Dartmoor National Park Management Plan Review

Evidence review paper: Natural Environment

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1 INTRODUCTION

Dartmoor National Park covers 94,500 hectares (945 square kilometres / 365 square miles). It is the largest upland area in southern England and the most extensive granite landscape in the country. Its internationally important vegetation communities include blanket bogs (3.5% of England's total resource); upland heaths (3% of the resource); upland oak woods (13%); Rhôs pastures (20%); lowland pastures (6%); and valley mires (percentage unrecorded). It hosts the headwaters of 9 main river catchments and is the principal source of drinking water for much of Devon. Its deep peat stores 10 megatonnes of carbon, equivalent to one year's CO_2 output from UK industry.

The current five year Dartmoor National Park Management Plan expires at the end of 2019. Its visions for 'Habitats and Wildlife' and 'Natural Resources' are as follows.

- Dartmoor's internationally and nationally important habitats are expanded and linked and in optimal condition, supporting resilient ecosystems with healthy populations of priority species.
- Dartmoor's distinctive and high quality natural resources are managed and enhanced for environmental and public benefits.



Dartmoor National Park Management Plan Review process and timetable

This is one of six papers produced to support the 2019 Management Plan Review. It has been prepared by Devon Biodiversity Records Centre (DBRC), an independent partnership-led organisation hosted by Devon Wildlife Trust, whose remit is to collate, manage and disseminate biodiversity information.

The paper provides overviews of Dartmoor's habitats and species, and summarises the drivers and forces for change that they face. It incorporates material and suggestions received from members of Dartmoor National Park Authority's Conservation and Land Management Team, and concludes with a section outlining questions and issues raised by other stakeholders including the participants at the Dartmoor Debate workshop (Natural Environment Evidence Review) on 16 November 2018.

Discussions at the workshop emphasised the importance of soils. Soil type, management and erosion have profound influences on vegetation cover, species diversity, farm productivity, water quality and many other factors relevant to Dartmoor's natural environment. Due to their complexity these issues are beyond the scope of this document, but they should be explored further as part of the wider preparations for the next Dartmoor Management Plan.

Further insights into issues addressed in this paper can be found in the following documents.

- Living Dartmoor: A Strategy to deliver benefits for Dartmoor's Wildlife (DNPA 2013)
- The State of the Park Report 2017 (DNPA)
- A Landscape Character Assessment for Dartmoor (LCU 2017)
- Dartmoor Local Plan Topic Paper 1 Natural Environment Version 2 (DNPA 2018)

2 DARTMOOR'S HABITATS

2.1 DESIGNATED SITES

Historically the primary means of identifying, protecting, monitoring and influencing the management of important wildlife habitats has been through systems of site designation.

28% (26,277 hectares) of Dartmoor National Park is statutorily designated and protected, lying within 42 Sites of Special Scientific Interest (SSSIs) (DNPA 2017). 16 of the SSSIs were designated for geological features. The remaining 26 were designated for their biodiversity interest: these are mostly large (and often spatially contiguous) tracts of open moorland and adjacent wooded valleys.

While the approach to SSSI notification on Dartmoor was to select large exemplar sites, much of the National Park's wildlife depends on the lower-lying ancient field landscape where few sites are statutorily protected for their species or habitat value. 237 mostly small and dispersed County Wildlife Sites (CWSs) cover 2,371 hectares (2.5% of Dartmoor), supporting such habitats as hay meadows, Rhôs pasture and small woodlands. A further 131 Unconfirmed Wildlife Sites (UWSs) covering 1,037ha (1% of the Park) meet the criteria for CWSs, but the owners are either unknown or not willing for their land to be designated (DNPA 2017). Neither CWSs nor UWSs enjoy any legal protection, although they are afforded some protection from development through Local Plan policies.

SSSI condition

Outcome 1A of 'Biodiversity 2020: A Strategy for England's Wildlife and Ecosystem Services' (Defra 2011) requires that at least 50% of SSSIs should be in 'favourable' condition by 2020, with at least 95% either 'favourable' or 'recovering'. The former target (50% 'favourable') is not achievable on Dartmoor within this timeframe.

The 2017 State of the Park report records 98% of Dartmoor's SSSI area as being in 'favourable' or 'unfavourable recovering' condition. However this combined figure masks the low rate of 'favourable' status, particularly for moorland SSSI units (see Figure 1). Just 16% of Dartmoor's SSSI area was in 'favourable' condition, compared to an average of 38% for England as a whole. Sites covering 21,700 hectares (82% of SSSI area, versus 57% nationally) were 'unfavourable recovering'; and most have been in this condition for more than 10 years. The most significant causes (in terms of areas negatively affected) include inappropriate levels of moorland grazing, hydrological degradation resulting from past drainage and peat cutting, and atmospheric nitrogen deposition.

The area of 'unfavourable recovering' SSSIs has risen over the last 10 years (see Figure 2). However this increase is not considered to reflect an actual decline in habitat condition. Rather it is a result of an administrative decision to incorporate smaller SSSI units (formerly assessed as 'favourable') into larger units assessed as 'unfavourable recovering' (DNPA 2017).



Figure 1. The condition of SSSIs and CWSs in Dartmoor National Park based on status dates of 2007-2017 (SSSIs) and 1990-2017 (CWSs).



Figure 2: Percentages of SSSI area in 'favourable' and 'unfavourable recovering' condition, for England (blue) and Dartmoor National Park (green). (Source: State of the Park 2017)

County Wildlife Site condition

With statutory protection focused on the high moor there have been limited resources available to maintain the wildlife value of unprotected lower-lying Dartmoor habitats, which are mostly small, often isolated parcels of land under multiple ownership.

With the implementation of the Living Dartmoor Strategy (2013) DNPA has begun to address this issue, producing action plans for some of the habitat types represented by Dartmoor's CWSs, the

majority of which are designated for grassland or woodland and lie within the enclosed areas of the Park. Nonetheless, given the growing emphasis on building ecological resilience through enhancing habitat quality and connectivity at landscape scale (following Lawton 2010), the absence of core protected areas (i.e. SSSIs) in many parts of the National Park may still be a hindrance.

Resources for monitoring CWSs are limited. A sample of sites is assessed every year to determine whether past and current management is having a positive wildlife impact. Of the 88 sites monitored since 2009, 39 (44%) were rated 'green' (good condition), 40 (45%) 'amber' (acceptable condition), and 9 (10%) 'red' (declining condition – which has mostly been due to inappropriate levels of grazing (DNPA 2017). See Figure 1.

With some valuable habitat types having been omitted from the process of SSSI notification on Dartmoor - for example neutral grassland, valley mire, Rhôs pasture and wet woodland - there are potentially many CWSs which are (or were) of SSSI standard in the National Park. However records of their condition may be many years out of date or non-existent. More than a third of CWSs have been unmonitored for 20 years or more, and some have not been resurveyed since their original designation. This is not just due to lack of resources: access may also be limited. CWS owners are under no obligation to permit monitoring, and nor are they obliged to manage their sites for the features for which they were designated.

At landowners' discretion there may be future potential to secure some level of protection for CWSs (as well as for undesignated sites) through Conservation Covenants (Defra 2019). If adopted in England, these legal agreements would allow landowners to commit to preserve and improve features of their land such as individual trees, whole woodlands and flower-rich meadows. They would be binding on both current and future owners of the land and would be overseen by responsible bodies (perhaps including DNPA) to ensure that the agreed land management obligations are delivered. A consultation on the possible implementation of Conservation Covenants was launched by the government on 22 February 2019.

Unconfirmed Wildlife Sites

Surveys of Dartmoor's ancient woodlands, Rhôs pastures and dry grasslands were carried out in the late 1990s and early 2000s. Once the results had been reviewed, the owners of sites meeting CWS criteria were contacted where possible and the sites designated as CWSs. Sites meeting the criteria but where the landowner could not be contacted, or did not give permission, became Unconfirmed Wildlife Sites - these are generally unmonitored and any changes in their condition are unknown.

There may also be some entirely overlooked sites of CWS standard. As recently as 2018 a 20 hectare mosaic of unimproved meadow (some of SSSI standard), Rhôs pasture and upland oakwood was designated as a CWS; prior to an approach from the landowner, the land had not been recognised even as a candidate for survey.

2.2 PRIORITY HABITATS

Section 41 of the 2006 Natural Environment and Rural Communities (NERC) Act lists 56 priority habitat types for England. Of these 17 are of particular relevance on Dartmoor. They include the habitats mapped in Figure 3a, together with two linear habitats (hedgerows and rivers).

Outcome 1A of 'Biodiversity 2020: A Strategy for England's Wildlife and Ecosystem Services' (Defra 2011) calls for 90% of priority habitats to be in favourable or recovering condition by 2020. Outcome 1B requires "more, bigger and less fragmented areas for wildlife, with no net loss of priority habitat and an increase in the overall extent of priority habitats by at least 200,000 hectares".

In order to assess progress against these goals on Dartmoor, the first requirement is to know how much priority habitat we have and where it is. Unfortunately estimates currently vary widely. Figure 3a shows the believed *minimum* extent of priority habitats - 30% of the National Park area - based on the combined areas of SSSIs (27.5%) and CWSs (2.5%) known to support these habitats. Meanwhile Figure 3b has been created from Natural England's open licence Priority Habitat Inventory dataset, together with a range of other source material held by DNPA including Farm Environment Plans, Rural Land Registry / Higher Level Stewardship data, and aerial photography interpretation. This indicates that priority habitats cover 52% of the National Park.

