ENGLISH NATURE

Assessing vegetation condition in the English uplands

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Assessing Vegetation Condition in the English Uplands

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Summary

- This report presents the results of a two year project commissioned by English Nature's Uplands Team to develop a rapid and repeatable method for assessing the condition of semi-natural vegetation in the English uplands. It supersedes the English Nature Research Report No. 220, "Optimal Vegetation Condition in the English uplands".
- The objective in the first year was to produce a definition of favourable vegetation condition for selected upland habitats. The second years work concentrated on defining grades of unfavourable vegetation condition and field trialing a survey methodology.
- Producing a definition of favourable vegetation condition is intended to assist both a consistent approach to the assessment of statutory sites, and a better understanding of the habitat condition of the wider countryside.
- Favourable vegetation condition is defined for the four most extensive habitats found in the English uplands: dry heath (which incorporates species-poor acidic grasslands), wet heath, blanket and raised mires and montane heath.
- These definitions are expressed as a series of criteria for each habitat which identify the features which characterise vegetation in favourable condition. The principal features used are sward composition and structure. The criteria focus on the effects of management on the condition of the vegetation, rather than on whether there is evidence that a particular management practise is, or has been, in operation. These criteria have been trialed on upland sites throughout England.
- A system of grading vegetation in unfavourable condition is presented.
- The effects of current upland management practices and other environmental factors on vegetation condition are discussed for each habitat.
- Three field sampling techniques are described and the survey results from trials of one of these techniques on four sites in England are presented.

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1. Introduction

This project is being developed as part of the English Nature Upland Strategy to assist the management of upland wildlife and natural features. The purpose of the project is to devise a relatively rapid and repeatable method for assessing the condition of upland semi-natural vegetation.

Earlier work established the principle of producing descriptions of the "optimal condition" of semi-natural habitats for nature conservation (Rowell, 1993 and SNH, 1994). These descriptions are expressed as a number of criteria which identify those features which characterise vegetation that is in optimal condition. The term "optimal" has since been replaced by "favourable".

Habitat condition assessment criteria have two main applications. They will assist a consistent approach to the assessment of statutory sites and can be used to gain a better understanding of the habitat condition of the wider countryside.

The country conservation agencies have a requirement to maintain the features of interest of statutory nature conservation sites: Sites of Special Scientific Interest (SSSIs), National Nature Reserves (NNRs) and Special Areas for Conservation (SACs). Under English Nature's current monitoring system for SSSIs, the condition of each interest feature (including habitats) is recorded under one of several categories ranging from 'favourable maintained' to 'unfavourable declining' and 'destroyed'. Individual sites are divided into units and are then assessed using a Site Unit Recording Form (SURF). At present there is no guidance given on how to recognise a habitat in either favourable or unfavourable vegetation condition. Assessments are based upon the personal experiences and knowledge of the individual conservation staff. Unfortunately, because there is a variation in experience and knowledge between individuals, the assessment of sites is likely to be inconsistent. A common problem is that while conservation staff may be very familiar with the range of variation in habitat condition in their area, they are often very much less familiar with how their sites compare with examples of the same habitats elsewhere in the country. These assessment criteria will therefore help to create a national standard for favourable vegetation condition of upland habitats. Similar work is presently being carried out by English Nature on producing such "generic guidelines" for defining favourable condition for all habitats and species present as features of interest within SSSIs in England.

There is very little information on the condition of habitats in the wider countryside. With the introduction of incentive schemes such as the Countryside Stewardship Scheme and the Moorland Scheme and payments for traditional management within Environmentally Sensitive Areas, the assessment of these habitats has become particularly urgent. This condition assessment methodology could be used to identify priority areas for management within existing schemes and could also be used to target future schemes at those areas most in need of positive management. Another particularly significant application of condition assessment could be for monitoring compliance with the 1994 environmental regulations within the livestock regime.

Defining the favourable nature conservation condition for semi-natural vegetation is complicated by the immense natural variation shown by each vegetation type across its range. During this project we have attempted to encompass as much of this natural variation as possible into our definition of favourable condition. We have identified the important elements that occur throughout the range of each habitat and that contribute to the overall

nature conservation value. Many of these relate to recognised principles of habitat evaluation such as species-richness and structural diversity.

We have also defined favourable condition strictly in the context of the English uplands. For example, the montane heaths of the Scottish Highlands have a greater species diversity than those of Northern England and this is largely due to natural variation. It would therefore be unrealistic to measure English montane heaths against a standard set by heaths in Scotland as such a condition could not be achieved due to climatic constraints. Our definitions of favourable vegetation condition have therefore been based on what can realistically be expected to occur in the English uplands under sympathetic management regimes. We have based these on existing English examples of vegetation that is considered to be in good condition in terms of composition and structure and, with caution, upon information on the range of variation in vegetation types elsewhere in the UK. The criteria for favourable vegetation condition described here are only applicable to the English uplands and should not be used elsewhere in the UK without extensive field testing and modification where required.

