Exmoor National Park

# Preparing for Climate Change

September 2011

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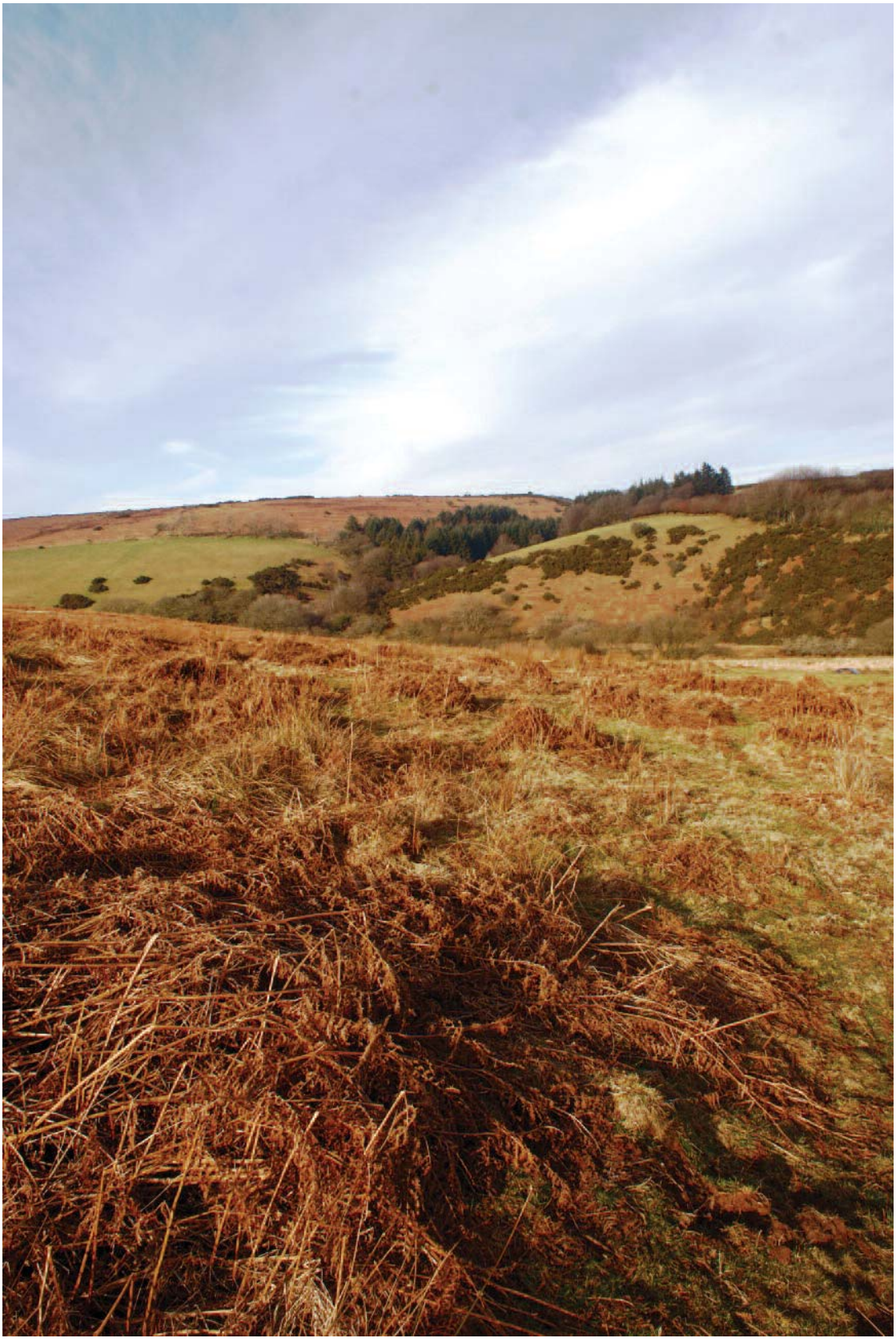


# 1. INTRODUCTION

1.1 Exmoor National Park is one of ten National Parks in England. It was designated as a National Park in 1954 in recognition of its outstanding scenery, its notable and abundant wildlife, its rich historic environment and its recreational space.

1.2 Exmoor has a temperate climate which is could be characterised as mild and wet, although long spells of dry and sunny weather are not uncommon. Annual rainfall varies from 800mm to the east to 2000mm on the higher plateau in the middle of the National Park.

1.3 The UK Climate Projections 09, predict significant changes to Exmoor's climate across a range of different greenhouse gas emissions scenarios. In all cases, a rise in temperature is seen to be a highly probably outcome, with the main doubt being around by how much temperatures will rise.

1.4 As a consequence of this change in climate we are likely to experience hotter, drier summers, and warmer, wetter winters. An increase in the incidence of extreme weather events such as severe flooding and drought is also likely to occur, and sea levels will rise.

1.5 The impact of climate change on Exmoor's landscape, wildlife, economy and way of life will be profound. Exmoor's communities therefore need to plan to adapt to climate change, facing up to the threat it poses and taking advantage of any opportunities presented. This report sets out those threats and opportunities together with any existing and potential actions that could be undertaken in response.

# 2. BACKGROUND

## 2.1 About Exmoor

2.1.1 Exmoor was designated as a National Park in 1954 and is situated within the counties of Somerset and Devon. Though one of the smallest of England's National Parks covering 693 km2, it contains a wealth of scenic variety including pretty villages, heavily wooded river valleys, and open moorland. The central plateau of moorland reaches 519m at Dunkery Beacon. To the north, the moorland terminates in towering cliffs including the highest in England, Great Hangman at 244m. Rocky headlands, steep wooded ravines and plunging waterfalls help to make this stretch of coast spectacular and an area of outstanding scenic beauty.