The uncertainty relates not just to the extent of priority habitats, but also their categorisation. For example with mosaics of blanket bog, upland heath and acid grassland, detailed spatial data on the extent of each component are not always available for mapping. Similarly baseline knowledge of the extent of Dartmoor's valley mires is still incomplete, having been mapped from aerial photos but not ground-truthed. As a result of such issues the Natural England Priority Habitat Inventory (on which Figure 3b is based) is sometimes vague. It shows approximately 1,300 hectares as 'No main habitat but additional habitats present'. In other instances mosaics of varied habitat are represented by an arbitrary headline habitat type (such as grass moorland, fragmented heath, good quality semi-improved grassland), none of which correspond the official priority habitats referred to by the NERC Act 2006 and the Biodiversity 2020 Strategy.

Assuming that we are eventually able to establish a reliable baseline for the extent of priority habitats on Dartmoor, maintaining up-to-date inventories will still be a challenge. Data for the National Park is held piecemeal in varying formats by a number of stakeholder organisations, having been derived from sources including Natural England's Priority Habitat Inventory, DBRC and DNPA surveys, and NBN data from SSSI survey and condition monitoring. Our knowledge changes as sites are resurveyed, and the sites themselves are constantly being expanded, reduced, transformed into different habitats (by design or by natural succession), or lost entirely due to changed management or development. Habitats within the large SSSI commons should in theory be easier to keep track of as these sites benefit from regular NVC vegetation mapping undertaken by Natural England, but even here there are difficulties – firstly with accessing the data collected, and then with the lack of resource available to carry out detailed analysis of it.

Notwithstanding their shortcomings, the maps in Figure 3a and Figure 3b do help us to visualise where the richest concentrations of Dartmoor's important habitats - and the intricate transitions between them - may lie.



Figure 3a. Indication of the believed *minimum* extent of Priority Habitat areas on Dartmoor, based on DBRC and DNPA data. Here mapped habitats cover 30% of the National Park.



Figure 3b. Map based on Natural England's Priority Habitat Inventory (2015) – indicates the believed *maximum* extent of priority habitat (52% of the National Park), with Living Dartmoor's Key Wildlife Areas superimposed (hatched).

If we accept that Figure 3b's estimate of overall priority habitat extent (52% of the National Park) is more accurate than Figure 3a's (30%), then - given that the full extent and condition of priority habitat on Dartmoor is incompletely recorded - progress towards Biodiversity 2020's priority habitat

goals can only be estimated by interpolation of sample figures. Furthermore the additional 22% of National Park area embraced by Figure 3b is all non-SSSI land, for which there are few resources (and in some cases possibly no landowner permission) to carry out condition monitoring – so our knowledge is likely to remain incomplete indefinitely.



2.3 LIVING DARTMOOR HABITATS – KEY WILDLIFE AREAS

Figure 4a. Living Dartmoor's Key Wildlife Areas (KWAs).



Figure 4b. The distribution of hedges (orange lines) within and around Key Wildlife Areas

The Living Dartmoor Strategy (DNPA 2013) targets conservation in 'Key Wildlife Areas' (KWAs) that cover just over two thirds of the National Park (Figure 4a, also available as an interactive map at http://www.dartmoor.gov.uk/about-us/about-us-maps/living-dartmoor-map). These are strategic areas identified as priorities for habitat conservation, enhancement and expansion. Each of the discretely mapped KWAs is primarily associated with one of four broad habitat types, as follows.

- Woodland (upland oakwood; lowland mixed deciduous woodland; some of the National Park's wet woodlands; veteran trees; traditional orchards).
- Rhôs pasture (including the remaining wet woodlands).
- Moorland (blanket bog; upland flushes; fens and swamps; upland heathland).
- Dry grassland (lowland meadow and lowland grassland).

A fifth KWA, 'Wider countryside habitats', encompasses rivers and other water bodies; hedgerows; stone walls and road verges; rocky outcrops; and quarries and caves. This KWA is not confined to discretely mapped areas. Rather it occurs inside other four KWAs and in the land around them (which Living Dartmoor refers to as 'white space'). In Figure 4b, the network of orange lines shows one component of this KWA, hedgerows and lines of trees.

Additional areas at and beyond the margins of the Park – 'Habitat Links' (outlined in red) - are also identified for their potential to support enhanced ecological connectivity between Dartmoor's natural resources and the biodiversity of the wider landscape.

2.3.1 MOORLAND

Dartmoor's internationally important moorland habitats cover 47,000 hectares (470 square kilometres), 50% of the National Park area. Most is common land, open to access on foot and on horseback, and with grazing rights for local farms. This is a multi-use landscape where biodiversity management must be integrated with other interests including agriculture, archaeology, recreation and military training.

The single moorland Key Wildlife Area stretches north-south from Okehampton to Ivybridge, and east-west from Haytor to Mary Tavy. Its mosaic habitats can be subdivided into blanket bog (8,500 hectares, 3.5% of the English resource); upland heath (7,300 hectares, 3%); plus smaller areas of lowland heath, grass moor & bracken, and valley mire.

Half of the moorland has SSSI status, and component SSSIs are monitored on a rolling programme by Natural England. As described in section 2.1 of this document (Designated Sites) the great majority of the National Park's SSSI moorland has 'unfavourable – recovering' status, and much of it has been in this condition for more than 10 years. Data on the condition of the other (non-SSSI) half of the moorland resource are lacking, as none of this area has CWS designation either. It is logical to surmise that it is in no better state than the SSSIs.

One reason for the decline in moorland condition is sub-optimal grazing levels – too high in some areas, too low in others, and sometimes using an inappropriate mix of grazing species. Living Dartmoor (2013) observes that achieving grazing levels suitable for all of the mosaic habitats within a common is always going to be difficult, not least because it is hard to stop unenclosed livestock from preferentially grazing some areas and neglecting others. It recommends that each common

should have its own tailored set of management prescriptions, and this is being explored through the 'Our Common Cause' project. Other causes of unfavourable condition include the drying out of blanket bogs due to past drainage and peat cutting, which may cause longer-rooted species such as purple moor grass to dominate; and atmospheric nitrogen deposition, which again promotes the increase of more vigorous plant species at the expense of more diverse swards. The South West Peatland Partnership is trialling peatland restoration on five sites on Dartmoor.



Two of the habitats that fall under the 'Moorland' heading. This upland heath (Haytor) and valley mire (Devon Wildlife Trust's Emsworthy nature reserve) are less than a mile apart.

2.3.2 DRY GRASSLAND

Dartmoor's dry grasslands consist of enclosed fields with acidic or neutral soil, managed either as hay meadows or permanent pastures. Those which have not been agriculturally improved often have rich botanical and invertebrate assemblages. The hay meadows are particularly noted for their orchid flora, their Living Dartmoor flagship species being the greater butterfly orchid. Dense swathes of bluebells are sometimes seen in permanent pastures across the eastern side of the moor.

More than 95% of England's species-rich dry grasslands have been lost since 1945. An estimated 7,500 hectares remain, of which 6% (450 hectares) are within Dartmoor National Park. Dartmoor's dry grasslands include a single 2.2 hectare SSSI (Dunnabridge Farm meadows), along with a number of County Wildlife Sites and Unconfirmed Wildlife Sites. All of Dartmoor's dry grassland County Wildlife Sites are being monitored on a 12-year rolling programme.

Living Dartmoor's Key Wildlife Areas for dry grassland focus on three main clusters of species-rich fields, around Postbridge, Dartmeet and Grenofen. While these KWAs total 1,190 hectares, only 183 hectares (15%) were covered by the target habitat when the Living Dartmoor delivery plan was produced, of which 40% were assessed as being in optimum condition, 40% as being in good condition, and 20% as needing urgent attention.

Living Dartmoor recommends that the other 1,007 hectares (85%) of land within the KWAs should be considered for creating new meadows where appropriate. Meanwhile an estimated 267 hectares of Dartmoor's existing species-rich dry grassland lie outside of the KWAs defined for this habitat: the Living Dartmoor delivery plan stresses that these should continue to be managed and conserved appropriately.



Dartmoor hay meadow (with greater butterfly orchid) and permanent pasture (with bluebells).

In 2015 the Moor Meadows community initiative was set up to restore, conserve and create flowerrich grasslands across Dartmoor. As at February 2019, 86 meadows covering 150 hectares had been registered by their owners on the project's website <u>https://moormeadows.org.uk/map/</u>. Some of these were already known to conservation bodies through their SSSI / CWS designation, but others are either newly restored / created or were previously unrecorded. The Moor Meadows database is a work in progress and there are more Dartmoor meadows still to be added.

2.3.3 RHÔS PASTURE

Rhôs pastures are typically enclosed wet valley bottoms populated by purple moor grass, rushes, flowering plants and wet woodland. Dartmoor's Rhôs pastures cover 1,200 hectares, more than 20% of the English resource of this internationally rare habitat. However because these sites were not surveyed until the mid-1990s they were not considered for SSSI designation, despite the fact that some are of the appropriate standard and merit SSSI levels of protection. Many do now have (unprotected) CWS status.

Dartmoor's four Rhôs pasture Key Wildlife Areas total 2,109 hectares, of which 659 hectares are actually covered by the target habitat. These represent Dartmoor's largest remaining concentrations of Rhôs pasture, supporting the main populations of all of its associated key species. However these 659 hectares are only 55% of the National Park's resource and it is essential that the remaining 45%, scattered outside the KWAs, should also be managed for their wildlife conservation value. 'Living Dartmoor' (2013) reported that monitoring of a sample of 26 Rhôs pastures over the four years prior to publication had found 42% of sites in optimum condition, 50% in good condition and 8% requiring urgent attention.