A further difficulty is that all habitats in England have developed against a backdrop of continued human intervention in the form of livestock grazing, cutting or burning. Many of these habitats are non-climax communities requiring continuing management to prevent natural succession. Montane heaths and blanket mires are exceptions to this however, as both are climax communities. Favourable condition does not necessarily equate to an unmanaged habitat that has reached a successional climax. If this were the case then all dry heath would be in unfavourable condition until it developed into broadleaved woodland. Therefore the central aim of this project is to provide a description of the favourable condition of certain broad vegetation types of wildlife importance which have resulted from traditional management and which may depend upon some continuing management.

The relationship between management and vegetation condition has influenced our choice of criteria for favourable condition. Given that management is required to maintain many upland habitats we have selected criteria that reflect management regimes that sustain wildlife interest. We have identified the vegetation characteristics which provide a measure of the intensity (or presence) of certain types of management. For example, a criterion for dry heath managed by burning is that all age classes of heather should be present, with at least 33 percent of the management unit unburnt. This would indicate a moderate burning regime where a large proportion of the heather is able to become mature or over-mature. The criterion will, in many circumstances, inform the site manager of the most appropriate changes in management that may be needed to improve vegetation condition.

This project is only concerned with defining the favourable condition of vegetation. In other words, the criteria for favourable vegetation condition are most usefully applied to those habitats where the maintenance (or enhancement) of the vegetation is the main objective. There will be situations where a habitat is of primary importance for some feature other than vegetation. For example the blanket mires of the South Pennines are of international importance for breeding waders, yet their vegetation condition is largely unfavourable. In these circumstances it may be necessary to accept unfavourable vegetation condition, as to alter the management to benefit the vegetation may reduce the bird interest.

Finally, it is important to emphasise that the condition assessment criteria should only be used within the broader context of site management objectives. The most appropriate location and extent of a habitat on any given site will depend upon these objectives. It is intended that condition assessment will be used as a tool to measure the success of management prescriptions that are implemented to achieve site objectives.

2. Methodology

The criteria for favourable upland vegetation condition have been drawn up following a process of consultation, site visits and field trials.

An initial draft of the criteria was drawn up using a combination of the field experience of English Nature staff and field indicators for varying degrees of impacts of management and natural processes, such as grazing, burning and disease on upland habitats drawn up by MacDonald *et al.* (in press) (Jerram, 1996). The validity of these criteria was then tested in the field through a series of site visits to a range of upland Sites of Special Scientific Interest throughout England. Sites were selected to cover the full range of geographical and floristic variation of upland heaths and blanket mires in England, with an emphasis on those sites, or parts of sites, which contained examples of the selected habitats in good vegetation condition in the opinion of English Nature Local Teams. Sites were visited during September and October 1996 with staff from Local Teams who were able to provide an overview of the uplands in their areas and the management history of the sites visited. A list of sites visited is given in Table 1 of Appendix 4.

The draft criteria were modified in the light of field observations and comments from Local Teams (Jerram, 1996) prior to a second series of site visits. During these visits, groups from English Nature Local Teams were taken to sites outside their normal working areas and asked to assess the habitat condition of areas of heathland, montane heath and blanket mire using the modified criteria. The assessment areas were in the region of 0.5km^2 in area and were thoroughly walked over for a 30 - 45 minute period by each member of the group. Each member was then asked to complete an assessment record card independently and without consultation with other members of the group. A debriefing session was then held to discuss the way the assessment was made and any problems with the process. Each member of the group was also asked to fill in a questionnaire about the habitat condition assessment procedure and criteria. These trials took place in November 1996 and a list of sites visited is given in Table 2 of Appendix 4.

The criteria for favourable vegetation condition for dry heath, wet heath, blanket mire and montane heath from Jerram (1996) were revised in the light of these field trials and comments resulting from the consultation draft of this report. In 1997, following feedback from consultees, a provisional grading system for unfavourable vegetation condition for each habitat type was drawn up. This system was modified during a series of field trials in May, June and July until a consistent and workable system was achieved. A draft of the grading system was then circulated amongst consultees for comment and further amendments were made. The revised criteria and grading system are presented and discussed below.

3. Favourable vegetation condition

The criteria for assessing favourable vegetation condition are given for each of the four principal habitats found in the English uplands: sub-montane dry dwarf-shrub heath, wet dwarf-shrub heath, blanket and raised mires and montane heath. Each habitat section is divided into four parts: a definition of the range of vegetation types for which that set of criteria should be used; the criteria for favourable vegetation condition; an explanation of the rationale behind the criteria; and the system for grading stands in unfavourable condition.

