Devon Biodiversity Records Centre

The Graze the Moor Project – Molland Moor aerial photo analysis

Final report

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We would like to acknowledge the help we received from David Boyce in providing a copy of his 2013 Molland Moor Vegetation Survey report and GIS layers for analysis in this study, and to Tim Parish of Exmoor National Park Authority for providing additional aerial photographs.

Background

Molland Moor lies within the South Exmoor Site of Special Scientific Interest (SSSI) which was notified in 1992 due to the presence of extensive areas of heathland, including lowland communities which are only found in South West England and South Wales. The most recent assessment of the moor found it to be in an unfavourable – recovering condition due to insufficient indicator species and bryophytes.

For many years, the Molland Estate has been concerned about the difficulty of managing the moor to a high standard. Grazing is the main management input to the Moor and there is an obligation under a management plan agreed with Natural England to graze the moor with cattle during the summer. Molinia dominance on the moor is a particular concern, and is thought to have resulted from burns carried out without being followed by appropriate grazing. There are also concerns that the areas allowed to be burnt under stewardship agreements are sometimes too small to have a positive effect on the condition and extent of heath.

The impact of site specific difficulties is that farmers have moved away from hill stock and the moor has suffered from a lack of management. The vegetation has become rank, coarse grasses have invaded, and invasive species, such as bracken, gorse and scrub woodland, have expanded onto the moor. The result of these changes is that the vegetation has lower food value and this in turn makes it less attractive to graziers.

In an effort to justify change to the current management of the moor, and reverse the downward spiral of its condition, the Graze the Moor project will gather information that will allow management decisions to be made based on local evidence.

Project Brief

The project aims to extend work completed in an earlier two year pilot, to allow robust conclusions to be drawn about the impact of the grazing management changes that will be introduced as part of the project.

In support of these aims there is a clear need to identify trends in habitat change from 1947 – present day. This exercise will be undertaken using Aerial Photograph Interpretation, and through digitisation of historic and up to date botanical survey data, allowing comparison.

Mapping and data analysis methodology

Aerial photograph interpretation is the act of identifying features within the natural environment from looking at an aerial photograph. Many factors are taken into account when assessing an aerial photograph, such as shape, colour, texture, pattern, shadow and time (e.g. looking at photographs from different years). These enable the interpreter to make decisions such as; categorising habitat type, detecting change between years and mapping of key features. Aerial photographs were used from three years; 1947, 1998, and 2010. Additionally two botanical survey reports were used, dating from 1991 and 2013.

In summary, five sources of data were obtained and analysed in this study, as follows:

1947 aerial photoset
1991 habitat survey by Exmoor National Park Authority (report)
1998 aerial photoset
2010 aerial photoset
2013 habitat survey by David Boyce (GIS layers)

An attempt was made to also use a GIS dataset obtained from a 2006 habitat survey by Penny Anderson Associates (GIS layers). However, there were found to be too many unknown variables in the methodology used in this dataset, and the data output was at too coarse a spatial scale, to allow direct comparison with the other datasets.

Habitats for each dataset were categorised and recorded according to Integrated Habitat System (IHS); refer to Appendix 2 for IHS definitions. To enable us to report on changes in the coverage of different habitats over time, habitats were digitised using MapInfo v.12.5 software with polygons created for each section of habitat so that figures for total area coverage could be calculated. For each polygon, additional data was recorded including other habitats present, matrix habitat, and land management.

Aerial photographs from 1947, 1998, and 2010 were georeferenced, and habitats digitised in what appeared to be homogenous sections. The 1947 and 2010 images were taken during the winter/early spring and therefore bracken habitat could not always be definitively identified, and in these images were typically identified as acid grassland. Therefore, it is not possible to interrogate all the datasets together when analysing temporal trends in bracken and acid grassland habitats.