Wet woodland in the four Rhôs pasture KWAs covers 43 hectares. This is an important resource in its own right, but one that will take over from open Rhôs pasture if sites are neglected or if suitable grazing animals are unavailable. The two flagship species chosen for the Rhôs pasture KWAs highlight the compromise that must be achieved. Marsh fritillary butterflies require open habitat with plenty of their larval food plant, devil's bit scabious; meanwhile willow tits need areas of scrubby woodland with decaying standing timber for nesting and foraging. To maintain this balance, regular cattle/pony grazing in summer and autumn should be combined with occasional mechanical

control of young birch and willow. Living Dartmoor recommends that each individual Rhôs pasture site be assessed in order to determine the ideal local ratio for open to wooded habitat, and to identify opportunities for restoration, creation and improved connectivity.

2.3.4 WOODLAND

Dartmoor's Atlantic oak woodland, often referred to as 'temperate rainforest', is of international importance as a breeding ground for a trio of African migrant birds, the pied flycatcher, redstart and wood warbler. It is also a stronghold for many other declining species including hazel dormice, barbastelle bats and blue ground beetles.

Wet woodlands of willow, birch and alder can be found adjacent to the oakwoods, and also blending into Rhôs pastures and valley mires. Dartmoor still has some orchards although these have declined in number from 780 in 1960 to 460 in 2000, and very few are still being managed. Veteran trees are not numerous but can still be found in a few places, for example at Whiddon Deer Park SSSI.

Recent publications indicate that 12% (11,242 hectares) of the National Park is covered in woodland (broad-leaved and conifer combined), and that 56% of this area is currently in active management (State of the Park 2017). Ancient semi-natural woodland (i.e. land that has been wooded continuously since at least 1600 AD) covers 2,957 hectares, with 249 hectares being plantations on ancient woodland sites or PAWS (Dartmoor Local Plan Topic Paper 1 – Natural environment). 17 Dartmoor woods covering 2,590 hectares are designated as SSSIs; and seven of these combine to form the 2,157 hectare South Dartmoor Woods Special Area of Conservation.

However although these figures provide a good guide to the extent of woodland n the National Park, the actual area is likely to be constantly growing, as unmanaged areas on the moorland fringe gradually revert from open land to tree cover. Furthermore, data on small parcels of woodland are incomplete. For example DNPA's work to refine the mapping of ancient woodland suggests that the resource is larger than suggested above, at 3,549 hectares. The advent of LiDAR data analysis may enable more accurate assessments to be made in the future.

Although unlikely to increase the aggregate area of the resource significantly, improved data on the spatial distribution of small copses and fragments of formerly larger woods (ancient and otherwise) could add much to our knowledge of the connectivity of Dartmoor's broadleaved habitat networks. This knowledge is likely to be invaluable in assessing the resilience of the Atlantic woodland resource (upland oak woods, upland mixed ash woods and certain communities of wet woodland) for which the Dartmoor valleys are an important international stronghold. Effects of climate change and atmospheric pollution on, for example, the specialist epiphyte communities of these woods may make functional woodland habitat networks more critical in the 21st century than before (Ellis 2009; Ellis 2010).

2.3.5 WIDER COUNTRYSIDE HABITATS

Wider countryside habitats include hedgerows, stone walls and road verges; rocky outcrops, quarries and caves; and rivers and other bodies of freshwater.

In some cases initiatives aimed at characteristic species (e.g. greater horseshoe bats in quarries and caves - see <u>http://devonbatproject.org/</u>) create a focus on the condition of these habitats. Likewise,

mechanisms focusing on water quality mean that the habitat condition of watercourses is watched and regulated.

Hedgerows

Analysis in Dartmoor's NCA profile (Natural England 2014) recognises the ecosystem services (for example pollination and habitat connectivity) provided by 'dense networks of species-rich hedgerows surrounding the moorland core'. Their biodiversity importance has been highlighted by a two-year study near Hatherleigh, just north of Dartmoor, which discovered 2,070 species in a single hedgerow that the author described as "nothing exceptional – there are thousands of similar roadside hedges throughout the county" (Wolton 2015). Meanwhile research currently being undertaken in the Blackdown Hills AONB indicates that hedgerows could also contribute several millions of pounds' worth of additional annual benefits such as flood attenuation, access and wellbeing, renewable fuel potential etc.

Dartmoor is rich in hedgerows, particularly in the 'white space' between other KWAs – see Figure 4. The high density of hedges right up to the moorland line constitutes an important ecological linkage between upland grazing areas, lower-lying enclosures, and more intensively farmed areas at the margins of the Park and in the adjacent Devon countryside. This network will be of vital importance where species are prompted - by agricultural intensification of in-bye land, and/or climate change - to move or extend their ranges. Hedgerows are key to the resilience of the natural environment across the whole National Park.

However the precise extent of Dartmoor's hedgerow resource is unclear. This represents an important gap in our knowledge of the Park's natural assets. An estimate can be made based on the 'Southwest woody habitat corridors' dataset developed from LiDAR manipulation by CEH (Broughton et al. 2017). This suggests there are in the region of 5,450 km of woody habitat corridors (hedgebanks with woody vegetation, simple hedges and non-woodland lines of trees) within the National Park boundary. 95% (length basis) of these features lie outside common land but 248km are closely associated with commons areas (generally boundaries between commons and in-bye). The density of features outside the commons can be expressed as an average of about 8km per 100ha (i.e. per 1 x 1km square) but this is a considerable underestimate in some areas. The LiDAR derived map has a few shortcomings causing some features to be omitted and others to be erroneously interpreted as hedges (e.g. small patches of scrub or isolated trees), but nevertheless gives a helpful indication of the resource and its distribution.

Rivers and other water bodies

Figure 5 shows that as at 2016, the WFD (Water Framework Directive) ecological status of most of Dartmoor's waterbodies was rated as 'good' or 'moderate'. The 'poor' status assessments for three waterbodies in the north east of the Park were associated with fish failure due to abstraction, barriers, bank erosion, point source industrial pollutants and diffuse agricultural pollutants.

Dartmoor is the main source of drinking water for around 840,000 people in Devon. The population in the National Park's hinterland is projected to increase by 13% in the next 20 years, so pressure on water supply will grow commensurately.



Figure 5. Ecological condition of Dartmoor's rivers, assessed against WFD objectives (2016 data)

A conservation focus on upper catchments should help to regulate flows and attenuate flood risk, improving water supply resilience and generally enabling more cost-effective water resource management, as well as bringing biodiversity benefits. Formally recognising the calculable natural capital value of SSSI blanket bog, for example, will help to ensure the quality of water in reservoirs downstream, and simultaneously boost wildlife conservation and community engagement.



The River Dart

2.3.6 'WHITE SPACE'

31,436 hectares – around one third of the National Park - lies outside of Living Dartmoor's Key Wildlife Areas and is shown on the KWA map (Figure 4a) as 'white space'. SSSIs and CWSs cover 1.3% of this area. DBRC mapping and analysis of Land Cover 2000 data (Centre for Ecology and Hydrology 2000) indicates that the approximate distribution of white space land use is as follows.

Land cover type	Estimated area within 'White Space' (hectares)	Estimated area as a % of 'White Space'		
Improved grassland	16,841	54		
Broad-leaved woodland	4,619	15		
Arable	4,252	15		
Acid grassland	1,932	6		
Other grassland	1,144	2		
Suburban/rural developed	855	4		
Coniferous woodland	765	3		
See also Figure 4b, which illustrates the density of hedgerows in the white space.				

Although designated sites and priority habitats cover a relatively low percentage of its area, the white space has records of 65% of the Park's Section 41 species (rare and threatened species listed under Section 41 of the 2006 Natural Environment and Rural Communities (NERC) Act). Localised records (at a tetrad scale or better) show the following distribution.

Living Dartmoor Koy Wildlife Areas	Number of	% of Dartmoor's
Living Dartmoor Key whome Areas	S41 species	total S41 species
Woodland	92	69%
White space (outside boundaries of KWAs)	86	65%
Moorland	66	50%
Habitat links	33	25%
Rhôs pasture	31	23%
Dry grassland	16	12%
Dartmoor Total	133	100%

It can be seen from these figures that unsympathetic land management in the white space could have serious impacts on species for which Dartmoor is an important stronghold, and that these areas should therefore continue to be treated as a wildlife conservation priority – even if a lesser one than the KWAs – in National Park planning and decision making.

2.4 LANDSCAPE CHARACTER

'A Landscape Character Assessment for Dartmoor National Park' (LCU 2017) records that "its landscape is of outstanding importance, protected under the first statutory purpose of National Parks" and that "one of the two Statutory purposes of the National Park is stated as to conserve and enhance the natural beauty, wildlife and cultural heritage of the National Park". It goes on to quote the following core strategic aim from the Dartmoor Local Plan:

"To conserve and enhance Dartmoor as a living, working, evolving landscape that continues to offer special qualities of peace and quiet, remoteness, solitude, unspoilt natural beauty, wide open spaces, wildness and wildlife habitats, the freedom to roam, and archaeological qualities/sense of history."

Conserving and enhancing all of the listed qualities simultaneously will prove problematic in some parts of Dartmoor. For example, the right to roam may compromise breeding success for certain birds such as ring ouzel and curlew. Equally, strict adherence to maintaining all 'wide open spaces' in their current 'wide open' form may sometimes conflict with efforts to improve the connectivity and resilience of other important habitats, and of any endangered species populations that depend upon them. Understanding the importance of balancing landscape and biodiversity priorities may help in establishing a new vision of what the National Park could look like in future.