Box 1 - Definitions of terms of abundance and distribution	
A number of terms are used throughout the criteria to describe specific levels of abundance and distribution. These terms are in common usage in ecology but can be given a variety of meanings. To avoid confusion their usage and meaning in the context of Vegetation Condition Assessment is defined here.	
Abundance terms:	**Definition**
Dominant	A single species which prevails over other species in terms of the ground cover of a stand of a particular habitat
Abundant	Found regularly throughout a stand of a particular habitat and contributing significantly to the ground cover of that stand (>5% cover)
Frequent	Scattered plants or small clumps of plants found regularly throughout a stand (found on at least one in every three footfalls when walking through vegetation) and making a modest contribution to the ground cover of that stand (<5% cover)
Occasional	Scattered plants found on less than one in three footfalls and generally not making a contribution to the ground cover of that stand
Rare	No more than a few individual plants or clumps of a species recorded in a stand
Distribution terms:	
Widespread	Widely distributed throughout a stand
Local	Restricted to particular areas or parts of a stand

3.1. Sub-montane dry dwarf-shrub heath

3.1.1. Definition:

Dry dwarf-shrub heath is defined as vegetation in which ericoid dwarf-shrubs (*Calluna vulgaris, Erica* spp., *Vaccinium* spp. and *Empetrum nigrum*) or western gorse (*Ulex gallii*) form more than 25% of the cover in relatively dry situations (NCC 1990).

In addition, species-poor acid grasslands (i.e. vegetation where species such as *Nardus stricta, Deschampsia flexuosa, Agrostis curtisii, Agrostis capillaris* and *Festuca ovina* are abundant and which has less than 25% cover of dwarf-shrubs) should also be included in this category

when assessing vegetation condition. This type of vegetation is generally derived from dwarf-shrub heath via grazing and burning and should be regarded as degraded dry heath in this context.

Sub-montane dry heath is sub-divided into two types for the purposes of vegetation condition assessment: "typical" *Calluna* dry heath and dry heaths with *Ulex gallii.* These are differentiated simply on the presence or absence of *Ulex gallii.*

Exclusions:
Exceptionally species-rich grasslands can occur on moorlands in England: for example, where base-rich strata lie close to the soil surface or where there is slight base-rich flushing. Where present, the condition of these grasslands should be assessed on a site specific basis as species-rich grassland rather than heath.

Agrostis - Festuca grasslands which retain a relic woodland flora (*e.g. Anemone nemorosa* or *Hyacinthoides non-scripta*), and hence show clear signs of having been derived from woodland, are also excluded and should be assessed on a site specific basis.

Any vegetation on blanket or raised peat bodies deeper than 0.5m should be assessed as blanket/raised mire.

Heath over 600m, particularly on or just below mountain summits, in which hypnaceous mosses are replaced by species such as *Racomitrium lanuginosum* and *Polytrichum alpinum,* and montane species such as *Diphasiastrum alpinum, Cetraria islandica, Carex bigelowii* or *Salix herbacea* are present, should be assessed as montane heath. Grasslands with abundant *Deschampsia flexuosa, Festuca ovina* or *Agrostis capillaris* on or just below mountain summits over 600m should also be assessed as montane heath as they are likely to have been derived from montane heath via grazing.

Stands of bracken (*Pteridium aquilinum*) with a more or less continuous cover of litter (>90% cover) should be mapped as bracken and should not normally be included in the dry heath assessment (but see Section 3.1.2.4. on bracken below).

3.1.2. Rationale

3.1.2.1. Sward composition

A dry heath in good condition will have a high cover of dwarf-shrubs. Throughout most of England *Calluna vulgaris* is likely to be the main constituent, though at lower altitudes in the midlands and south-west *Erica cinerea* and *Ulex gallii* frequently predominate and *Calluna* may be absent entirely. English heaths are naturally floristically poor and this tendency has been enhanced on the grouse moors of northern England by the high frequency of burning aimed at maintaining *Calluna* in the middle phases of its growth cycle (pioneer, building and early mature phases; Watt, 1955). Burning heath on an 8-15 year cycle, which is typical of English grouse moors, favours *Calluna* over other heathland species, including other dwarf-shrubs and bryophytes. As a result, the most intensively burnt areas of grouse moor are almost mono-cultures of *Calluna* with virtually no other higher plants and only a thin patchy ground layer of encrusting lichens and acrocarpous mosses. The botanical diversity of these stands is so poor that they cannot be considered to be in favourable nature conservation condition in terms of their vegetation.

A heath in favourable vegetation condition will have some diversity in its dwarf-shrub composition. Species and structural diversity will be greatest with an even mix of several dwarf-shrub species. However, the ability of *Calluna* to shade out other species during its building and mature phases, together with the prevalence of the use of fire as a management

tool on heaths, which enhances the competitive ability of *Calluna* over other dwarf-shrubs, means that this is an unrealistic expectation. However, heaths with several dwarf-shrub species, at least two of which form an important part of the sward, are regularly found throughout England, though in some areas such stands may be confined to less frequently burnt locations. Stands dominated by a single dwarf-shrub species other than *Calluna*, say by *Vaccinium myrtillus* or *Erica cinerea*, should be judged as unfavourable under the same criteria as *Calluna*-dominated heath.