A survey map from 1991 was similarly georeferenced and the habitats digitised. For analysis of this dataset, heath was presumed as being present where habitat descriptions showed heath as being present with less than 4 other habitat types (i.e. where heath formed greater than 25% of the habitat, as defined by the IHS heath classification. Where other habitats were described as being in a matrix (e.g. acid grassland with purple moor-grass) these habitats were recorded as being co-dominant. GIS layers for the 2013 vegetation survey report were assigned to IHS categories based on the description for each compartment contained in the report text.

Results

Layerable PDF files have been created to accompany this report which show heath coverage for each dataset, as well as all habitats mapped for each dataset. Additionally, GIS files have been created which provide additional data on matrix habitats, other habitats present, and land management for each polygon (refer to Appendix 2 for definitions used in GIS habitat digitisation).

Heath

- There has been a significant decline (56.2%) in total heath cover between 1947 and 2013 (refer to Figure 1). Refer to the maps in Appendix 1 for a comparison of heath coverage between 1947 and 2013.

- It appears that there is an accelerating negative trend in heath coverage, with a 16.2% decline in the extent of heath between 1947 and 1991 followed by a 47.7 decline between 1991 and 2013 (Figure 1.).

- 87.43 ha of heath (28.9% of total heath reduction recorded during the study period) were lost in the 44 years between 1947 and 1991, while 215.54 ha (71.1% of total) were lost in the 22 years between between 1991 and 2013 (Table 1.).

Year	Coverage (ha)
1947	539.12
1991	451.69
1998	413.84
2010	313.81
2013	236.15

Table 1. Heath coverage on Molland Moor

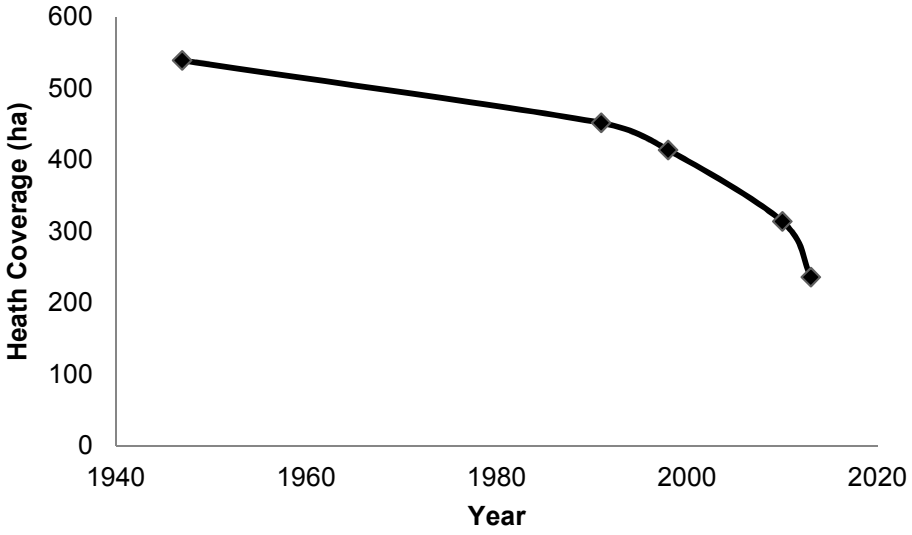


Figure 1. Heath coverage on Molland Moor between 1947 and 2013

Purple moor-grass and Bog

It is not always possible to discriminate between purple-moor grass and bog habitats during aerial photograph interpretation. Therefore, in considering temporal trends in the coverage of these habitats, data for purple moor-grass and bog are combined for analysis.

- There has been a significant increase in the extent of purple moor-grass coverage (including bog) between 1947 and 2013 (Table 2.).

- There is an accelerating positive trend in purple moor-grass (including bog) coverage, with over 84% of the increase in purple moor-grass coverage ccuring between 1991 and 2013 (Figure 2.).