2.1.2 To the east lie the cultivated Brendon Hills, which are heavily forested in the north, but feature enclosed fields surrounded by banks and fine beech hedges to the south. This typical landscape extends right across the south western lower slopes of the moor. It is farmed, mainly with beef cattle and sheep, but there is also some arable farming on the dry northern slopes.

2.1.3 Nearly half of Exmoor's 11,000 population is concentrated into three small towns (Lynton, Dulverton and Porlock), which act as rural centres for employment and services. The remainder of its population is spread amongst a number of small villages, hamlets and isolated farmhouses.

2.1.4 Most of the people who work on Exmoor, work in agriculture, forestry, tourism and related services. A significant proportion of the working population travel outside the National Park for work.

2.1.5 Despite its attractions, Exmoor is one of the least visited National Parks and its tranquillity is rated amongst visitors as one of its greatest assets.

## 2.2 Exmoor's special qualities

Exmoor's 'special qualities'

- Large areas of open moorland providing a sense of remoteness, wildness and tranquility rare in southern Britain
- A distinct and diverse landscape of softly rounded hills and ridges, with heather and grass moors, spectacular coastal views, deeply incised wooded valleys, high sea cliffs, fast flowing streams, traditional upland farms and characteristic beech hedge banks.
- A landscape mostly free from intrusive development such as major roads, power lines, military activities, quarrying, mining, large scale developments, light pollution and clutter
- A mosaic of habitats supporting a great diversity of wildlife including herds of wild red deer, rich lichen communities, rare fritillary butterflies, bats, and other species uncommon in southern Britain
- A complex and rich historic landscape that reflects how people have lived in, exploited and enjoyed Exmoor over the past 8000 years, including burial mounds on ridges, discrete stone settings, ancient farmsteads and settlements, picturesque villages and historic estates
- A deeply rural community closely linked to the land with strong local traditions and ways of life
- A farmed landscape with locally distinctive breeds such as Red Devon cattle; Devon Closewool, and Exmoor Horn sheep, and herds of free living Exmoor Ponies
- An exceptional rights of way network and extensive areas of open country, providing superb opportunities for walking, riding and cycling
- A landscape that provides inspiration and enjoyment to visitors and residents

## 2.3 Exmoor facts

- Area: 69,280 hectares
- Land cover:

| | |
|---|---|
| Farmland | 55.8% |
| Water | 0.2% |
| Moorland and heath | 27.5% |
| Cliffs and foreshore | 1.1% |
| Woodland | 12.2% |
| Other (roads and gardens) | 2.3% |
| Urban | 0.9% |

- Population: 10,873 (2001 census)
- Main rock types: Old and new red sandstones; Devonian slates; shales; and limestone
- Highest point: Dunkery Beacon 519 m (1,704 ft)
- Highest cliff: Great Hangman 244 m (800 ft)
- Length of coast: 55 kilometres (34 miles)
- Length of main rivers from source to sea:
- Flowing to the English Channel: R.Exe 86 km (54 miles), R.Barle, via R.Exe: 86 km (54 miles)
- Flowing to the Atlantic: R.Bray, via R.Taw 62 km (39 miles); R.Mole, via R.Taw 62km (39 miles)
- Rainfall: up to 2000mm per annum on 'The Chains'; 800mm in lowland to the east of Exmoor
- Sunshine: up to 1,600 hours per annum
- Mean daily maximum July temperature of approximately 21°C

## 2.4 Management of the National Park

2.4.1 The management of Exmoor is guided by the National Park purposes which are:

- To conserve and enhance the natural beauty, wildlife and cultural heritage of the area
- To promote opportunities for the understanding and enjoyment of Exmoor's special qualities by the public

2.4.2 In taking forward the National Park purposes, National Park Authorities (NPA) have a duty to seek to foster the economic and social wellbeing of communities within the National Park.

2.4.3 **Exmoor National Park Authority** is responsible for ensuring the fulfillment of National Park purposes. It does this in partnership with a wide range of statutory and non-statutory organisations, communities, landowners, farmers and local businesses across the National Park. The need for a partnership approach is underlined by section 62(2) of the Environment Act 1995, which requires other authorities and relevant bodies to "have regard to" the purposes of National Parks when carrying out their work. The work of the NPA relates to:

- developing planning polices;
- development management;
- wildlife conservation and enhancement;
- sustainable management of Exmoor's trees and woodlands;
- conservation of Exmoor's cultural heritage including its historic environment;
- sustainable land management including farm wildlife conservation;
- information and interpretation;
- education;
- ranger services;
- field services;
- sustainable development; and
- sustainable tourism;

The NPA is the statutory local planning authority within the National Park

2.4.4 Exmoor National Park Authority employs approximately 70 people. It also supports approximately 300 volunteers who provide valuable support to staff in delivering their duties. The Authority's headquarters are based at Exmoor House in Dulverton, situated within the flood plain of the River Barle. It also owns 3 National Park Centres, an education centre at Pinkery, a field services depot in Exford and various smaller buildings across the National Park. It has recently taken ownership of the Lynmouth Pavilions building in Lynmouth which following rebuilding and refurbishment will become a major coastal interpretation centre for the National Park.

2.4.5 The NPA's core funding comes via the National Park Grant it receives from Defra. In 2011/12, this grant was £3,764,715. Following the Government's review of public expenditure, the grant is set to be cut by 21.5% over the next four years, in addition to a 5% cut made during 2010/11.

# 3. METHODOLOGY USED TO UNDERTAKE THE EXMOOR RISK ASSESSMENT

3.1 A risk assessment has been undertaken by staff within Exmoor National Park Authority using a template jointly developed by the English National Park Authorities through their Climate Change Working Group. Through a series of workshops and one-to-one meetings, a range of staff were involved including (amongst others) the Natural Environment Manager, the Historic Environment Manager, the Head of Information and Access, the Sustainability and Economy Manager, the Finance and ICT Services Manager, and the Corporate and Customer Support Services Manager.