The presence of a significant bryophyte layer and, to a lesser extent, a non-crustose lichen component adds to both the species and structural diversities of the heath sward. Both these elements tend to develop in *Calluna's* later developmental phases and, consequently, heaths which are burnt frequently tend not to have a well developed bryophyte and lichen component. Bryophyte layers consisting almost exclusively of *Polytrichum* and *Campylopus* species are excluded from this criterion as they tend to be indicative of a high frequency of burning (MacDonald *et al.* in press).

3.1.2.2. Sward structure and burning

Structural complexity is seen as an important feature of heathlands. Complexity can be increased through the presence of bryophytes and lichens, as described above, together with large shrubs and trees, or through management in the form of burning to create a mosaic of patches of different ages as is found on grouse moors. In terms of vegetation condition, the former is more desirable as it increases both species diversity (of plants) and architectural complexity.

Structural complexity is of particular importance for heathland invertebrates. Both Gimingham (1985) and Barclay-Estrup (1974) found that the greatest invertebrate species diversity is associated with the pioneer and degenerate growth phases of *Calluna*; the latter due to the increased architectural complexity of this phase and the former due to the presence of specialists of bare ground. Rotational burning may reduce invertebrate diversity as, while it will maintain a proportion of the heather in the pioneer phase, the majority of the heather on a moor managed in this way will be in the building and mature phases and very little will be in the degenerate phase (Usher and Gardner 1988). It is also likely that invertebrate diversity will be increased by the presence of other structural components such as well developed bryophyte layers and trees. Thus, while some rotational burning is beneficial to invertebrate species diversity, the presence of extensive areas of heath outside the burning rotation which is allowed to become degenerate and have at least some scattered trees is equally, if not more, important for invertebrate species diversity.

The requirement for a mix of age classes and a minimum cover of unburnt heath is intended to allow a range of management options while ensuring that structural diversity and a significant proportion of unburnt heath is maintained. Stands of old heather are uncommon on many English moors and are important requirements for breeding hen harrier and merlin as well as being more botanically diverse than younger stands.

The sward structure criterion will allow for burning to maintain grouse numbers. However, if the bryophyte criterion is also to be met then rotations will probably need to be longer than the traditional 8-15 years. Usher and Thompson (1993) suggest operating two simultaneous burning cycles on a moor to maximise heathland diversity. One rotation would be short, in the conventional 8-15 year range producing a large number of small burnt patches, and the other would be on a long rotation of at least 30-35 years creating a smaller number of large burnt patches, or perhaps a combination of the two. A burning regime along these lines should produce a similar effect to that which the sward structure criterion presented here is aiming to

achieve, though ideally one would still like to see some entirely unburnt stands present.

Table 1 Typical *Calluna* sub-montane dry dwarf-shrub heath
Criteria for favourable vegetation condition

(for vegetation to be favourable all the criteria must be met)

- Dwarf-shrubs are dominant over grass species.
  Minimum of 75% cover of dwarf-shrubs, excluding recently burnt stands.
- A range of dwarf-shrub species should be present, no one dwarf-shrub species should be dominant to the exclusion of all others and at least one species other than the dominant species, should be frequent and widespread in the sward.
- Bryophytes (excluding *Polytrichum* spp. and/or *Campylopus* spp.) and/or "bushy" *Cladonia* spp. lichens (e.g. *C. impexa* and *C. arbuscula*) should be at least frequent and forming luxuriant patches below or, in more open swards, between the dwarf-shrubs.
- Either: all age classes of *Calluna* present with at least 33% of the management unit excluded from any burning rotation
  or: management unit unburnt.
  Stands which are never burnt should be present on level or gently sloping ground, not entirely confined to steep slopes. Note that in stands which are never or infrequently burnt where *Calluna* is regenerating through layering the pioneer phase need not be present and it may be hard to distinguish between the building, mature and degenerate phases.
- Alien shrubs and trees (e.g. *Rhododendron, Picea, Larix, Pinus etc.*) no more than rare (<5 individuals in any given 25ha block of heath).
- Grazing impacts should be light
  (An absolute maximum of 5% of the grazing unit may show signs of current heavy grazing).

  Indicators of light grazing:

  < 33% of long shoots of *Calluna vulgaris* or *Vaccinium myrtillus* showing signs of having been grazed where average shoot growth is > 4cm,
  or, where average shoot growth is < 4cm then < 16% of shoots grazed.$_{SNH}$
  Note that this indicator may only be reliable in late winter and early spring as *Calluna* in particular is mainly grazed in autumn and winter.