Year	Coverage (ha)
1947	48.53
1991	79.59
1998	117.21
2010	193.67
2013	247.13

Table 2. Purple moor-grass and Bog coverage on Molland Moor

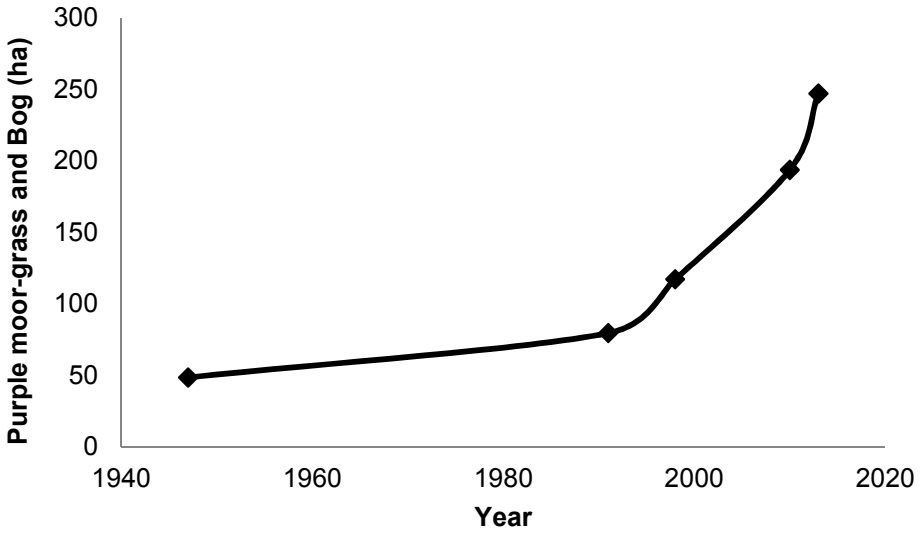


Figure 2. Purple moor-grass and Bog coverage on Molland Moor between 1947 and 2013

Bracken

- Because the 1947 and 2010 photographs were taken in winter, identification of bracken was not possible using these images. Therefore when considering changes in bracken coverage, only the summer datasets from 1991, 1998, and 2013 can be used. The data indicates that bracken coverage on Molland Moor increased between 1991 and 1998, but has declined significantly between 1998 and 2013 (Table 3).

Year	Coverage (ha)
1991	68.84
1998	84.91
2013	24.26

Table 3. Bracken coverage on Molland Moor

Scrub

- There has been a significant increase in the extent of scrub coverage on Molland Moor between 1947 and 2013, although the total area remains small in the context of the total size of the moor (Table 4).

Year	Coverage (ha)
1947	1.80
1991	11.42
1998	19.25
2010	21.21
2013	29.54

Table 4. Scrub coverage on Molland Moor

Acid grassland

- Due to the constraints in interpreting the different datasets when identifying acid grassland (see Limitations of Assessment) it is not possible to make direct comparisons between all the datasets. Instead, analysis can only be made between the winter aerial photograph data (1947 and 2010), and between the summer datasets (1991, 1998, and 2010).

Year	Coverage (ha)
1947	88.42
2010	141.87

Year	Coverage (ha)
1991	60.30
1998	42.03
2013	139.97

Table 5. Acid grassland coverage on Molland Moor

- Separate comparison of these dataset groupings suggests that there has been a significant increase in the extent of acid grassland on Molland Moor. Between 1947 and 2010 acid grassland coverage increased by 60.5%. Between 1991 and 2013 acid grassland coverage increased by 132%.

Discussion

There has been a significant decline in heath cover on Molland Moor between 1947 and 2013 (56.2%) with a simultaneous large increase in purple moor-grass (409%), and acid grassland (62% between 1947 and 2010; 43% increase between 1991 and 2013). Some of the increase in purple moor-grass cover identified in the 2013 dataset may be as a result of recent burning management; appropriate management through grazing may result in the return of these new areas of purple moor-grass to heath.

Because the datasets used in this study capture only one point in time, with multiple years between each time point, it is not possible to make clear associations between any management recorded as occurring in one year, and changes in habitat identified in later

datasets. However, trends in habitat cover that have been identified in this report can be used to support the creation of a land management programme to halt the decline in heath cover on Molland Moor.