3.2 The risk assessment considers the implications of the 'medium emissions' scenario for climate change, as set out by the UK Climate Projections (UKCP09). The UKCP09 provides national, regional and local information about projected changes in climate during the 21st century. Data is provided for the 2020s, the 2050s and the 2080s and shows a range of possible outcomes and the probability of those outcomes, together with four headline predictions namely, 'hotter, drier summers', 'warmer, wetter winters', 'more extreme weather events' and 'sea level rises'. For the Exmoor area, the data is as follows:

### Hotter, drier summers

| Time period | Increase in mean summer temperature is: | | | Change in mean summer rainfall is: | | |
|---|---|---|---|---|---|---|
| | very unlikely to be less than: | most likely to be: | very unlikely to be more than: | very unlikely to be less than: | most likely to be: | very unlikely to be more than: |
| 2020s | 0.5°C | 1.5°C | 2.6°C | -27.6% | -8.3% | 14.5% |
| 2050s | 1.2°C | 2.6°C | 4.4°C | -43.5% | -20.5% | 7.2% |
| 2080s | 2°C | 3.7°C | 6.1°C | -51.1% | -25% | -6.9% |

### Warmer, wetter winters

| Time period | Increase in mean winter temperature is: | | | Change in mean winter rainfall is: | | |
|---|---|---|---|---|---|---|
| | very unlikely to be less than: | most likely to be: | very unlikely to be more than: | very unlikely to be less than: | most likely to be: | very unlikely to be more than: |
| 2020s | 0.6°C | 1.3°C | 2°C | -3.2% | 4.6% | 13.7% |
| 2050s | 1.1°C | 2°C | 3.1°C | 1.6% | 11.6% | 25% |
| 2080s | 1.6°C | 2.8°C | 4.2°C | 2.6% | 15.6% | 34.6% |

**More extreme weather events** - a subjective outcome against which, no data is provided

### Sea level rises

The relative (against 1990 baseline) sea level rise at Minehead (just outside Exmoor National Park) is anticipated to be as follows:

| Probability | 5% | 50% | 95% |
|---|---|---|---|
| 2020s | 5mm | 10mm | 14.7mm |
| 2050s | 10.8mm | 22.1mm | 33.4mm |
| 2080s | 17.5mm | 36.8mm | 56mm |

3.5 The implications of these projections for Exmoor are considered across a range of themes that are broadly representative of those found in National Park Management Plans across the country, namely:

- landscape;
- biodiversity;
- historic environment;
- cultural heritage;
- farming and land management;
- access, recreation and tourism;
- culture, community and the economy; and
- business continuity (for the National Park Authority).

3.6 The assessment considers both 'risk' on a scale of 0 to minus 25 and 'opportunity' on a scale of 0 to plus 25. The scores are arrived at by multiplying the likelihood of the event occurring on a scale of 1 to 5 against the potential impact on a scale of minus 5 to plus 5 (see below):

| | | Score |
|---|---|---|
| Likelihood | Rare | 1 |
| | Unlikely | 2 |
| | Possible | 3 |
| | Likely | 4 |
| | Almost certain | 5 |

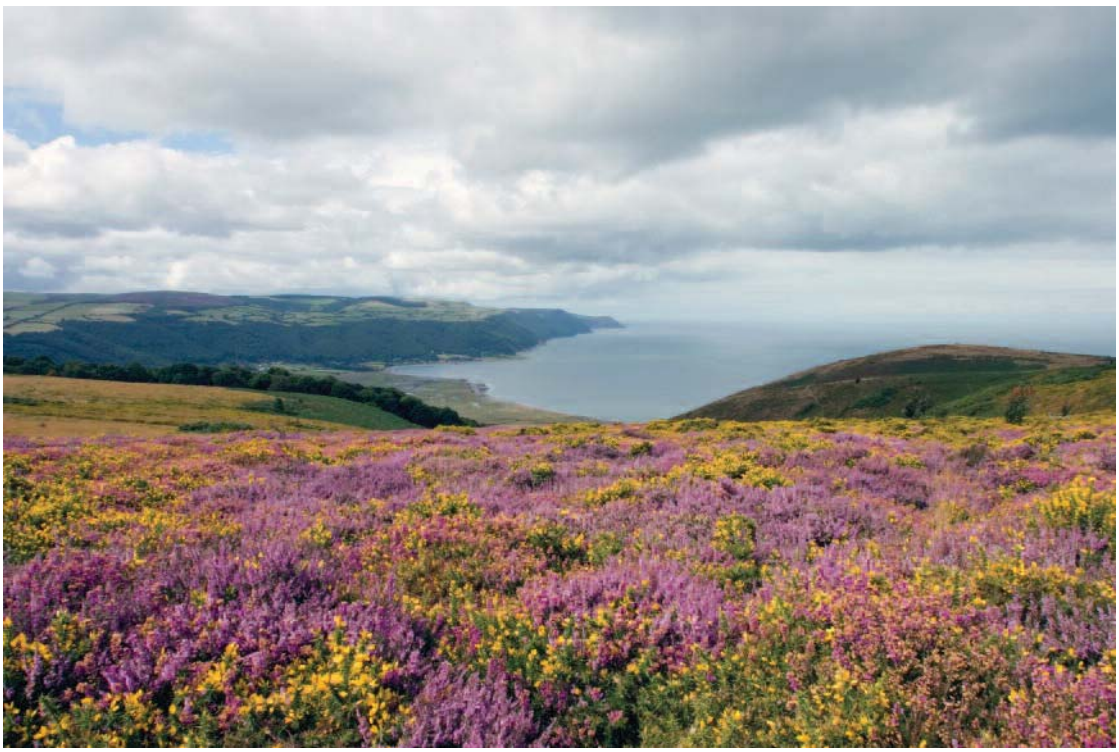
| | Likelihood: | Score |
|---|---|---|
| Risk | Catastrophic | -5 |
| | Major | -4 |
| | Moderate | -3 |
| | Minor | -2 |
| | Slight | -1 |
| | No change | 0 |
| Opportunity | Slight | 1 |
| | Minor | 2 |
| | Moderate | 3 |
| | Major | 4 |
| | fantastic | 5 |

# 4. KEY RISKS AND OPPORTUNITIES IDENTIFIED

4.1 The full risk assessment was undertaken and is available on request. For sake of clarity, an abridged, condensed and edited version of the risk assessment is set out below. A full description of the methodology used to undertake this risk assessment can be found in appendix A.