  Where stands of dwarf-shrubs lie adjacent to stands of preferentially grazed vegetation such as grassland, flushes, or recently burnt heath, any marginal band of distinctly grazed dwarf-shrubs should not exceed 1m in width.$_{SNH}$

  Little or no signs of grazing of *Empetrum nigrum, Vaccinium vitis-idaea* or *Nardus stricta,* if present.$_{SNH}$

  Upright growth of *Calluna vulgaris* and *Vaccinium myrtillus* with regular but infrequent branching. Bush canopy open, not a tightly packed mass of contorted shoots. Very few or no instances of "drumstick", "topiary" or "carpet" growth forms.$_{SNH}$

  Negligible bare ground attributable to grazing pressure.$_{SNH}$

  Herbivore dung should be rare and very difficult to find in short vegetation.$_{SNH}$

  No uprooted dwarf-shrub seedlings in areas regenerating after fire.$_{SNH}$

SNH denotes field indicators taken from MacDonald *et al.* (in press)

Table 2 ***Ulex gallii*** **sub-montane dry dwarf-shrub heath**
Criteria for favourable vegetation condition

(for vegetation to be favourable all criteria must be met)

- Dwarf-shrubs (*Calluna, Erica* spp, *Vaccinium* spp, *Empetrum* and *Ulex gallii*) are dominant over grass species.
  Minimum of 75% cover of dwarf-shrubs, excluding recently burnt stands.
  Note that when grazing is light *Agrostis curtisii*, where present, can be dominant for the first few years following burning.

- A range of dwarf-shrub species should be present, no one dwarf-shrub species should be dominant to the exclusion of all others and at least one species other than the dominant species, should be frequent and widespread in the sward.

- *Ulex gallii* should not exceed 50% cover, neither over a whole stand of *Ulex gallii* dry heath nor within individual age class stands where burning is practised.

- All age classes of dwarf-shrub present, with a maximum of 33% of the dwarf-shrub in the pioneer/newly burnt age class (<10cm tall) and 15% in the late mature/degenerate age class (>25cm tall).
  (Heights in parentheses should be used where *Calluna* is absent)

- Alien shrubs and trees (e.g. *Rhododendron, Picea, Larix, Pinus* no more than rare (<5 individuals in any given 25ha block of heath).

- Grazing impacts should be light
  (An absolute maximum of 5% of the grazing unit may show signs of current heavy grazing).

  Indicators of light grazing:

  < 33% of long shoots of *Calluna vulgaris* or *Vaccinium myrtillus* showing signs of having been grazed where average shoot growth is > 4cm,
  or, where average shoot growth is < 4cm then < 16% of shoots grazed.$_{SNH}$
  Note that this indicator may only be reliable in late winter and early spring as *Calluna* in particular is mainly grazed in autumn and winter.

  Where stands of dwarf-shrubs lie adjacent to stands of preferentially grazed vegetation such as grassland, flushes, or recently burnt heath, any marginal band of distinctly grazed dwarf-shrubs should not exceed 1m in width.$_{SNH}$

  Little or no signs of grazing of *Empetrum nigrum* or *Vaccinium vitis-idaea*, if present.$_{SNH}$

  Upright growth of *Calluna vulgaris* and *Vaccinium myrtillus* with regular but infrequent branching. Bush canopy open, not a tightly packed mass of contorted shoots. Very few or no instances of "drumstick", "topiary" or "carpet" growth forms.$_{SNH}$

  Negligible bare ground attributable to grazing pressure.$_{SNH}$

  Herbivore dung should be rare and very difficult to find in short vegetation.$_{SNH}$

  No uprooted dwarf-shrub seedlings in areas regenerating after fire.$_{SNH}$

SNH denotes field indicators taken from MacDonald *et al.* (in press).

It is important to note that burning is not required to maintain dwarf-shrub cover, rather it is a tool used by land managers to improve feeding and nesting conditions for red grouse or sheep (MacDonald 1996). *Calluna* is able to regenerate vegetatively through adventitious rooting of prostrate stems (layering) particularly on humus-rich and peaty soils. This process is much more common than was previously thought and has been recorded across the full range of habitats and environmental conditions in which *Calluna* occurs (Scandrett and Gimingham 1989 and MacDonald 1996). This brings in to question the assumption that burning is always necessary to maintain upland heath, particularly where burning threatens bryophyte-rich heath communities (MacDonald *et al.* 1995). It should be noted that these observations apply only to heath without *Ulex gallii*. Dry heath with *Ulex gallii* appears to differ from "typical" *Calluna* heath in that it seems not to develop a significant bryophyte layer and botanical diversity is at a maximum in the earlier phases of post-burning regeneration.