Limitations of assessment:

The following factors should be taken into account when interpreting the results of this study:

Analysis of aerial photographs

- Digitising error – there will be a degree of error during digitisation due to the resolution of the photographs used. The 2010 image is of higher resolution than the 1998 and 1947 photos, which could account for small digitising differences and uncertainties about mapping the boundaries of some habitat polygons in the lower resolution images.

- As well as being of poorer resolution, the monochrome nature of the 1947 photograph presented challenges in interpreting habitats, as colour is a useful indicator of habitat type. Therefore, there may be some discrepancies in habitat interpretation in the 1947 digitisation.

- It was not always possible to discriminate between purple moor-grass/acid grassland and bog habitat. Therefore measurements of bog habitat in the photo dataset cannot be directly compared with bog habitat area calculated from the 1991 and 2013 survey reports.

- The 2013 and 1947 aerial photographs were taken in the winter/early spring and bracken was not visible. Therefore bracken coverage could only be determined in the 1998 photograph, and therefore comparison of bracken coverage could only be made between the 1998 photograph and the 1991 and 2013 report data.

- The IHS defines bracken habitat as that where bracken coverage is greater than 90%. Dense bracken often occurs on acid grassland; interpretation of the winter photographs of 1941 and 2010 would record such habitat as acid grassland habitat only, as bracken would not be present. However, the same habitat in the summer datasets (1991, 1998, and 2013) would be recorded as bracken habitat rather than acid grassland. Therefore acid grassland coverage may have been over-counted in the winter datasets in comparison with the summer datasets, and similarly bracken may have been underestimated in the winter datasets in comparison with the summer datasets.

- Additionally, bracken may also grow above other habitats (e.g. scattered heath) which would be identified during winter aerial interpretation as heath, rather than bracken. Thus it is not possible to look at overall trends for acid grassland and bracken by simply combining data for acid grassland and bracken for each dataset.

Analysis of 1991 and 2013 vegetation reports

- In this report the IHS definition of 25% coverage of heath species is used to classify heath. Although very detailed, the 2013 vegetation survey report does not always