**Key:**

| Risk/opportunity assessment score | Risk rating |
|---|---|
| -25 to -16 | High impact |
| -7 to -15 | Medium impact |
| -1 to -6 | Low impact |
| 1 to 6 | Low opportunity |
| 7 to 15 | Medium opportunity |
| 16 to 25 | Big opportunity |



## Access, recreation and tourism

| Potential impacts | Rating | | | Existing (E) or potential (P) actions |
|---|---|---|---|---|
| | 2020s | 2050s | 2080s | |
| Greater risk of heath and woodland fires leading to restricted access and a potential danger to the public | | | | • **ENPA and Exmoor Fire Partnership** working to develop longer term proposals for the management of moorland vegetation to reduce fire risk and support annual swaling programme (E)<br>• In situ burning of forest residue generally not permitted (E)<br>• Programmed forest management of ENPA woodlands restricted to winter where risk is lowest (E) |
| Increased likelihood of 'extreme' weather events causing damage to 'rights of way' infrastructure and roads | | | | • Erosion risk assessment undertaken of 'rights of way' (E)<br>• Field service team able to undertake emergency repairs (E) |
| Increased likelihood of paths becoming unusable as a consequence of higher winter rainfall, thereby deterring users | | | | • Erosion risk assessment undertaken of 'rights of way' (E) |
| Low flow levels during summer and higher temperatures may reduce game fish numbers and impact adversely on angling tourism | | | | • River Exe Project working to improve habitat for and build resilience of salmonid population (E)<br>• Exmoor Mire Restoration Project helping to maintain water table in upland parts of Exmoor (E) |
| Landscape change over time may impact negatively on visitor numbers | | | | • No long term actions planned or deemed necessary at this stage |
| Landscape change over time may impact positively on visitor numbers | | | | • No long term actions planned or deemed necessary at this stage |
| Better weather during summer may increase pressure on infrastructure and experience at tourism hotspots with water features e.g. Wimbleball Lake and Tarr Steps | | | | • No long term actions planned or deemed necessary at this stage |
| Increased likelihood of storm surge and sea level rises combining to damage low lying tourist hotspots such as Porlock Weir and Lynmouth, adversely affecting future tourism | | | | • Little that can be done to protect against the risk to areas highlighted. Impact on tourism can be mitigated by increasing the quality of tourism across Exmoor generally. This is currently being addressed through the **Exmoor Tourism Partnership Action Plan** (E) |
| Low reservoir and river levels during summer may diminish opportunities for water-based recreation during peak summer months, reducing the number of visitors and income of associated businesses | | | | • No long term actions planned or deemed necessary at this stage |
| Increased pressure on local healthcare during summer months arising from heat related illnesses/conditions | | | | • No long term actions planned or deemed necessary at this stage |
| High river and reservoir levels during winter resulting in increased opportunity for water-based and 'white water' recreation | | | | • No long term actions planned or deemed necessary at this stage |

## Biodiversity

| Potential impacts | Rating | | | Existing (E) or potential (P) actions |
|---|---|---|---|---|
| | 2020s | 2050s | 2080s | |
| Increased frequency of wildfires (natural, accidental, deliberate) damaging a range of habitats may result in change in the balance of species composition and a range of indirect impacts on biodiversity | | | | • **ENPA** and **Exmoor Fire Partnership** working to develop longer term proposals for the management of moorland vegetation to reduce fire risk and support annual swaling programme (E)<br>• Moorland Case Studies programme is assessing the impact of swaling on moorland invertebrates and flora.<br>• Exmoor Mire Restoration Project helping to maintain water table in upland parts of Exmoor (E) |
| Increased year-round temperatures are likely to result in changes in the composition and balance of species. | | | | • Building habitat resilience through woodland planting and other habitat improvement work (E)<br>• Phenological studies are being undertaken annually to monitor the effects of climate change on woodland and hedgerow trees (E)<br>• Moorland bird surveys undertaken every 8 years (E) |
| Chronic shortage of water during summer may place stress on certain plants and trees, causing them to reduce/die out over time | | | | • Exmoor Mire Restoration Project helping to maintain water table in upland parts of Exmoor (E) |
| The combined effect of warmer winters and hotter, drier summers may increase the risk of pests and diseases causing damage to woodland | | | | • Forestry Commission developing and implementing policies and practices to ensure woodlands remain resilient to the effects of climate change. Species composition, structure and scale of forests are being modified to mitigate risks posed by climate change (E) |
| Increased temperatures throughout the year and drier summers may have an adverse impact on bryophyte communities (some of which are rare) and lichens | | | | • Ensure woodland management regimes take account of increased vulnerability of bryophyte and lichen communities (P) |
| Lower summer flows and higher water temperatures in Exmoor's rivers may have a negative impact on fish (including important species such as salmon and trout) due to depleted oxygen levels and low flows | | | | • River Exe Project working to improve habitat for and build resilience of salmonid population (E) |
| Increased vulnerability of Exmoor's non-flying fauna to climate change by virtue of barriers (e.g. Bristol Channel) to movement to new, more suitable habitats | | | | • Where possible, seek to improve habitat to promote resilience, particularly for species that could reasonably be expected to migrate to higher altitudes (P) |
| Drier summers may cause mires to dry out leading to erosion and shrinkage of peat stores which would have knock-on (adverse) impacts on biodiversity, landscape and carbon storage | | | | • Exmoor Mire Restoration Project helping to maintain water table in upland parts of Exmoor (E) |