Figure 6: Dartmoor's Landscape Character Type Classification

3 SPECIES

3.1 SPECIES MONITORING

It is commonly perceived that biodiversity is well audited within protected landscapes. However while good records for many of the charismatic flagship species are kept, the desired level of monitoring for others is difficult to maintain in a systematic way. Some require specialist skills, either to identify or survey (for example lichens and the bog hoverfly). Often data are collected by unpaid workers who may have only limited time to devote to the task. Lack of monitoring resources and niche knowledge could result in the disappearance of species whose decline had not been identified in time for appropriate action to be taken.

Even for the small selection of Priority Species targeted in Living Dartmoor for their special conservation importance, best assessments of status and population change at any one time may still depend on expert judgement rather than hard evidence. For example, the 2013 delivery plan for the bog hoverfly sets apparently modest targets, as follows:

1. By 2018, have records from the past 5 years for at least 15 sites in 8 areas

2. By 2023, have records from the past 10 years for at least 18 sites in 10 areas

...yet at present, post-2013 records for the species fall some way short of these goals. (New technology currently in development through a PhD project may help, by enabling the detection of bog hoverfly larvae through eDNA analysis.)

Another issue to be addressed is record submission and sharing. DNPA & DBRC collect and maintain species records for the National Park, and DBRC collates species & monitoring data for the whole of Devon. However there are now many online records submission systems, in addition to the traditional curators of biological data like DBRC. This may have created a paradox of choice for some recorders, with the result that important records are not submitted to any repository at all and therefore cannot be used to our understanding of current status and long term change.

3.2 LIVING DARTMOOR'S 12 KEY SPECIES FOR CONSERVATION

Because it would be impossible to monitor the full range of Dartmoor's characteristic biodiversity, effort has typically been focused on priority species (defined at national, county or Park level).

Living Dartmoor's 12 Key Species for Conservation were chosen due to their need for directly targeted conservation management (because of scarcity, vulnerability or specialist habitat requirements). They comprise:

- Blue ground beetle
- Bog hoverfly
- Deptford pink
- Dunlin
- Flax-leaved St John's wort
- Greater horseshoe bat
- High brown & pearl-bordered fritillaries
- Red-backed shrike
- Ring ouzel
- Southern damselfly
- Vigur's eyebright

The State of the Park Report 2017 reports that populations of 11 of these 12 species are currently 'stable' or 'increasing'. Improvement in their fortunes might be interpreted as an indication of broader biodiversity gains. However there is little evidence that these 12 species as a suite provide an adequate barometer for the health of the National Park's wider habitats, outside of their own particular niches. The heat map (Figure 7) shows that the density of records pertaining to all 12 combined is low over most of the Park, as might be expected for rare and threatened organisms. Their intrinsic biodiversity value is clear, but in order to assess the status of wider species

assemblages and habitats, it will be necessary to monitor other indicators. Selecting more widespread species for regular monitoring would provide more (and more universally relevant) information. Furthermore it could be argued that keeping common Dartmoor species common is as crucial as saving rarities from extinction.



Figure 7. The intensity of recording of the Living Dartmoor Strategy's Key Species for Conservation, in relation to the strategy's Key Wildlife Areas.



Figure 8. The intensity of recording of NERC S41 species (as estimated from DBRC data holdings) in relation to designated sites. The main concentrations of records are away from the main concentrations of SSSIs. This may be a true picture of S41 species abundance on Dartmoor, or it may merely indicate those places where the most recording effort has taken place.

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3.3 DEVON'S SPECIAL SPECIES

The list of priority species for the Devon Biodiversity Action Plan (published 1998) has been updated by DBRC and Devon County Council through a process of consultation with a wide range of experts. This resulted in the publication of a long list of 1,600 species known to be rare in Devon (Priority Species) and a short list of 96 species (Devon's Special Species) for which Devon has a particular responsibility (see: http://www.dbrc.org.uk/devon-special-speci-2/).

Appendix 1 shows the 29 short list species (out of the 96 for the whole county) that are known to be present on Dartmoor. These – in addition to Living Dartmoor's 12 Key Species - could be considered as candidates for monitoring and conservation priority for the forthcoming Management Plan period. However once again, we should not assume that monitoring these rarities will tell us everything we need to know about the health of Dartmoor's wider biodiversity.

Key Wildlife Area	Flagship Species
Moorland (including blanket bog, upland heath, valley mire, acid grassland, bracken slopes, lowland heath)	Skylark, snipe
Dry grassland	Greater butterfly orchid
Rhôs pasture (including wet woodland)	Marsh fritillary, willow tit
Woodland	Pied flycatcher
Wider Countryside Habitats - hedgerows, stone walls and road verges	Dormouse
Wider Countryside Habitats - rivers and other water bodies	Otter, salmon
Wider Countryside Habitats - rocky outcrops, quarries and caves	Greater horseshoe bat

3.4 LIVING DARTMOOR'S KEY WILDLIFE AREA 'FLAGSHIP' SPECIES

The Living Dartmoor strategy (DNPA 2013) explains that 'some familiar and relatively widespread species of each Key Wildlife Area have been chosen to represent the importance and value of the habitats that support them'. The ten KWA flagship species are shown in the accompanying table. Two of these (marsh fritillary and greater horseshoe bat) are also Living Dartmoor Key Species (see 3.2 above). The strategy goes on to say that there will not be any particular emphasis on monitoring

and site management for the other eight flagship species 'unless this is needed to further the conservation of the habitat or increase public involvement in wildlife issues'.

It would be valuable to consider now whether a focus on these organisms in Dartmoor National Park *would* actually be more widely beneficial than solely monitoring and managing for species with more limited populations and ranges. Some of the flagship species are already subject to considerable specialist interest and detailed recording within the National Park. Bringing all of this information together to support the management and enhancement of Dartmoor's Key Wildlife Areas might have considerable merit. Furthermore it would enable DNPA to engage more directly with the large number of local volunteers who help to deliver these initiatives, many of whom will have little knowledge of the Authority's involvement with the natural environment.

- Snipe and willow tits are both currently the subjects of multi-partner, species-specific surveys across Dartmoor.
- Marsh fritillary flight and web counts take place annually, coordinated by Butterfly Conservation.
- Pied flycatcher monitoring has been continuing uninterrupted since 1955, and the Dartmoor-based http://www.piedfly.net/ is using the huge data set generated to undertake numerous migrant bird studies and publish articles in academic journals.
- There are several PTES-affiliated dormouse nestbox schemes within the National Park, as well as individual licensed dormouse surveyors collecting anecdotal records from various parts of the moor.
- DBRC's Otter Spotter network has been generating quarterly monitoring results from many reaches of Dartmoor's rivers for more than 20 years.
- Salmon numbers and health are closely monitored by anglers.
- The Devon Greater Horseshoe Bat Project includes one of the largest citizen science initiatives ever seen in the South West, the Devon Bat Survey. Parts of Dartmoor are included in its priority target areas, and copious distribution data is being generated for bats in general, and for greater horseshoes in particular.



Dartmoor's marsh fritillaries and pied flycatchers have both been the subjects of intensive volunteer-led monitoring schemes for many years.

3.5 MISSING SPECIES

Many species that were once widespread on Dartmoor are currently absent or occupying muchreduced ranges. Local reintroductions of lost or declining species could potentially bring benefits for the natural environment and also for human populations in and around the National Park, through enhanced ecosystem services (such as water quality and flood alleviation) and eco-tourism revenues.

Species could be considered by the Management Plan Review for reintroduction on a Park-wide, catchment-wide or smaller scale basis. The symbolic restitution of charismatic species could bring economic and social benefits in its own right, but there may be more support for species that bring tangible physical advantages as well.



Wild-living beavers are being studied through East Devon's River Otter Beaver Trial (2015-2020). Their dams and channels are restoring natural processes to tributaries and headwaters (top right). The animals are breeding successfully and attracting visitors as well as proving popular with local people. Meanwhile Devon Wildlife Trust's Enclosed Beaver Project in West Devon has shown beavers' ability to enhance water quality (bottom left) and increase biodiversity. Candidates for reintroduction could include species selected for their ability to restore habitats and increase ecosystem resilience (for example beavers); those that help to control invasive species (such as pine martens, which could predate grey squirrels); and species that have simply disappeared / declined, but have potential to resume their niches given restoration of lost habitat and/or reduced predator populations (such as curlews).

A key consideration in the selection of reintroduction species is whether the extent, quality and functional continuity of available habitat (i.e. the ability of possibly disjunct patches of habitat to function as a continuum for the species concerned) meets the minimum required for a sustainable viable population. Species reintroduction may need to be preceded by habitat restoration.

In the case of **European beavers**, it would be the animals themselves that carry out their own habitat restoration work. The evidence for the far-reaching environmental, ecosystem and public benefits that could be realised from beavers living elsewhere in Devon (Elliot et al. 2017) is compelling. Experts have little doubt that these animals would thrive in some Dartmoor catchments, maintaining mires and restoring connectivity between riverine and adjacent terrestrial habitats at landscape scales.

Whilst fish, plants and aquatic insects are used as indicators of rivers' ecological condition, the absence of characteristic riparian mammal species is not always perceived as an indication of a compromised habitat, perhaps because humans have grown accustomed to their absence. This seems little basis for arguing against the return of **water voles** to Dartmoor's rivers, if promising mink-free habitat can be identified; especially if recent reintroductions in two other upland National Parks (Exmoor in 2018 and Yorkshire Dales in 2016) prove to be successful.