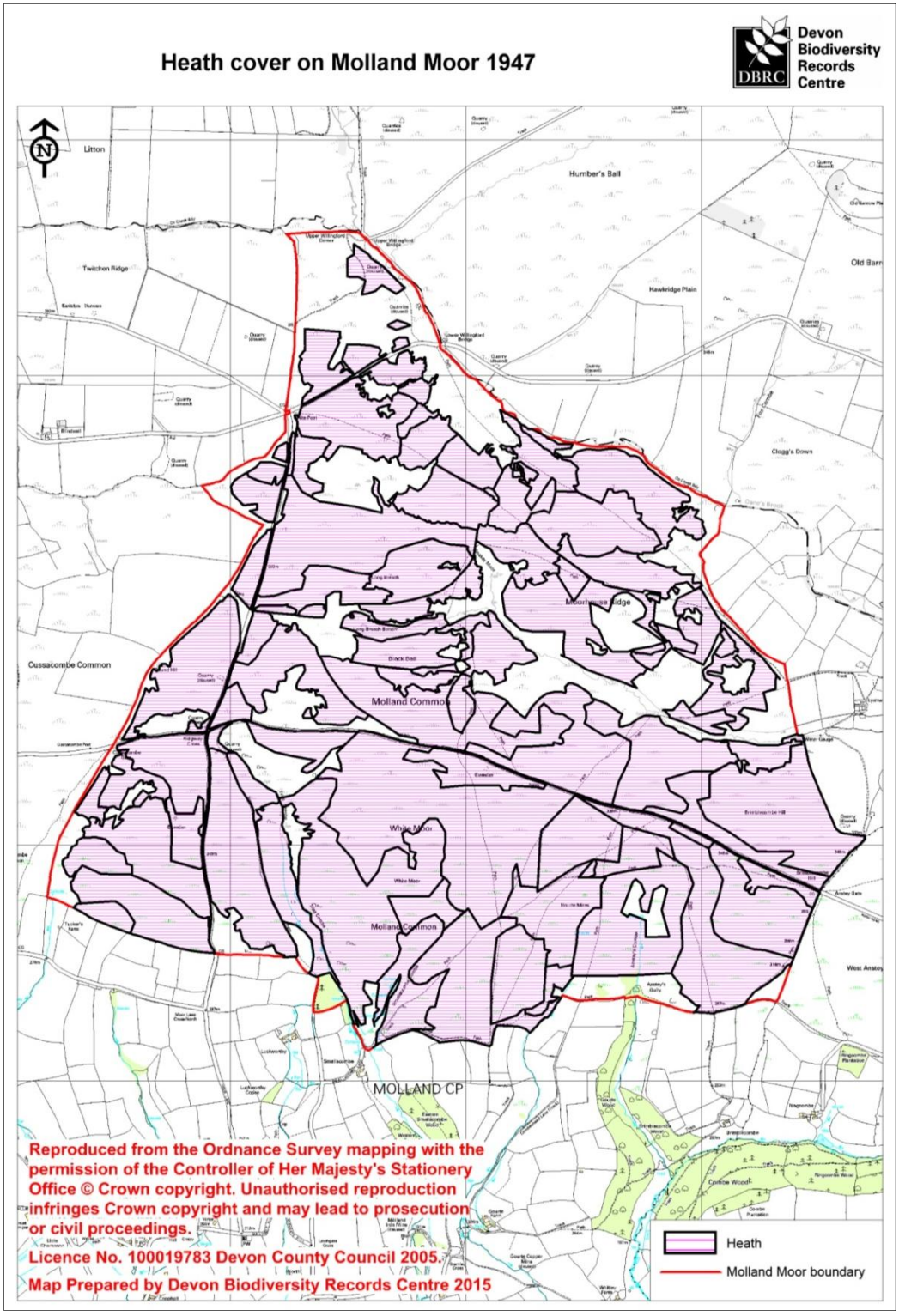
give percentage cover estimates of heath cover in the different compartments described. Therefore judgements had to be made about the probable percentage coverage of heath in compartments based on the text description, and it is possible that there may be some discrepancies in habitat classification as a result.