The requirement for a mix of age-classes in a management unit is intended to cover sites which are burnt on a regular basis, either in a controlled or uncontrolled manner, for red grouse or livestock. On rare occasions whole management units or extensive stands which have not been burnt for many decades, resulting in large areas of degenerate *Calluna*, may be encountered. Such areas should not be regarded as unfavourable as they provide examples of a more natural vegetation than is found on regularly burnt heaths. These stands will almost certainly support invertebrate species not generally found on more actively managed upland heath sites; they are likely to be important as breeding areas for moorland raptors and, in the absence of succession to woodland, are likely to be self-sustaining in the majority of circumstances. While there may be a number of pronounced cycles lasting 25 - 40 years following the cessation of burning in which the *Calluna* passes through successive growth cycles, in the long-term a stand of heath is likely to stabilise into an unevenly structured stand of *Calluna* (MacDonald 1996).

The presence of stands of heath which have not been burnt for forty years or more greatly enhance the habitat diversity of these areas and there are very few circumstances where, on the grounds of nature conservation, intervention would be justified. In particular, the reintroduction of burning is likely to be highly detrimental to the nature conservation interest of such stands. In the longer term, natural succession will lead to the development of native scrub and broadleaved woodland on unburnt and lightly grazed heathland. In terms of nature conservation objectives, this is desirable as the development of mosaics and transitions from open heath to woodland will increase habitat and species diversity. Thus, there is no strong nature conservation reason for intervening in the succession of some areas of heathland to woodland in locations such as the North Pennines where existing semi-natural woodland cover is very limited in comparison to that of open heathland (see Section 3.1.2.5).

3.1.2.3. Grazing

Heavy grazing is one of the main threats to the cover of dwarf-shrubs on the moorlands of England. It has accounted for the majority of the 22% of heath lost in England over the past fifty years and continues to be a significant threat on a large proportion of moors (Thompson *et al.* 1995). The presence of anything other than extremely localised, moderately heavy or heavy grazing impacts on a heath will lead to poor vegetation condition within a few years and in the medium to long term, may result in the loss of dwarf-shrub cover.

3.1.2.4. Bracken

Bracken is an important and natural component of moorland ecosystems in England and can form extensive stands on lower slopes. It has, however, been excluded from this project as a habitat in its own right as there is no meaningful definition of favourable vegetation condition for a stand of bracken.

Bracken is often regarded as an agricultural weed. However it does have nature conservation interest as it provides important habitat for whinchats and forty species of invertebrate are known to feed on it, eleven of which are found solely on bracken (Pakeman and Marrs 1992). Long standing areas of bracken on the moorland fringe and on valley sides should not be regarded as undesirable in nature conservation terms unless there is direct evidence that stands are spreading into core areas of dry heath. Historical presence or absence should be checked using aerial photographs and not anecdotal evidence from site managers, owners, occupiers or other parties as this can be unreliable. Control of bracken should be restricted to the areas of encroachment and should not aim to eliminate bracken from whole hillsides.

Bracken is also a natural component of dry heath vegetation, occurring both as individual fronds and small clumps within stands of dwarf-shrubs. A stand of dry heath containing

bracken will only become unfavourable if the bracken reduces the cover of dwarf-shrubs in that stand to less than 75%.

3.1.2.5. Woodland and scrub

The extent to which tree invasion should be accepted on upland heaths has caused a great deal of debate during the consultation stages of this project. There is a conflict between a general desire to see increased structural diversity in upland ecosystems through increased tree cover, especially in areas where woodland is particularly scarce like the Pennines, and concern that internationally important dry heath communities could be lost through natural succession to woodland. In the north of England, the prevalence of grazing regimes that threaten the continued existence of heathland through heavy grazing impacts means that, except in unusual circumstances or on isolated fragments of heath where grazing has ceased, loss of heathland via succession to woodland is rarely a problem. On some upland heaths in the midlands and in the south-west, however, low stocking levels have resulted in problems with scrub invasion from adjacent woodland.

As sub-montane heath is a plagioclimactic habitat resulting from the arresting of the natural succession path to woodland by grazing and/or burning, native trees must be a natural part of heathland communities. It is not possible for an assessment scheme such as this to account for between-site variation in the desirability or otherwise of trees within areas of heathland and this should be judged on a site by site basis by site managers. Where the maintenance of dry heath vegetation is the primary objective, stands will only become unfavourable where native trees or shrubs reduce the cover of dwarf-shrubs to less than 75%.

Alien trees and shrubs, especially conifers and rhododendrons, are not a natural component of English heaths and the presence of anything other than very small numbers of these species is regarded as being detrimental.