The **pine marten** is frequently mentioned in conjunction with Dartmoor and the apparently spontaneous re-colonisation of Dartmoor woods by a related mustelid, the polecat, suggests a landscape with the necessary ecological capacity. Feasibility assessments undertaken by the Vincent Wildlife Trust (MacPherson 2014) did not identify Dartmoor as a priority reintroduction area but restoration and reconnection of the larger native woodland complexes in the near future – for example in the Teign Valley between Chagford and Dunsford - could raise the viability of the National Park as a base for a future Devon population.

There may also be arguments for bolstering the populations of still present, but declining, Dartmoor species. For example the National Park's few remaining **curlews** are the last still attempting to breed in Devon, following a severe county-wide decline since 1985. They are therefore of great cultural as well as conservation importance. In 2018 the Duke of Cornwall convened a meeting at Two Bridges to discuss the plight of upland waders, which included a visit to targeted area for possible curlew recovery. However the birds occupying the National Park's last four territories are believed to consist largely of elderly birds for whom egg production may no longer be viable. In that contingency, introducing younger individuals from stronger populations elsewhere might rescue Dartmoor's breeding curlews from extinction.

Much of the attention concerning species reintroductions focuses on vertebrate life. Generally speaking larger organisms need more space, so research into the potential habitat restoration benefits of reintroducing smaller species (i.e. invertebrates) on smaller spatial scales could be a cost effective and uncontroversial launch point for a long term species reintroduction strategy. For example the **narrow-headed ant** *Formica exsecta*, whose only remaining English population is in the

nearby Bovey Basin, was once resident on Dartmoor. It is now the focus of a 'Back from the Brink' rescue programme led by Buglife, and trial reintroductions are already taking place outside the National Park. If a successful technique is found, reintroductions on Dartmoor could be a logical next step. Reintroductions to bolster the populations of still extant, but scarce, dragonfly / damselfly species might also be considered.



Non-breeding curlew foraging at Emsworthy Mire, spring 2018. (Photo: Robin Morrison)

4 DRIVERS AND FORCES FOR CHANGE IN THE NATURAL ENVIRONMENT

This section focuses on agents of change affecting species and habitats that are important to stakeholders. The sequence in which they are presented does not imply any ranking of importance. The specific threats and opportunities implied by these forces have been addressed in detail elsewhere.

4.1 CLIMATE CHANGE

The available data suggest that climate change is already affecting Dartmoor's rainfall patterns, its seasonal temperatures, and the growing seasons of both natural and agricultural vegetation. It could also bring increases in seasonal floods and droughts, riverbank erosion, visitor pressure and wildfire frequency; reductions in the uplands' water and carbon storage capacity, and reduced water quality; as well as complex changes in wildlife communities' constituent species and species interactions.

Summary of likely major impacts from climate change on Dartmoor's natural environment (adapted from DNPA's Dartmoor Local Plan Topic Paper 1: Natural Environment)

Warmer, wetter winters		
Increased frequency of river torrent and floods	Water environment : increased potential for catchments to become more prone to sudden spates – 'flashiness' - with the consequent erosion affecting both water quality and habitat quality, e.g. through acidic flushing. Positive feedback of erosion on channel flow rates leading to diminished water holding capacity of headwater streams.	
	Biodiversity : rapid soil erosion damages habitat, forcing movement of fauna into new areas. Erosion of peat leading to loss of important habitat and water / carbon storage capacity.	
	Access and recreation: flooding / waterlogging makes rights of way difficult to use.	
Longer growing season	Biodiversity : longer growing season (the 1981-2010 average plant growing season was 15 days longer than that for the 1971-2000 period, which was in turn 6 days longer than the 1961-1990 average) results in the realignment of competitive interactions between species leading to change in vegetation communities, with some characteristic species being lost or diminished. For example a shift from heathy to grassy environments may be seen. Knock-on effects for associated species including the rise of thermophilous (warmth-loving) grasses and herbs on former heathy bracken slopes, leading to loss of heath/bracken specialist species (including conservation priorities such as pearl-bordered and high brown fritillaries).	
Phenological disruptions	Biodiversity : greater food resources for native/wintering species, and potential for asynchrony between spring-active species and their food sources (insects and nectar, nesting birds and insects). For example earlier oak leaf-burst triggers earlier emergence of canopy-dwelling micro-moth larvae, forcing earlier breeding by woodland birds that rely on caterpillars to feed their young. Major problem for migrant breeders if they cannot change arrival time enough in response. (Pied flycatchers at East Dartmoor NNR have advanced their average first egg laying date by 2 weeks since the 1960s, but may not be able to adjust further due to other climate-related constraints on migration route.)	

Milder conditions affecting overwintering patterns of different species	Biodiversity : raised metabolism in hibernating species leading to abnormal need to feed during winter when there are minimal food resources and cold spells; overall result is reduced rate of survival in hibernating species (for example dormouse, bats). Pollinating insect populations impacted by increases in parasites and pathogens, with consequences for pollination services and predators higher up the food chain.				
Hotter, dryer sumr	Hotter, dryer summers				
Drier conditions and increasing likelihood of drought	Land use : loss of moisture in soil leading to loss of upland heath habitat, poorer grazing pasture, reduced fodder yield and reduced drinking water availability for livestock.				
	Biodiversity : drought particularly impacting more susceptible species (e.g. Sphagnum mosses) and smaller habitats (e.g. small areas of Rhôs pasture, flushes and mires).				
	Conditions expected to favour invasive species with competitive advantage in warmer temperate environments (including migration of native lowland species to new areas).				
	Water environment : increased pressure on water resource, lower water table, and threat to potable and irrigation water supplies, leading to need either for a further reservoir on Dartmoor, or to source water from outside region at large cost for consumers.				
Fire risk and fire control	Biodiversity : Increased risk of wildfire (especially in conjunction with higher visitor rates in hot weather) and potential loss of habitat and small animal populations.				
	Controlled fires (swaling) increasingly difficult to manage, leading to loss of moorland habitat and biodiversity (and also impacts on Water Quality).				
More people holidaying in the UK	Biodiversity : increased visitor numbers and consequent pressures on landscape could lead to more trampling of vegetation and disturbance of sensitive species in heavily visited areas, together with disturbance of livestock and disruption to grazing patterns.				

Understanding the role of changing climate in the ecology of the National Park's upland species and habitats is a particularly important issue as Dartmoor is at the southern and lower altitude end of the spectrum of British uplands. Warming may therefore be expected to affect it earlier and with greater severity then higher and more northern hills. The combination of higher temperatures and

longer growing seasons could expand the margins of agricultural productivity and bring changes to livestock systems, with complex interrelated secondary effects on upland habitats mediated by altered grazing regimes.

While current evidence suggests a wetter Dartmoor climate overall, it is the potential for longer and hotter drought periods which may be more critical. Studies in the Italian Alps have shown that such events can lead to widespread desiccation and death of peat-forming Sphagnum mosses (Bragazza 2008), which on Dartmoor are key to the central mires' ability to absorb and retain water. Seasonal drying of moorland substrates and long term shrinkage or degradation of mires could result, making them unsuitable for some priority species. For example, wading birds such as dunlin depend on the ability to probe into soft sediments supporting good populations of moisture-demanding organisms. It could also have other far-reaching effects on ecosystem services such as water retention/provision and recreation.

We cannot prevent climate change altering habitats to at least some degree. The loss of some iconic species may prove to be inevitable, reducing the public benefits provided by the National Park. However there may also be opportunities to realise compensatory benefits, if new conditions enable other organisms to colonise Dartmoor or extend their existing ranges here – in the same way that (for example) great white egrets from mainland Europe have established a breeding population on the Somerset Levels in recent years.

Warming may also favour some species of warmth-loving insects (e.g. certain wasps, bees and ants). Richer and more abundant insect life could potentially yield many public benefits in terms of underpinning ecological systems - providing food resources for mammals and birds and pollination and dispersal services for plants. Where habitat resources are more fragmented, such as in parts of the moorland edge and farmed valley slopes, there may be a significant impact on building ecological resilience.

4.2 VEGETATION CHANGE

Vegetation change is inevitable (and often desirable) in any landscape managed and protected for its natural assets. The problem arises when the change is deemed to be towards a less desirable state, or is irreversible and/or unmatched by a compensatory change elsewhere in the landscape.

Dartmoor's plant communities are dynamic and will continue to change to some extent no matter what is put into policy. But in order to retain healthy populations of the National Park's priority species, we need to provide them with the habitats they require – so the extent, direction and reversibility of change need to be closely monitored and understood.

Several key issues in habitat conservation come under the broad theme of vegetation change. They include woodland creation, restoration and expansion; loss of open land on loss of open land on the commons through natural succession; hydrological restoration of peatlands; establishment of invasive non-native species; and the response of vegetation communities to climate change and atmospheric pollution. Where vegetation is maintained dually for its natural and agricultural values, as enshrined in the Dartmoor Commons Act, some change is inevitable unless the economic conditions of farming are static from year to year. Even if enough animals to maintain a given current or historical level of landscape openness could be found, shifting ratios of animal type and

associated changes in seasonality of grazing would still bring constant change to the pattern of moorland plant communities. For example, historical increases in the sheep-to-cattle ratio have been suggested as the cause of phases of bracken expansion in upland grazing areas (Miles 1979; Pakeman 1992).

Woodland succession

Natural England's Natural Character Area Profile for Dartmoor contains a number of 'Statements of Environmental Opportunity', one of which is 'to protect, manage and enhance Dartmoor's open moor' with specific mention of avoiding woodland creation in open areas. Woodland area may increase through neglect as well as intent; succession on commons and the development of wet woodland on valley mires and Rhôs pasture sites are issues that need to be considered. DNPA holds GIS data that has been derived from the interpretation of aerial photographs taken in 1999. If a similar exercise were to prove possible in 2019 using current aerial images, we would be able to quantify the extent to which important open habitats have been encroached upon over the 20 years through succession caused by lack of management. At the same time we should also bear in mind the views of organisations such as the RSPB, to the effect that scrub, bracken and gorse can be important habitats in their own right, and that a balanced mixture is needed.