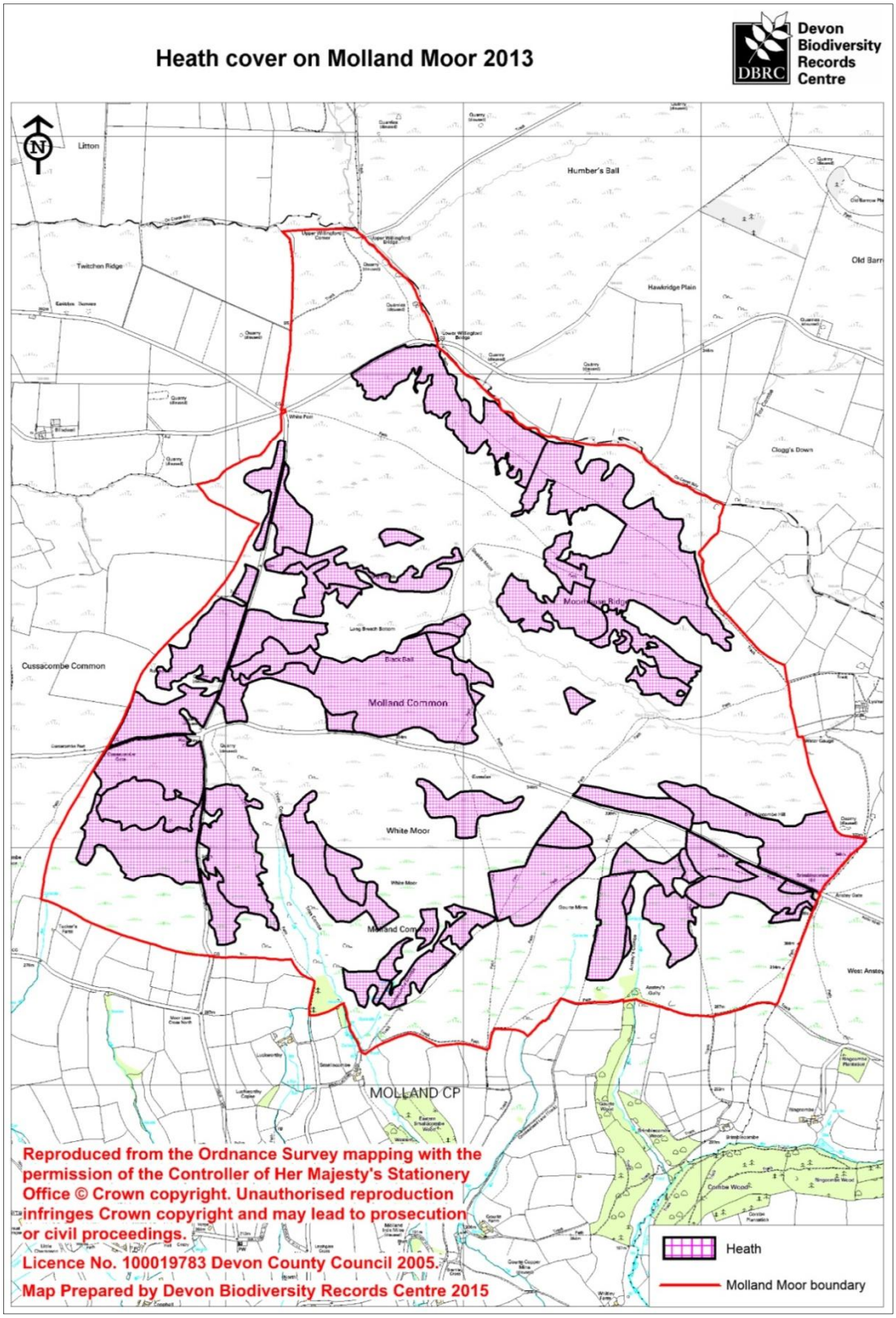
References

Boyce, D. (2013). Molland Moor Vegetation Survey. Unpublished report.

Appendices

Appendix 1. Heath coverage on Molland Moor in 1947 and 2013




Heath cover on Molland Moor 2013
Devon Biodiversity Records Centre
DBRC
N
Litton
Humber's Ball
Twitchen Ridge
Hawkridge Plain
Old Barr
Clogg's Down
Cussacombe Common
Molland Common
White Moor
MOLLAND CP
Combe Wood
Heath
Molland Moor boundary
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Map Prepared by Devon Biodiversity Records Centre 2015

Appendix 2. Integrated Habitat System (IHS) Habitat Codes

WB2 Scrub woodland (SC)

Description: Includes patches of broadleaved and juniper scrub with a continuous closed canopy (>90% cover) of >0.25ha. Scrub woodland includes locally native shrubs, usually less than 5m tall, (occasionally with a few scattered trees), including: common gorse *Ulex europaeus*, broom *Cytisus scoparius* and juniper *Juniperus communis* scrub; bramble *Rubus fruticosus* and dog rose *Rosa canina* scrub; and hawthorn *Crataegus monogyna*, blackthorn *Prunus spinosa* or grey willow *Salix cinerea* stands even if more than 5m tall (but see below for exceptions). Also included are stands of non-native shrubs, for example areas greater than 0.25ha of planted shrubs in extensive ornamental gardens.

Not included: Patches of dwarf-gorse scrub (*Ulex minor, U. gallii*) should be included in a HE~ Dwarf-shrub heath category. Grey willow *Salix cinerea* carr or stands of bog myrtle *Myrica gale* more than 1.5m tall should be included under a WB34~ category. Montane willow scrub should be included in MH~ Montane Category, and scrub on sand dunes and shingle is included in SS~ Supralittoral sediment (Jackson D. L., 2000). Low or patchy bog myrtle *Myrica gale* should be included under an EO~ or EM~ category. Stands of young or stunted trees or stump regrowth less than 5m high should be included under the appropriate WB~ category for their species mix and habitat type. See WB0.