## Community, culture and economy

| Potential impacts | Rating | | | Existing (E) or potential (P) actions |
|---|---|---|---|---|
| | 2020s | 2050s | 2080s | |
| Warmer temperatures are likely to lead to an increased demand for cooling and a reduced demand for heating. This may impact negatively on the demand for wood fuel. The impact on fuel poverty is difficult to assess, though likely to be negative since cooling tends to use more expensive sources of energy (i.e. electricity) than most heating systems | | | | • Encouraging better insulation of buildings and use of solar PV through '**Carbon Neutral Exmoor**' - solar PV and air-conditioning are very complementary technologies (E). |
| Increased demand for coastal and rural properties from those seeking to escape even higher temperatures in other parts of the country may add to affordability problems for local residents | | | | • Seek to ensure that planning policies enable the provision of affordable housing to meet local need (P)<br>• Continuing to support the **Exmoor Rural Housing Project** (E) |
| Significantly increased risk of extreme weather events such as the 1952 Lynmouth flood (also high winds/heavy snow etc) posing a risk to life and livelihoods | | | | • **Defra Multi-Objective Flood Management Demonstration Project** (DMOFMDP), taking place in Porlock, should provide robust, catchment scale evidence regarding the influence of land management change on flood risk (E) |
| More frequent flooding events may cause insurance premiums of businesses located in flood plains to rise. | | | | • Learn from DMOFMDP and implement land management changes to reduce the risk of flooding (P) |
| Loss of low lying land to sea, especially near Porlock | | | | • **Somerset Coastal Change Pathfinder** has helped to raise awareness of risks posed by rising sea levels in Porlock (E) |
| Increased risk of coastal flooding, particularly in Porlock Vale, causing damage to property | | | | • **Somerset Coastal Change Pathfinder** has helped to raise awareness of risks posed by rising sea levels in Porlock (E) |
| Longer growing season, higher temperatures and fewer frosts may provide opportunities to grow new crops (e.g. fruits, grapes, etc) providing new business and employment opportunities, and creating a new cultural landscape | | | | • No long term actions planned or deemed necessary at this stage |
| Change to year round growing conditions is likely to have implications for tree planting. There will be a need to ensure that species selection is appropriate to producing the desired economic and environmental outputs | | | | • Research could be undertaken through the **Exmoor Woodland Carbon Project** to inform species selection (P)<br>• Phenological studies are being undertaken annually to monitor the effects of climate change on woodland and hedgerow trees (E)<br>• Forest Research and Forestry Commission are adapting and updating guidance on species choice and selection to ensure objectives are maintained to accommodate wider species choice e.g. use of non-native species as part of new native woodland schemes (E) |
| Increase in pests and diseases possible due to warmer conditions which may in turn deter visitors | | | | • Monitor trends regarding pests and diseases and raise awareness regarding avoidance (P) e.g. leaflet regarding avoidance of tick bites (E) |
| Higher temperatures throughout the year and more reliably warm summers may lead to a more outdoor lifestyle for Exmoor's residents, boosting cardiovascular health but increasing the risk of developing skin cancer | | | | • No long term actions planned or deemed necessary at this stage |
| Hotter summers should provide more opportunities for running outdoor cultural events, especially during evenings | | | | • No long term actions planned or deemed necessary at this stage |
| Changing climate will have implications for water resource management and could potentially impact negatively on householders and businesses e.g. through water use restrictions | | | | • There will be a need to store more water when it falls and use water more wisely during drier spells. The creation of ponds on farms and for larger households could provide a win-win for climate change adaptation and biodiversity (P)<br>• Raise awareness of increasing pressure on water supplies and encourage increased water efficiency amongst businesses and households (P) |

## Historic environment

| Potential impacts | Rating | | | Existing (E) or potential (P) actions |
|---|---|---|---|---|
| | 2020s | 2050s | 2080s | |
| Tree planting on a significant scale for climate change adaptation/mitigation purposes could seriously damage historic field patterns and archaeological sites | | | | • **Exmoor Woodland Carbon Project** could take this factor into account in drawing up a vision for the contribution that woodland can make to a carbon neutral landscape (P) |
| Increase in flooding may cause damage to historic bridges and buildings | | | | • Learn from DMOFMDP and implement land management changes to reduce the risk of flooding (P) |
| Extreme flood events could result in the destruction of historic buildings and settlements | | | | • Learn from DMOFMDP and implement land management changes to reduce the risk of flooding (P) |
| Storm surge accompanied by high tide may damage/destroy historic settlements, especially those around Porlock Bay | | | | • Ensure all valuable historic information is recorded (P) |
| Long periods of wet weather followed by long periods of dry weather could cause heave leaving older properties without foundations susceptible to severe structural damage | | | | • No existing or potential plans in place |
| Changes to historic field patterns in response to changing climatic conditions (and farming practices) | | | | • Assess **Landscape Action Plan** 2010 -2013 and review actions in light of climate change impacts assessment (P) |
| Bracken encroachment and 'scrubbing-up' as a consequence of climate change and vegetation change may churn up and destroy archaeological deposits, and hide features from view | | | | • Encourage bracken management and bracken composting (P)<br>• **Exmoor Landscape Conservation Grant Scheme** available for (amongst other things) controlling bracken cover (E) |
| Creation of new or reinstatement of existing ponds by farmers could increase water storage, restore historic features of the landscape and provide local biodiversity benefits | | | | • **Exmoor Landscape Conservation Grant Scheme** available for (amongst other things) the reinstatement of ponds (E)<br>• Awareness-raising to encourage take-up of grants for the purpose of creating ponds (P) |
| Responses to climate change such as solar PV and solar water heating could detract from the heritage of buildings and settlements | | | | • Develop and promote case studies to demonstrate good practice in the placement of solar panels (E) |
| Reinstatement of historic water mills in response to climate change | | | | • A number of mills (Exmoor Renewable Energy Group) supported in developing hydropower schemes through the Exmoor National Park Sustainable Development Fund (E) |