Purple Moor Grass

Purple moor grass *Molinia caerulea* is widely considered to be over-dominant in Dartmoor's open habitats, reducing diverse vegetation communities to near-monocultures that support reduced numbers of animal species. The speed at which it has spread is uncertain. There are informal estimates of a twenty-fold increase in Molinia cover since 1989/90, when one estimate gives Molinia cover at less than 1% (Colston 2017). Conversely Mercer (2009) reports Molinia in 1970 covering '35% of the common land and higher level new takes'. And although there is little hard evidence for the latter measurement, it is supported by anecdotal records going back more than 200 years that document Molinia as a prominent feature of mire vegetation communities. The problem is that communities where Molinia is a component, rather than dominant, are difficult to disentangle in the absence of long-term quantitative studies. Better evidence is available for the declining coverage of heather, which has been replaced by other plants (and Molinia in particular) across large areas of the moor. Colston (2015) provides maps showing the dramatic extent of this decline in the Plym Valley, over just 16 years from 1990 to 2006.

Natural England's Natural Character Area Profile for Dartmoor calls for a reduction in the overall area of acid grassland through encouraging heather regeneration. The research-based management remedy for areas of perceived Molinia over-dominance of 'herbicide application, raking off the litter, soil disturbance and re-seeding with heather' is unlikely to be sustainable in the long term. But targeting control action on a native plant, one that provides important food for upland grazing animals (especially in spring), may not even be justifiable. Molinia is likely to return to previous levels when the treatment (herbicide, flailing, grazing) ceases. The impacts of burning – and of burning and grazing combined – are not fully understood and need to be monitored at a more detailed level, but they may cause Molinia to spread rather than decline. A more sustainable route could be to treat Molinia dominance as a symptom rather than a cause of habitat deterioration, and tackle the underlying problem. Because of its long roots Molinia has a competitive advantage on poor-condition peatland where the water table is low. Re-wetting degraded peatlands reduces this

advantage and has been shown to be an effective counter to Molinia dominance in other UK settings (Anderson 2015).

4.3 CHANGE IN GRAZING REGIMES

Upland commons

The story of Dartmoor's open habitats can largely be told through a history of livestock farming. The interaction of herbivores and vegetation communities, the habitats they give rise to and the species they attract is a complex subject with a large body of literature. Nonetheless the ecological processes governing the nature of vegetation in mixed-habitat upland grazing areas like the Dartmoor commons are still not fully understood.

The issues for the habitats of the Dartmoor commons are no longer of over-grazing or under-grazing alone, but of the pattern of grazing in space, over time and from season to season (i.e. winter vs summer grazing), and of the ratios of the three main grazing species (cattle, sheep and ponies).

Defra farming statistics (Figure 9) indicate that the current cattle-to-sheep ratio is significantly lower than that prevailing 10 years ago. This change has been accompanied by a well-publicised fall in pony numbers. There is a great deal of anecdotal evidence for the negative effects of pony decline on habitat quality, but this has not yet been translated into incentives supporting a reversal of the situation. However Natural England has recently made it known to Commoners that they would consider requests to increase pony numbers on the commons under Higher Level Stewardship (Pony Action Group minutes April 2018).





Grazing on the commons near Headland Warren



Intensification of in-bye land-use

Dartmoor's enclosed field networks and their associated linear features not only support their own rich wildlife communities, they also provide ecological corridors between the upland interior and the wider countryside outside the National Park. Monitoring and management of ecological threats to these landscapes is therefore critical for the future wellbeing of the natural environment of the whole Park and its hinterland. Unfortunately few of Dartmoor's species-rich enclosed habitats enjoy statutory protection; aside from Dunnabridge Meadows SSSI, most have unprotected County Wildlife Site status or no designation at all.

While reduced grazing on some of the commons is driving a transition from mire and heath towards scrub and woodland, increased stocking levels on in-bye land is leading to a change from seminatural grassland and hay meadows (of which the UK has already lost 97%), towards improved grassland. According to Defra June surveys (Defra 2016), 66,332 hectares (67% of the National Park) is currently farmed. Estimates from automated remote sensing in 2000 indicated that 25% of Dartmoor was given over to improved pasture (CEH 2000). The Devon Historic Landscape Character data (<u>http://map.devon.gov.uk/dccviewer/</u>) show a widespread decline in the number of field units between the 19th century baseline and the present day, and the majority of this reduction is likely to have occurred since 1945. Combining fields into larger units inevitably requires the removal of hedgerows and other field boundary features, although we cannot put an accurate figure on the scale of the losses.

One vital consideration for the management of all grazed habitats is the need to fund the proper maintenance of stock-proof boundaries – whether fences, stone walls or hedges. With boundaries in disrepair we have no means of controlling grazing levels effectively, as stock on the commons are likely to invade adjacent supposedly enclosed land if foraging looks easier there, and vice versa. Boundary maintenance and replacement can be very expensive; and as with all other issues regarding the management of Dartmoor's farmed habitats, it is vital to take into account the financial ability of farm businesses to produce and sustain the desired outcomes for the natural environment.

4.4 DEVELOPMENT AND RECREATION IMPACTS

Although development of the built environment is more restricted on Dartmoor than in surrounding local authority districts, recent years have seen significant localised construction of housing in particular (for example at Moretonhampstead and Chagford). Planning policy requires that potential impacts such as habitat loss and fragmentation, severance or obstruction of habitat corridors, possible increases in watercourse and light pollution, predation (from domestic cats), and additional disturbance of both wildlife and livestock (for example from vehicles and extra pressure from dogs and walkers) are taken into account. The emerging revised Local Plan includes requirements for biodiversity gain from development.

Dartmoor National Park Authority can only control development within the Park boundary. In the adjoining areas it must work co-operatively with its neighbouring planning authorities. While the Park itself is sparsely populated, its neighbours include significant towns and cities which will continue to grow considerably in the coming years. A recent report produced by the University of Exeter as part of the SWEEP programme (Day et al. 2018) summarises the population growth around the National Park as follows.

Strategic Grouping	Unitary Authority	Persons 2014	Persons 2039	Change	Change %
Plymouth & Surrounds	Plymouth South Hams West Devon	262,000 84,000 54,000	287,000 92,000 63,000	25,400 7,600 8,600	9.7 9.1 15.9
Exeter & Surrounds	Exeter Teignbridge East Devon Mid Devon	124,000 127,000 136,000 79,000	145,000 149,000 161,000 89,000	21,100 21,200 24,400 10,100	17.0 16.7 17.9 12.7
Torbay & surrounds	Torbay	133,000	148,000	15,500	11.7
Total		1,000,000	1,134,000		

Figure 10: projected population growth around Dartmoor National Park, 2014-2039

The report suggests that with the human population in the National Park's hinterland rising by 13% by 2039, increased recreational pressure on Dartmoor may result in 10,854 m² of bare ground being exposed along the path network, and increased gullying along 42km of path.

Increased conflict between recreation and wildlife can be expected around Burrator, Dart Valley and Venford Reservoir, Fernworthy, Haytor, Soussons and Warren House. Hiking, dog-walking and large events are key concerns. Analysis identifies twelve species that might be vulnerable to disturbance from increased recreational activity. These include the cuckoo, nightjar, ring ouzel and wood warbler.

In addition to direct damage and disturbance, it is anticipated that increased visitor pressure may also lead to growing problems involving pollution and inadvertent introduction of invasive species.

4.5 INVASIVE NON-NATIVE SPECIES

Analysis carried out by Devon Biodiversity Records Centre in 2018 showed that invasive non-native plant species have been recently recorded in every 10km square of the National Park. Many pose current or potential dangers to native wildlife communities, riverbank stability and water quality. These threats may accelerate if climate change makes upland areas of the Park more hospitable for non-native organisms.

A table of the main county-wide threats can be downloaded from the Devon Invasive Species Initiative web page <u>https://www.naturaldevon.org.uk/home/devon-invasive-species-initiative/</u>; the majority of the terrestrial species listed should be considered as potential problems on Dartmoor.

American skunk cabbage is a DNPA target for control across the National Park, and the spread of Himalayan balsam is being tackled in selected catchments from the top down. Other plants cited as concerns by Dartmoor stakeholders include garden escape *Cotoneaster* species, which are now well scattered across the Park, as well as curly waterweed, fringed water-lily, monkeyflower (*Mimulus* species and hybrids, becoming widespread by ditches and stream sides) and *Rhododendron ponticum*. Japanese knotweed and montbretia (*Crocosmia* species, now common on lowland Devon roadsides and with the ability to spread inland to higher value semi-natural habitats) are both identified as problems on Exmoor, but are not current priorities for control on Dartmoor; nonetheless their status should be monitored closely.

Examination of BSBI distribution maps strongly suggests that the spread of invasive non-native plant species is mostly dependent on river and road corridors – an example of the wrong sort of ecological connectivity within the National Park, and between the Park and its hinterland. Further research is needed on the timing, spatial pattern and trajectory of spread for the well recorded species: this could supply information of value in tackling any new wave of species triggered by climate change and increased visitor pressure. Pirri-pirri burr was first recorded at Yarner Wood in the early 20th century for example, and in spite of a notorious capacity for invasive spread elsewhere it seems to have performed relatively poorly so far on Dartmoor, with records limited to the same area. American skunk cabbage on the other hand has few and scattered records from the 1980s and 1990s, but after 2000 seems to have accelerated its rate of colonisation. The trajectory of this

species suggests that it could still be controlled at this stage, but that further delay will result in its naturalisation, threating multiple semi-natural riparian vegetation communities.