3.1.2.6. Grades of unfavourable vegetation condition

Table 3 Dry heath (without *Ulex gallii*) Vegetation condition grading system

Criteria	Favourable (0 points)	Unfavourable (1 point)	Unfavourable (2 points)	Unfavourable (6 points)
Dwarf-shrub cover	> 75%	26 - 75%	5 - 25%	< 5%
Range of dwarf-shrubs	2 or more spp widespread & frequent	no more than 1 spp widespread & frequent		
Bryophyte/lichen abundance	frequent patches	occasional	rare	
Age structure	> 33% excluded from burning	< 33% excluded from burning		
Alien trees & scrub	< 5 per 25ha	> 5 per 25ha		
Grazing impact	light	moderate	heavy	

Table 4 *Ulex gallii* **Dry Heath**
Vegetation condition grading system

Criteria	Favourable (0 points)	Unfavourable (1 point)	Unfavourable (2 points)	Unfavourable (6 points)
Dwarf-shrub cover	> 75%	26 - 75%	5 - 25%	< 5%
Range of dwarf-shrubs	2 or more spp widespread & frequent	no more than 1 spp widespread & frequent		
Cover of *Ulex gallii*	< 50%	> 50%		
Age structure	> 33% newly burnt/pioneer and/or ≥15% late mature/ degenerate	< 33% newly burnt/pioneer and/or <15% late mature/ degenerate		
Alien trees & scrub	< 5 per 25ha	> 5 per 25ha		
Grazing trend	light	moderate	heavy	

Box 2 Grading unfavourable vegetation

Where stands, survey units or entire management units fail to meet all the criteria for vegetation to be classified as favourable then that vegetation unit is classed as being in unfavourable vegetation condition. Clearly not all vegetation in unfavourable condition is the same and there will be different degrees of unfavourability. If we take dry heath as an example, one unfavourable management unit may exhibit signs of moderately heavy grazing over 20% of its area but meet all the other criteria, while another unit may be acid grassland with no dwarf-shrubs present whatsoever. The latter area of dry heath is clearly in far worse condition than the former, which could probably be restored to favourable condition within a few years by fairly modest changes in the grazing regime. However, to restore the acid grassland to heath in favourable condition would take many decades and a considerable amount of management intervention, which even then might not be successful. The ability to distinguish between different degrees of unfavourability will greatly aid land managers and conservation organisations in directing scarce resources at those areas of unfavourable vegetation where the resources are likely to be of most benefit.

A weighted scoring system has been devised to distinguish between different degrees of unfavourable vegetation condition. Points are awarded for each criterion on which the vegetation fails, so that favourable stands score zero points, a stand failing one criterion scores one point, a stand failing two criteria scores two points and so on. Additional weighting is given to those criteria which are considered to be of particular importance in determining vegetation condition (e.g. cover of dwarf-shrubs in dry heath, or *Sphagnum*/bryophyte cover in blanket mires). These criteria are sub-divided and additional points are scored for poorer examples of that vegetation condition component.

Scores are graded as follows:

0 points: favourable

1 - 5 points: unfavourable

>6 points: severely unfavourable

Within the unfavourable grade, the number of points scored can be used to give a further indication of the relative level of the unfavourability of a stand. However, within the severely unfavourable grade there is little value to be gained from comparing scores.

This grading system can be applied to individual stands or parts of stands of a habitat (polygon mapping), sample squares (raster mapping), facets (facet mapping) or whole management units. It must be noted, however, that in the first three situations the age structure criteria can only be assessed over a whole management unit and should not be applied to individual sample squares, stands or facets.

3.2. Wet dwarf-shrub heath

3.2.1. Definition:

Wet heath is defined by the presence of an ericoid dwarf-shrub cover of more than 25% in wet situations where peat depth does not exceed 0.5m (NCC 1990), though dwarf-shrubs may be scarce or absent in degraded stands. *Erica tetralix* is generally frequent in wet heath whereas it is usually no more than occasional in dry heath. Bryophytes, including *Sphagnum* spp, are generally abundant, though again they may be absent in degraded stands. *Molinia caerulea, Juncus squarrosus* and *Scirpus cespitosus* may also be frequent or abundant, and where any of these are dominant or abundant in the absence of frequent *Eriophorum vaginatum* on peat less than 0.5m deep, the vegetation should be assessed as wet heath. Note, however, that herb-rich *Molinia* grasslands should not be categorised as wet heath and are not covered by this project.

Exclusions:

Any vegetation on blanket or raised mire peat greater than 0.5m in depth should be assessed using the blanket and raised mire criteria.

3.2.2. Rationale

3.2.2.1. Sward composition

Unlike dry heath, wet heath can have a much more open and varied sward structure, incorporating tussocks of grasses and sedges and carpets of bryophytes as well as dwarf-shrubs. High cover of dwarf-shrubs in wet heath is often indicative of a drying out of soil conditions brought about by drainage or frequent burning.

Only two dwarf-shrub species, *Calluna* and *Erica tetralix*, are common in wet heaths so it would be unrealistic to require species other than these to be present. *Calluna* is grazed in preference to *E. tetralix* and a predominance of the latter in a sward can be indicative of high grazing levels either currently or in the past.