## Farming and land management

| Potential impacts | Rating | | | Existing (E) or potential (P) actions |
|---|---|---|---|---|
| | 2020s | 2050s | 2080s | |
| There is an increased likelihood of moisture being removed from the top layer of exposed soils leading to erosion, poor subsequent fertility and nitrous oxide/carbon dioxide emissions. This may also contribute to greater sedimentation of rivers and reduced aquatic biodiversity | | | | • Identify the most vulnerable soils and bring them into long-term management that enhances infiltration thereby preventing soil erosion (P)<br>• SW Water "**Upstream Thinking**" project helping to reduce diffuse pollution and runoff into water courses (Mire Project and Wimbleball catchment project) (E) |
| Wetter winters may result in greater runoff, loss of soil nutrients and an increase in sedimentation of watercourses | | | | • Identify the most vulnerable soils and bring them into long-term management that enhances infiltration thereby preventing soil erosion (P)<br>• SW Water "**Upstream Thinking**" project helping to reduce diffuse pollution and runoff into water courses (E) |
| There is an increased risk of chronic water shortages, reducing water availability for livestock and arable crops | | | | • Encourage farmers to store water that could be collected during wetter winters and summer downpours e.g. through pond creation and rainwater harvesting (P) |
| Grazing animals are likely to require more shade during summer to gain respite from higher temperatures (biodiversity & carbon storage) | | | | • Encourage farmers to plant more woodland for shade, woodfuel, carbon storage etc (P) |
| Opportunity to plant more woodland for carbon storage, biodiversity, landscape and economic benefits, flood mitigation and shaded recreation | | | | • Vision for contribution of woodland to a carbon neutral landscape is being drafted through the **Exmoor Woodland Carbon Project** (E) |
| Opportunities for farmers and land managers to consider other forms of farming activity to replace or supplement existing regime e.g. vineyards, fruit, arable crops. | | | | • No long term actions planned or deemed necessary at this stage |
| Risk that diversification to arable crops may lead to further soil degradation as a consequence of ploughing regimes used and wetter winters leading to increased greenhouse gas emissions and lower soil fertility. It would also place further pressure on water resources | | | | • Identify the most vulnerable soils and bring them into long-term management that enhances infiltration thereby preventing soil erosion (P) |
| Increased threat to livestock from pests and diseases which are likely to thrive during warmer, wetter winters | | | | • Influence legacy of South West Healthy Livestock Initiative, seeking to ensure that future programmes take account of threat from climate change (P) |

## Landscape

| Potential impacts | Rating | | | Existing (E) or potential (P) actions |
|---|---|---|---|---|
| | 2020s | 2050s | 2080s | |
| Increase in number of trees in the landscape planted for climate change adaptation, mitigation and other ecosystem services (negative or positive impact) | | | | • **Exmoor Woodland Carbon Project** could take this factor into account in drawing up a vision for the contribution that woodland can make to a carbon neutral landscape (P) |
| Strong likelihood that growing conditions brought about by hotter, drier summers and warmer, wetter winters will result in changes to vegetation which will in turn result in landscape change (negative or positive impact) | | | | • Assess **Landscape Action Plan** 2010 -2013 and review actions in light of climate change impacts assessment (P)<br>• **Exmoor Landscape Conservation Grant Scheme** available to build resilience in landscape (E) |
| Increased likelihood that land management practices will change in response to changing growing and grazing conditions resulting in new landscapes (negative or positive impact) | | | | • Assess **Landscape Action Plan** 2010 -2013 and review actions in light of climate change impacts assessment (P) |
| Increased demand for water and water storage solutions may result in requirement for additional reservoir capacity to be developed on Exmoor. This could result in positive or negative landscape impacts | | | | • South West Water has confirmed that no additional reservoirs are planned for the foreseeable future (next 30 years) – no further action deemed necessary at present (E) |
| Increased risk that heather and grass moorland that characterises a significant proportion of Exmoor may change in response to temperature rise | | | | • **Landscape Action Plan** 2010 -2013 and **Exmoor Moorland Initiative** helping to build resilience in moorland landscape (E)<br>• **Moorland Management Fund** (E) provides small grants towards the cost of projects that work towards maintaining and improving heather moorlands through (for example) swaling, scrub control, heather restoration and improved livestock grazing |

## National Park Authority business continuity

| Potential impacts (risks/opportunities) | Rating | | | Existing or potential actions |
|---|---|---|---|---|
| | 2020s | 2050s | 2080s | |
| An increasing incidence of heatwaves may lead to increased staff absenteeism due to sickness or the need to look after other members of the family that may be sick. This may in turn result in disruption to services | | | | • **Business Continuity and Disaster Recovery** (BCDR) plan in place (E)<br>• Many staff have the option to work from home (E)<br>• ENPA operates a highly flexible working policy with no core hours (E) |
| Increased risk that prolonged dry spells may result in water use restrictions which may in turn cause health and safety and sanitation issues for staff | | | | • Enable home working where possible (E)<br>• Install grey water recycling and other water conservation measures at ENPA owned sites (E) |
| Increased likelihood of moorland and forest fires which could endanger staff working out in the field and damage ENPA buildings | | | | • Fire risk assessments, fire equipment and procedures in place (E) |
| Hotter drier summers may result in higher levels of solar radiation which may in turn increase the risks associated with sun exposure (e.g. sun burn, heat stroke, skin cancer) | | | | • Flexible working hours (anytime from 8am to 6.30pm) already in place which allow for working during cooler parts of the day (E).<br>• Extension of flexible working to enable work during times that would currently be considered 'out of hours' (P) |
| Higher summer temperatures could increase the risk of legionella contamination of water stored on ENPA premises presenting a health risk – particularly to males over the age of 40 | | | | • Treatment and monitoring programme in place (E) |