Correlates with: NVC (W21-W25) amongst others.

GA0 Acid grassland (BHT)

Description: This habitat type is characterised by vegetation dominated by grasses and herbs on a range of lime-deficient soils which have been derived from acidic bedrock or from superficial deposits such as sands and gravels. Such soils usually have a low base status, with a pH of less than 5.5. It also includes pioneer annual rich calcifuge communities on dry sandy soils as well as wet acidic grasslands typified by species such as heath rush *Juncus squarrosus*. (Jackson D.L., 2000)

Not included: Saltmarsh and sand-dune communities should be included under an appropriate supralittoral category. *Molinia* meadows and rush pastures are included under EM4~ in the Fen, marsh and swamp category. Acid grassland types and snow-bed communities which occur exclusively in the montane (Alpine) zone are included in the MH~ Montane category and acid grassland types found on shingle habitats are included in the SS~ Supralittoral sediment category. Continuous patches of non-dwarf-gorse scrub >0.25ha (including common gorse) should be included under WB2 Scrub woodland (SC). Continuous patches of bracken >0.25ha should be included under a BR~ Bracken category. Patches of dwarf-gorse scrub should be included under a HE~ Dwarf-shrub heath category.
Required multiplex codes: Include scattered trees by cross-referencing to a TS~ category; scattered scrub by cross-referencing with SC12; patches of non-dwarf-gorse scrub species with a continuous canopy up to 0.25 ha by cross-referencing with SC11; and patches of scattered bracken and continuous bracken <0.25ha by cross-referencing with a Patchy Bracken (PA1~) category. Where the habitat is part of a coastal or floodplain grazing marsh complex, it should be cross-referenced with CF1 (Coastal and floodplain grazing marsh) from the Habitat Complexes section. In cases where the habitat lies over limestone pavement, it should be cross-referenced with a LP1 (Limestone pavement) habitat complex.

Correlates with: NVC (U1), U2-U3, (U4), U5, (U6), SD10, SD11

BR0 Bracken (BHT)

Description: Includes areas >0.25ha in extent dominated by continuous bracken *Pteridium aquilinum* with a canopy cover of > 95% at the height of the growing season. (Jackson D.L., 2000). Not included: Scattered bracken, or patches of continuous bracken <0.25ha are not included here. They are part of the Matrix Vegetation Section categories for Patchy Bracken (i.e. a PA1~ category). Areas of bracken under forest or woodland canopy are included in either WB~ Broadleaved, mixed and yew woodland or the WC~ Coniferous woodland category.

HE0 Dwarf shrub heath (BHT)

Description: This habitat type is characterised by vegetation that has a greater than 25% cover of plant species from the heath family (ericoids) or dwarf gorse *Ulex minor*. It generally occurs on well-drained, nutrient-poor, acid soils. Heaths do occur on more basic soils but these are more limited in extent and can be recognised by the presence of herbs characteristic of calcareous grassland. Dwarf shrub heath includes both dry and wet heaths types and occurs in the lowlands and the uplands. (Jackson D. L., 2000)

Not included: This habitat types does not include dwarf shrub dominated vegetation in which species characteristic of peat-forming vegetation such as cotton-grass *Eriophorum* spp. and peat-building *Sphagna* are abundant, or that occurs on deep peat (greater than 0.5 m) as they are included in EO0~ Bog category. Heath types exclusively alpine in distribution are included in the MH~ category. Heath on sand dunes or shingle are included in the SS~ category under SS14~ Decalcified fixed dunes. Heath on maritime cliffs and slopes that are influenced by salt spray are included in the SR~ category. Heathland should also be cross-referenced with an HL1 (Lowland heathland) or HU1 (Upland heathland) Habitat Complex as appropriate. If the habitat lies within a machair system, it should be cross-referenced with the MA1 (Machair) habitat complex. In cases where the habitat lies over limestone pavement, it should be cross-referenced with a LP1 (Limestone pavement) habitat complex.