A key knowledge gap could be filled by systematically mapping and quantifying the extent of all nonnative species living wild in the Park so that an assessment of the risk associated with <u>potential</u> future invasive species can be made, and a policy towards them adopted. There is also a necessity to identify species which are colonising analogous habitats elsewhere in the UK, so that the response to likely arrivals can be immediate if and when they arrive on Dartmoor.

The bulk of the recent records of invasive species within the National Park are located in the fringing lowland areas, in particular in the wooded valleys, with the upland areas generally experiencing lower rates of invasion. However the general dispersion of records suggests that the upland interior of the Park will be the next frontier for invasion, especially as the transition from lowland to more hostile upland environment may be softened by the effects of climate change and atmospheric eutrophication. There is some anecdotal evidence to suggest that increased nitrogen deposition on upland habitats is shifting the competitive balance between certain native species so that some start to behave invasively - for example Molinia and Deschampsia grasses increasing their cover at the expense of heathers and Sphagnum (Caporn 2015).

4.6 PESTS AND DISEASES

Ash dieback poses a major immediate threat to important components of the Dartmoor habitat matrix, such as lowland mixed deciduous woodland, localised stands of upland ash wood, and hedgerows. Other risks facing the National Park include heather beetle, *Phytophthora kernoviae* (affecting bilberry), *Phytophthora alni* (affecting alder), and oak decline. A detailed, regularly updated analysis of these threats, as well as any others that are emerging and will continue to emerge in the future, is needed in order to counter their spread and mitigate for their impacts.

4.7 ATMOSPHERIC NITROGEN DEPOSITION

Nitrogen deposition is a concern for all Dartmoor habitat types, in particular woodland and blanket bog (State of the Park 2017). Brown & Farmer (1996, quoted by Colston 2017) showed that from 1989 to 1992 nitrogen deposition exceeded critical loads across 93.3% of Dartmoor's total area, making it the second worst performing Natural Area in England. Nitrogen has also been implicated as a contributory factor in the spread of Molinia and heather beetle outbreaks in Dartmoor's upland habitats, although the evidence has not been formally tested.

Livestock ammonia emissions account for an estimated 41.5% of nitrogen deposition on Dartmoor's moorland SSSIs. Other sources include vehicle traffic and wind-borne pollution from outside the National Park (State of the Park 2017).

Future planning needs to take into account the findings of academic studies into the long term impacts of nitrogen pollution, in an effort to understand to what extent it may be possible to control deposition and/or mitigate for its impacts. It is also important to understand whether any of the undesirable vegetation change taking place on Dartmoor is an inevitable by-product of nitrogen enrichment; and if so, whether there is any logic in using scarce resources in an effort to reverse that change.

4.8 NATIONAL POLICY

All of the issues outlined above will need to be viewed, and National Park priorities will need to be set, in the context of future national policy - particularly as regards land-based subsidy schemes. Some argue that the investment of hundreds of millions of pounds in agri-environment grants over the last decades has achieved comparatively little in terms of environmental protection or biodiversity gain, and has only served to degrade and homogenise the landscape. Is a more creative approach required?

The government's signalled intention is a fundamental shift of emphasis in agricultural support payments, the aim being to target the use of public money towards providing public goods (Agriculture Bill 2017-19). The scope of these public goods is expected to be shaped by the priorities for environmental improvement set out in the 25 year Environment Plan (2018), but the full details will become clearer over the course of 2019. The Government's Review of Protected Landscapes being led by Julian Glover is also due to report later in 2019 and is likely to provide further suggestions for nature recovery within National Parks.

5 STAKEHOLDERS' ISSUES, QUESTIONS AND SUGGESTIONS

This section records issues, questions and suggestions that have been raised by stakeholders for possible consideration in the 2019 Dartmoor National Park Management Plan Review. It also includes input from participants attending the Dartmoor Debate workshop (Natural Environment Evidence Review) on 16 November 2018.

Designated sites (refer to section 2.1)

82% of Dartmoor's **SSSI** area has 'unfavourable - recovering' status and much of it has been in this condition for over 10 years.

- How can we speed up the rate of recovery?
- How helpful is the SSSI land management advice being given, and how effective are the actions being undertaken?
- Perhaps the designation 'unfavourable recovering' makes landowners, advisors and responsible agencies complacent. Should it be replaced by 'unfavourable'?

The government's Biodiversity 2020 strategy calls for a minimum of 50% of **SSSIs** to be in favourable condition by 2020. This is not achievable on Dartmoor.

- Can the target figure be achieved at all, even given an extended deadline?
- Can widespread condition improvements be achieved through Dartmoor Farming Futures (a partnership project piloting a new approach to realising public and environmental benefits on the Dartmoor moorland) as suggested in 'State of the Park 2017' (page 9)?
- What other actions might also be necessary?

Much of Dartmoor's wildlife depends on 237 **County Wildlife Sites** (including hay meadows, Rhôs pastures and small woodlands) that have no statutory protection. Many have not been re-surveyed for 20 years (or since designation).

- The habitats and species for which the CWSs were designated could be in undocumented decline due to lack of resources / lack of permission to access. Should some key CWSs be given protected SSSI status?
- With minimal funding for CWS survey, can we devise new approaches to securing the data required to underpin their conservation?
- Should future investment target relatively low rates of professional monitoring, or achieving
 greater input from volunteer recorders, landowners and community groups (so that the
 CWSs can be monitored more frequently, triggering action and advice where necessary)?
 The latter approach could foster community involvement in designation and conservation.
 However, such systems may still require significant resources and leadership to establish and
 maintain.
- Can we use the government's proposed Conservation Covenants scheme (Defra 2019) to give greater long term protection to Dartmoor's CWSs?

UK Priority Habitats (refer to section 2.2)

Information about the extent and location of Dartmoor's UK priority habitats is held piecemeal across various organisations. Estimates for priority habitat coverage vary widely, from 30% to 52% of the National Park area.

• With such conflicting estimates of priority habitat coverage, it may be impossible to agree what issues need to be tackled or where / how to tackle them. Should refining our understanding of Dartmoor's habitat resource be tackled as an urgent priority, and if so, how?

Living Dartmoor Key Wildlife Areas (refer to section 2.3)

• The extent of **semi-natural woodland** on Dartmoor is greater than current records suggest as some wooded areas (in particular small woodland parcels) are currently unrecorded. Can these small areas be incorporated into woodland databases to provide better knowledge of habitat connectivity, and enable better-informed management planning?

Wider Countryside Habitats (hedgerows): Maintaining and enhancing Dartmoor's hedgerows as a coherent network promises multiple wildlife and economic benefits. However their extent and condition are currently unknown. Can the 2019 Management Plan Review consider how to improve our knowledge, and how to work with landowners and commoners to maximise the benefits that their hedgerows provide?

Wider Countryside Habitats (rivers and other waterbodies): Dartmoor is already the main source of drinking water for around 840,000 people, and this figure could rise by 13% in the next 20 years.

• Increased abstraction could reduce flows and hence ecological status. A Management Plan focus on retaining water in the upper catchments should help to reduce the risk of low flows, thereby maintaining / enhancing ecological status, as well as attenuating flood risk.

- Do Water Framework Directive assessments tell us everything we need to know about Dartmoor's freshwater environment? Should additional parameters be considered in order to get a fuller picture of their ecological value?
- Drinking water supply and the additional ecosystem services provided by Dartmoor's rivers and other water-sequestering habitats (blanket bog, Rhôs pasture, valley mire etc.) are frequently referenced in the current Management Plan, but without an explicit water strategy. Should such a strategy be considered in the 2019 Management Plan Review?

A third of the National Park consists of **'white space'** lying outside of Living Dartmoor's identified Key Wildlife Areas.

 Although priority habitat covers just 10% of its area, the white space supports populations of 65% of the Park's Section 41 species. Unsympathetic land use here could have serious impacts on species for which Dartmoor is an important stronghold. Should the Management Plan Review specifically address the issue of promoting wildlife-friendly management of the white spaces?

Species monitoring (refer to Section 3.1)

Species monitoring on Dartmoor is hampered by limited resources (a general problem affecting all organisms of interest) and the degree of specialist knowledge needed for some key taxa (for example lichens, bog hoverfly). This could result in the disappearance of species whose decline is not identified in time for appropriate action to be taken.

• Should the Management Plan Review address the need to enthuse and train a network of professionals and/or volunteers to undertake the long term monitoring of a suite of representative Dartmoor species?

Living Dartmoor's 12 key species (see Section 3.2) are important in their own right, but due to their restricted ranges their status provides little insight into the health of Dartmoor's wider wildlife communities.

- If scarce resources are focused primarily on monitoring scarce non-representative organisms, there is a risk that declines in more widespread species will not be noticed in time for corrective actions to be taken.
- The Management Plan Review should address the importance of keeping Dartmoor's common species common by selecting a representative suite of organisms indicative of broader habitat health for regular long term monitoring. Ideally these should be species that could be monitored alongside existing priority species, adding valuable information without a significant increase in survey efficiency perhaps Living Dartmoor's flagship species for Key Wildlife Areas?
- Does a focus on species' occupancy of known historical sites perpetuate gaps in species distribution knowledge? A shift towards less frequently monitored sites could lead to the discovery of hitherto unknown populations of important species.

Missing species (refer to Section 3.5)

Many species that were formerly widespread on Dartmoor are currently absent or occupying muchreduced ranges.