Very frequent burning can also favour some grasses, particularly *Molinia caerulea*. Frequent burning over periods of tens to hundreds of years can result in the total dominance of *Molinia* to the exclusion of almost all other species, as can be seen over large tracts of Exmoor and Dartmoor. Other graminoids, such as *Juncus squarrosus*, can become prominent in the sward under high grazing pressures. In most instances, high cover of graminoids is indicative of poor vegetation condition brought about by either past or current inappropriate management. *Carex* spp. can, however, be abundant in stands in favourable vegetation condition, especially where there is localised flushing.

The presence of a well developed bryophyte layer is an important component of wet heath. Again, both fire and drainage can have detrimental effects on the extent and composition of the bryophyte layer.

3.2.2.2. Sward structure and burning

The peaty soils which support wet heath mean that *Calluna*, at least, is able to regenerate through layering on wet heaths and that burning is not required to maintain dwarf-shrub cover (MacDonald 1996). Due to the potentially detrimental effects of fire on wet heath, this vegetation will probably maximise its condition if not burnt at all, or at most very infrequently, say no more than once every 25-30 years. Frequent burning is likely to lead to the replacement of dwarf-shrub species by *Molinia caerulea* and *Scirpus cespitosus* and this probably accounts for the dominance of *Molinia* over large areas of Exmoor.

The effects of burning management for grouse on the invertebrates of wet heath is less clear than it is for dry heath. Wet moorland habitats support different assemblages of invertebrates

to dry heath (Usher 1992 and Coulson and Butterfield 1985) and it is not known how these respond to burning. In addition, it is not clear how Usher's (1992) "boggy" and "damp heath" relate to the habitat definitions used here and some of his sample sites may be flushes rather than wet heath.

3.2.2.3. Grazing

As with dry heath, grazing at high levels can convert wet heath to grassland and the presence of indicators of heavy current grazing is indicative of heath in unfavourable condition.

Table 5 Wet dwarf-shrub heath
Criteria for favourable vegetation condition

(for vegetation to be favourable all criteria must be met)

- Sward composed of a variety of higher plants and bryophytes. Dwarf-shrubs should not dominate the sward and there should be a minimum of 25% cover of species other than dwarf-shrubs.
- At least two dwarf-shrub species should be present, no one dwarf-shrub species should be dominant to the exclusion of all others and at least one species other than the dominant species, should be frequent and widespread in the sward.
- Bryophytes (excluding *Polytrichum* spp. and/or *Campylopus* spp.) should be at least frequent and forming luxuriant patches below or, in more open swards, between the dwarf-shrubs.
- Either: all age classes of *Calluna* present with at least 50% of the management unit excluded from any burning rotation
  or: unburnt management units.
  Note that in stands which are never or infrequently burnt where *Calluna* is regenerating through layering the pioneer phase need not be present and it may be hard to distinguish between the building, mature and degenerate phases. Stands which are never burnt should be present on level or gently sloping ground, not entirely confined to the steeper slopes.
- *Molinia caerulea, Scirpus cespitosus, Deschampsia flexuosa, Juncus squarrosus* or other graminoids should not dominate over other species.
  Total cover of graminoids should not exceed 50%.
- Alien shrubs and trees (e.g. *Rhododendron, Picea, Larix, Pinus etc.*) no more than rare (<5 individuals in any given 25ha block of heath).
- Grazing impacts should be light
  (An absolute maximum of 5% of the grazing unit may show signs of current heavy grazing).

  Indicators of light grazing:

  < 33% of long shoots of *Calluna vulgaris* or *Vaccinium myrtillus* showing signs of having been grazed where average shoot growth is > 4cm,
  or, where average shoot growth is < 4cm then < 16% of shoots grazed.$_{SNH}$
  Note that this indicator may only be reliable in late winter and early spring as *Calluna* in particular is mainly grazed in autumn and winter.

  Where stands of dwarf-shrubs lie adjacent to stands of preferentially grazed vegetation such as grassland, flushes, or recently burnt heath, any marginal band of distinctly grazed dwarf-shrubs should not exceed 1m in width.$_{SNH}$

  Little or no signs of grazing of *Erica tetralix, Empetrum nigrum* or *Vaccinium vitis-idaea*, if present.$_{SNH}$

  No evidence of encroachment by graminoid species such as *Juncus squarrosus, Deschampsia flexuosa* or *Nardus stricta*.$_{SNH}$

  Upright growth of *Calluna vulgaris* and *Vaccinium myrtillus* with regular but infrequent branching. Bush canopy open, not a tightly packed mass of contorted shoots. Very few or no instances of "drumstick", "topiary" or "carpet" growth forms.$_{SNH}$

  Negligible bare ground attributable to grazing pressure.$_{SNH}$

  Herbivore dung should be rare and very difficult to find in short vegetation.$_{SNH}$

  No uprooted dwarf-shrub seedlings in areas regenerating after fire.$_{SNH}$

SNH denotes field indicators taken from MacDonald *et al.* (in press)