN
Viola lutea	LC	NT
Viola tricolor	NT	NT

About Natural England

Natural England is here to secure a healthy natural environment for people to enjoy, where wildlife is protected and England's traditional landscapes are safeguarded for future generations.

Further Information

This report can be downloaded from the Natural England Access to Evidence Catalogue. For information on Natural England publications or if you require an alternative format, please contact the Natural England Enquiry Service on 0300 060 3900 or email enquiries@naturalengland.org.uk.

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