EO0 Bog (BHT)

Description: Mire habitats on deep acid peat (>0.5 m) which are rain-fed (ombrotrophic). The vegetation of bogs which have not been modified by surface drying and aeration or heavy grazing is dominated by acidophilous species such as bog-mosses *Sphagnum* spp.cotton-grass *Eriphorum* spp. and cross-leaved heath *Erica tetralix*. The water table is at or just below the surface. Water and nutrient input is mainly from rainwater supply, rather than from the surrounding land. Bogs may be described as modified/degraded or unmodified, inactive or active. Modified bogs contain little or no *Sphagnum*. Peat depth, although somewhat arbitrary, is used as the primary criterion to separate types of modified bog vegetation from HE~ Dwarf-shrub heath category and certain types of EM~ Fen, marsh and swamp. Includes blanket bog, raised bogs, and mixed bog habitat types. Also included are pools <0.1ha associated with bogs. (Jackson D.L., 2000)

Not included: In lowland areas with predominantly acid substrata there are examples of valley and basin mires that receive acid surface seepage, which give rise to vegetation

similar to that of bogs. These habitat types are included in EM~ Fen, marsh and swamp category. Required multiplex codes: Where the habitat is part of a heathland habitat complex, it should be cross-referenced with either HL1 (Lowland heathland) or HU1 (Upland heathland) from the Habitat Complexes section as appropriate.

EM4 Purple moor grass and rush pastures (Molinia-Juncus) (PHT)

Description: Includes vegetation of fen-meadow and rush-pasture on poorly-drained peats or peaty gleys which are moist for a substantial part of the year, and at least moderately base-rich, often acid, sometimes calcareous, with a pH usually above 4.5. Although purple moor-grass *Molinia caerulea* and rushes *Juncus* spp. especially sharp-flowered rush *J. acutiflorus* are usually abundant it is difficult to provide a list of diagnostic species. (UK Biodiversity Group, 1995). **Not included: See EM0.**Required multiplex codes: See EM0.

Correlates with: NVC M22-25 (M26).

Matrix Vegetation

SC1 Dense/continuous scrub (PH1)

Description: All patches of continuous (>90% cover) scrub <0.25ha. (JNCC, 2003)
Not included: See SC1.
Required multiplex codes: See SC1.
Correlates with: Phase 1 - A2.1; NVC - W1-7, W19-25, M15, M25 (with tall *Myrica* dominant)

SC2 Open/scattered scrub (PH1)

Description: All areas including patches of open/scattered (<90% cover) scrub. (JNCC, 2003)
Not included: See SC1.
Required multiplex codes: See SC1.
Correlates with: Phase 1 - A2.2; NVC - W1-7, W19-25, M15, M25 (with tall *Myrica* dominant).

TS0 Scattered trees (SC)
Description: Usually native trees growing at low density, with canopy cover <20%. They generally occur as a relic of a former landscape, or as planted specimen trees, or as early stage self-sown secondary woodland.

Required multiplex codes: It is no longer necessary to qualify the species mix by cross-referencing with a WS~ tree species type category.

PA0 Patchy bracken (SC)

Description: Areas with scattered patches of bracken *Pteridium aquilinum*, or dominated by it (>50% cover).

PA3 Scattered bracken (PH1)

Description: Patches of bracken *Pteridium aquilinum* covering <50% of an area. (JNCC, 2003) Correlates with: Phase 1 - C1.2; NVC - U20, W25.

Habitat Management

GM0 Undetermined grassland etc. management (LU)
Description: Use where it is not possible to define the management regime. This group of codes can be used with any open habitat such as grassland, heath, wetland, where relevant.

GM1 Grazed (LU)
Description: Either managed deliberately by farm stock, or naturally by wild animals, one a sufficient scale and regularly enough to maintain a closed grassland sward.

GM2 Mown (LU)
Description: Managed by regularly cutting the grassland mechanically. This may be in conjunction with stock grazing, or not.

GM5 Burning/Swaling (LU)
Description: The controlled periodic burning of vegetation (heather, grass, bracken, gorse etc.) for agricultural benefit and/or habitat management.