- The Management Plan Review should consider whether a reintroduction strategy would help achieve its vision of increased ecosystem resilience.
- What species should be considered for reintroduction?
- Should the potential of invertebrate (as well as mammal and bird) reintroductions to aid habitat restoration be investigated?
- When should direct reintroduction be supported, and when should natural colonisation following enhancement of habitat condition and connectivity be the target?

Climate change (refer to Section 4.1)

- Longer growing seasons could change upland vegetation communities by giving competitive advantages to certain species. Can Dartmoor's habitats be buffered against these effects in any way?
- Bragazza (2008) documented the detrimental impact of longer, hotter drought periods on water-trapping, peat-forming sphagnum mosses in the Italian Alps. Should research be undertaken to gauge the likely impact of changing rainfall, temperature, CO² and nutrients on Dartmoor's vital sphagnum communities? If seen here, loss of sphagnum could accelerate the drying-out of the uplands and the erosion of watercourses. Could at least some of the impacts be countered by investing in an array of natural flood management techniques, thereby slowing flows from the high moor and the river headwaters?
- If rising temperatures and reduced water retention threaten the survival of iconic upland species (for example breeding dunlin, which prefer colder environments and need damp ground for feeding), should scarce resources be used in an attempt to retain them? Or should those resources instead be allocated to maximising any positive outcomes of a warming climate (for example encouraging better habitat for species moving from lower altitudes / latitudes?).

Vegetation Change (refer to Section 4.2)

Dartmoor's open habitats and their characteristic species could decline if woodlands are allowed to expand significantly through planting and/or natural succession.

- Some level of vegetation change is inevitable. For the Park's next Management Plan period, there needs to be agreement on what the acceptable limits of change should be, how we can work to stay within these limits, and what resources will be needed in order to achieve this.
- The Management Plan Review should consider whether some increase in semi-natural woodland cover could actually be beneficial in overall terms. To what extent could it increase water quality by reducing erosion, and attenuate flood risk in the wider Dartmoor / Devon landscape?
- Committing to a long term programme of regular woodland cover monitoring (by remote sensing and/or ground survey) would enable threats to the wildlife communities depending on open landscapes to be assessed.

Molinia is widely regarded as over-dominant in open moorland habitats, although opinions about its historical extent on Dartmoor (and hence to what extent it is now over-dominant by comparison) vary very considerably.

- An agreement needs to be reached the desired extent of Molinia cover that future management should work towards.
- The nature of any future management to reduce Molinia cover needs to be thoroughly investigated and different methods trialled. Should the focus be on physical removal (through herbicides, flailing and grazing), or habitat modification to remove Molinia's competitive advantage (for example by re-wetting and raising the water table)?
- Re-wetting degraded peatlands has been shown to be an effective counter to Molinia dominance in other UK settings. If the same strategy appears suitable for Dartmoor, would it be advantageous (or even possible) to 'buy out' some Commoners' grazing rights, in order to obtain sufficient control over moorland management?

Change in grazing regimes (refer to Section 4.3)

Dartmoor's upland commons and enclosed in-bye land are products of centuries of livestock grazing by cattle, sheep and ponies. The numbers of animals, the proportions of the different species involved, and the seasons in which they are present on different areas, have varied (and continue to vary) considerably over time. This brings constant change to the landscape's appearance and ability to support biodiversity.

- Parts of the upland commons are experiencing reduced grazing, particularly by ponies. This is resulting in the transition of scarce habitats such as mires and heaths towards scrub and woodland. To counter this Natural England has indicated that higher stocking levels of ponies might be supported on commons in Higher Level Stewardship.
- Can Commoners be encouraged and assisted to take advantage of this opportunity in areas where additional grazing would bring biodiversity benefits?
- Could similar outcomes be promoted through Dartmoor Farming Futures, a project designed to provide ecosystem services through agri-environment delivery on the Dartmoor commons?
- Meanwhile rising stocking levels on Dartmoor's in-bye land (whose biodiversity is almost entirely unprotected) is driving a change from hay meadows and semi-natural grassland, towards improved grassland.
- The Management Plan Review should consider ways of promoting wildlife-friendly management of the remaining unimproved in-bye fields and their hedgerows, perhaps through a modified Dartmoor Farming Futures style approach.

Development and recreation impacts (refer to Section 4.4)

Research indicates that a rapidly rising human population in the National Park's hinterland will significantly increase recreational pressure on Dartmoor.

- How can biodiversity at visitor 'honeypot' sites that also provide important habitat for key species be protected?
- Are we doing enough to plan for the increase in recreational pressure and the impact from disturbance? 'Premier Archaeological Landscapes' are being identified by DNPA, with a view

to protecting their unique cultural heritage from damaging activities. In a similar vein, could the modelling of species disturbance impacts help us to map opportunities for protective 'biodiversity zoning'?

- If so, what criteria should be used? Should we focus on steep and/or wet topography, where associated ecosystem services benefits (such as erosion relief and enhanced water quality) could be achieved alongside biodiversity protection?
- Where development is taking place within the National Park, can planners be encouraged to embrace opportunities for offsetting biodiversity gain (for example incentives to incorporate of swift and bat bricks into new build homes, to ensure that lighting schemes are appropriate for bats and other sensitive nocturnal species, and make new gardens hedgehog-friendly)?



Migrating ring ouzels are still seen in good numbers feasting on Dartmoor's autumn berry crops. However breeding pairs, once relatively numerous, have undergone severe declines over recent years. Increased human disturbance in the more remote areas of the National Park where they prefer to nest is believed to be a key factor in this trend (DNPA 2013). (Photo: David Cawthraw)

Invasive non-native species (refer to Section 4.5)

- Invasive non-native plants are spreading along Dartmoor's road verges, rivers and ditches, and are now encroaching on upland areas from which they were previously absent. Thy pose current or potential dangers to native wildlife communities, riverbank stability and water quality, and these threats may accelerate if climate change makes upland areas of the Park more hospitable for non-native organisms. Intensive vigilance and investment in removal, over extended periods, will be needed. With limited resources for monitoring, control and research, what are the most cost-effective measures that can be taken?
- Research on the spread of well-recorded species could help in predicting and tackling any new waves of species invasions that may be facilitated by climate change and increased visitor pressure.
- Japanese knotweed and montbretia are both identified as problems on Exmoor and are subject to targeted control programs there; should they be treated as a similar priority on Dartmoor?

• There is evidence that invasive plants in particular can be spread by recreational visitors. Should the Management Plan Review consider biosecurity and public awareness measures at well-used points of entry to the Park? Displays relating to the inadvertent spread of invasives would also provide opportunities for engagement with the public on wider natural environment issues.

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APPENDIX 1

Dartmoor and 'Devon's Special Species'

Devon's 96 'Special Species' are those for which the county has a particular responsibility, if their continued survival in the British Isles is to be ensured. Of those 96, the 29 below are known to be present on Dartmoor – which confers a share of the wider responsibility onto the National Park.

Taxonomic group	Common name	Scientific name	Living Dartmoor
Birds	Cirl bunting	Emberiza cirlus	F
Birds	Willow tit	Poecile montana	F
Birds	Whinchat	Saxicola rubetra	
Flowering plants	Cornish (Vigur's) eyebright	Euphrasia vigursii	К
Flowering plants	Toad-flaxed leaved St John's-wort	Hypericum linariifolium	К
Flowering plants	Bastard balm	Melittis melissophyllum	
Flowering plants	Devon whitebeam & allied species	Sorbus devoniensis agg.	
Insects - bees, wasps and ants	Mountain (or bilberry) bumblebee	Bombus monticola	
Insects - beetles	Blue ground beetle	Carabus intricatus	К
Insects - beetles	Gravel water beetle	Hydrochus nitidicollis	
Insects - butterflies	High brown fritillary	Argynnis adippe	К
Insects - butterflies	Pearl-bordered fritillary	Boloria euphrosyne	К
Insects - butterflies	Marsh fritillary	Euphydryas aurinia	К

Taxonomic group	Common name	Scientific name	Living Dartmoor
Insects - butterflies	Wood white	Leptidea sinapis	
Insects - butterflies	Brown hairstreak	Thecla betulae	
Insects - dragonflies	Southern damselfly	Coenagrion mercuriale	К
Insects - moths	A leaf-mining moth	Ectoedemia heckfordi	
Insects - moths	Narrow-bordered bee hawk-moth	Hemaris tityus	К
Insects - true flies	A muscid fly	Coenosia pudorosa	
Insects - true flies	Bog hoverfly	Eristalis cryptarum	К
Lichens	A horsehair lichen	Bryoria smithii	
Lichens	A lichen	Parmelia submontana	
Lichens	Fringed shield lichen	Parmelina carporhizans	
Lichens	String-of-sausages lichen	Usnea articulata	
Lichens	A lichen	Wadeana dendrographa	
Mammals	Hazel dormouse	Muscardinus avellanarius	F
Mammals	Greater horseshoe bat	Rhinolophus ferrumequinum	К
Mosses and liverworts	Multi-fruited Cryphaea moss	Dendrocryphaea lamyana	
Spiders and harvestmen	Lichen running spider	Philodromus margaritatus	

K = Living Dartmoor key species for conservation

F = flagship species for Living Dartmoor Key Wildlife Areas



The pearl-bordered fritillary is one of Living Dartmoor's Key Species for conservation, and is also one of 29 "Devon's Special Species" that have been recorded in the National Park.

Image credits

Beaver and beaver kits – Mike Symes Beaver habitat – Devon Wildlife Trust / University of Exeter Curlew – Robin Morrison Ring ouzels – David Cawthraw

All other photographs – Andrew Taylor