# 5. CONCLUSIONS

5.1 Responding to climate change is one of the four key challenges highlighted in Exmoor National Park Management Plan 2007 – 2012. Actions to mitigate and adapt to climate change therefore feature strongly in the plan. Climate change has also been highlighted during the development of the new Partnership Plan for Exmoor (its National Park Management Plan for 2013 - 2018) as one of the continuing priorities; this risk assessment will help to ensure that an appropriate response is taken to the risks and opportunities that are presented by climate change. The following are considered to be the most significant issues for Exmoor in relation to climate change adaptation.

5.2 Inevitable landscape change

The changing climate will bring about inevitable landscape change over an exceptionally short period of time in geological terms. Warmer temperatures throughout the year, drier summers and wetter winters will change the balance and composition of plant species. Land management practices are also very likely to change with farmers (for example) seeking to adapt or diversify their businesses in the face of new opportunities (e.g. arable, fruit growing), and foresters, seeking to plant new tree species that will thrive in a changed climate. It should be acknowledged that such changes may not always have a negative impact on the landscape.

Adaptation and mitigation responses to climate change are also very likely to impact significantly on the landscape and on historic features within that landscape. For example: major tree planting programmes are possible driven by (amongst other things) markets for carbon sequestration, demand created by the shift to a low carbon economy, and flood mitigation; and visible renewable energy technologies such as wind turbines and solar panels are likely to increase in response to drivers for climate change mitigation.

National Park stakeholders will need to consider this inevitable change when developing new policies and actions, ensuring that work programmes in the National Park Management Plan reflect the landscape's increasing dynamism. There is also a need to accept that the 'special qualities' of the National Park will almost certainly be impacted upon by the changing climate and by mitigation and adaptation responses.

### 5.3 Inevitable changes to the composition and balance of species (flora and fauna)

The substantial climatic change predicted will inevitably impact on the composition and balance of species, but the complex interrelationships between species and the unprecedented pace of climatic change make the likely outcome almost impossible to predict.

Exmoor's geography and location will act as a significant barrier to the movement of species in response to climate change. The Bristol Channel represents a 'brick wall' to northward migration of species that cannot fly (and fly the expanse of the Bristol Channel). Meanwhile, the even warmer temperatures anticipated to the east of Exmoor are likely to cut off the only land-based 'escape route' for terrestrial species. However, species that thrive on the lower slopes of Exmoor, may be able to move upwards in altitude to locate more climatically suitable habitats.

There is much existing activity in Exmoor National Park contributing towards building more resilient eco-systems – the key question for stakeholders over the coming years will be "where best to focus resources?" The inevitability of climate change may also call into question the benefits of existing activity to protect threatened species that are likely to be vulnerable to the impacts of climate change.

To inform this debate, it will be more important than ever before to develop and maintain records and research regarding the responses of a wide range of fauna/flora to changes in the climate.

### 5.4 Scale and pace of potential loss of historic features in the landscape

Exmoor has been shaped by human activity for at least the last 8,000 years and contains a wealth of interesting historical landscapes, sites, buildings and artefacts. Throughout that time, methods of managing the land have changed, different ethnic groups have come and gone, and the climate has fluctuated. In short, the passing of time has time has left its mark helping to create the landscape and the historic features of that landscape that we see and value today. However, the pace of climate change predicted is thought to be far more rapid and significant than anything that has gone before and is anticipated to have a huge impact on the historic environment. In particular, severe

flooding events may destroy historic buildings, landscapes and archaeology. Sea level rises may also damage, erode or submerge archaeological sites, historic buildings and settlements. Climate change may also lead to 'scrubbing up' of vegetation which could hide some archaeological features from view and cause damage to subterranean remains.

It will be important to identify which historical assets are most vulnerable to climate change to develop mitigation strategies where possible and to ensure comprehensive records exist where loss is inevitable. Strategies to mitigate flooding are also likely to be beneficial to protecting historic assets, for example through changes to land management.

### 5.5 Risk of catastrophic flood events

The 1952 Lynmouth disaster remains fresh in the mind to many and provides a powerful reference point for Exmoor in relation to the destructive potential of flash flooding. Nine inches of rain fell in just 24 hours and was channelled into the East and West Lyn rivers which were already swollen from previous rainfall. The resulting torrent of water devastated the coastal community of Lynmouth with the loss of 34 lives and the destruction of many buildings.

Many of Exmoor's rivers and streams, especially those to the north of the moor are prone to responding rapidly to rainfall and pose a severe threat to communities living downstream. Porlock is thought to be particularly at risk of a catastrophic flood event. The Defra Multi Objective Flood Management Demonstration Project is focusing on two river catchments that flow into Porlock Bay, adopting a catchment scale approach flood mitigation. The project is exploring the potential of changes to land management practices to reduce flood risk and to bring about a range of ecosystems services benefits.

Lessons learned from this project can and will be applied to the management of other catchments across Exmoor.

### 5.6 Water resource issues

Climate change is likely to put pressure on water resources, largely as a consequence of the likelihood of hotter, drier summers, but also as a consequence of more frequent droughts. Though this may be offset to a degree by wetter winters, the annual profile of rainfall is likely to be such that there will need to be a far greater emphasis on

storing water when it falls for use when it is more scarce.

Exmoor already provides water for communities outside the National Park, through abstraction from its rivers downstream and through the provision of drinking water via Wimbleball Lake. The possibility of increased demand for water, driven by a rising population in the South West and more business activity raises the prospect of (an)other reservoir(s) being created in Exmoor National Park to meet that demand. This could provide increased opportunities for water-based recreation and depending on its location, landscape benefits. However, it could also cause displacement of communities, adversely affect local eco-systems and could potentially represent a loss of landscape value if poorly sited.

Farmers could in particular come under threat from water shortages affecting irrigation and the provision of drinking water for livestock. Opportunities may exist for farmers in relation to reinstating or creating new ponds. These in turn may provide biodiversity benefits in addition to water storage facilities.

There are also opportunities, particularly in new buildings to install rainwater harvesting and grey-water recycling. Planning policies could be used to encourage this type of development.

5.7 Threats and opportunities relating to soils and grassland

Prolonged bouts of drier weather, warmer year-round temperatures, and a tendency for shorter spells of heavy rainfall could all combine to have a negative impact on Exmoor's soils. In particular, topsoils are likely to become starved of moisture, making them susceptible to erosion, especially during heavy rainfall. This in turn could reduce the fertility of Exmoor's soils and increase the amount of sediment entering watercourses.

Exmoor's peat soils store significant amounts of carbon, absorb pollutants, regulate runoff and improve water quality downstream. They also harbour interesting plant species such as sphagnum moss. They are at significant risk of drying out rapidly and eroding in a warmer, drier climate, as the climatic envelope for peat shrinks. They are also at particular risk from moorland fires.

It is difficult to predict exactly how Exmoor's peat will respond to climate change of the nature envisaged. However, it is likely that the consequences of the peat soils drying out would be significant and

highly damaging to the level of public benefit that they provide. It is therefore essential that work continues to be undertaken to maintain a high water table in Exmoor's mires and the ongoing Exmoor Mire Restoration Project should help in achieving such an aim.

Exmoor's grasslands also store significant quantities of carbon and often provide a haven for wildlife. Extensive sheep and beef farming (often mixed) are the predominant farming systems in operation on Exmoor. A warmer climate may favour a shift (or diversification) to arable crops and fruit growing, though this may be tempered by poor soil quality, particularly at higher altitudes.

Any change towards more arable farming would be likely to negatively impact on Exmoor's permanent and semi-permanent grasslands releasing carbon and reducing biodiversity. If farmers do switch from livestock to arable farming, then the use of low tillage methods should be encouraged to reduce soil erosion and carbon losses.

There is evidence that climate change may increase growth of legume-based swards (grass plus white clover, red clover or Lucerne) providing positive conditions for livestock farming. However, the threat of serious droughts could offset such benefits. Farmers would need to ensure that the optimised their conserved feeds to see them through such periods of low herbage growth [1]

5.8 The need to ensure existing and new buildings are well adapted to climate change.

The need to adapt new and existing buildings in the face of climate change is highly complementary with activity to mitigate climate change. Improving insulation both reduces the rate of heat loss during cooler weather and heat gain during warmer weather, and represents a significant opportunity for Exmoor. Generally, it is inexpensive, especially in the case of loft insulation. It may also help to ease fuel poverty. However, many of Exmoor's buildings have solid walls making them more difficult and expensive to insulate. The addition of some wall insulation systems, especially to exterior walls may also adversely impact on the historic character of buildings. So, the task of encouraging adoption of such measures may be difficult at this stage and require a financial incentive. The Green Deal proposed by the Government for 2012 may provide such an opportunity.

[1] Climate change impacts and grassland, Alan Hopkins, IGER 2004

High standards of insulation already apply to new buildings, though there is scope for further improvement in this regard for only a marginal increase in cost.

Other worthwhile adaptation measures could include encouragement for buildings to incorporate grey-water recycling systems (making this a requirement for new buildings) and rainwater harvesting. This would also help to mitigate climate change by reducing the demand for processed water (which requires an energy input).

It will be difficult to encourage householders and businesses to install adaptation measures at this stage as for many, significant changes to climate feel a long way away, beyond their horizon of consideration in relation to their own lives.

### 5.9 The impact of responses to climate change on the landscape

In addition to changes to landscape caused by land use change, measures to mitigate climate change may impact significantly and sometimes negatively on the landscape. For example, poorly sited wind turbines and the cumulative impact of a large number of smaller machines may detract from the landscape. Building-integrated renewable energy systems such as solar PV and solar hot water heating, especially their cumulative impact, may damage the character of historic buildings and settlements.

Many of these technologies are considered 'permitted development' subject to scale and certain caveats, making it difficult to control potentially negative impacts. It may therefore be necessary to encourage well sited and appropriate renewable energy development by providing examples and encouraging adoption off good practice in that regard.

New planning policies are likely to be required to address concerns in relation to cumulative development.

### 5.10 Moorland and forest fires

Exmoor already experiences moorland wildfires during spells of dry weather. Swaling (controlled burning) has been practiced for centuries on Exmoor and provides a range of benefits:

- It encourages the regeneration of vegetation and provides grazing for livestock

- It helps to reduce the risk presented by wildfires by creating breaks in vegetation that is prone to fire in dry spells of weather
- It helps to provide good habitat for game birds such as grouse.
- It can help to improve biodiversity
- It can help in maintaining landscape character over a prolonged period of time.

However, uncontrolled, wildfires of the sort started accidentally, deliberately or naturally and poorly managed swaling, can have negative impacts[2] including (but not limited to):

- degradation of carbon stores (especially if peat bogs or other areas where peat is exposed are burned and if woodland is burned);
- loss of habitat;
- watercourse erosion
- high costs relating to extinguishing fires and protecting communities; and
- a danger to walkers and to communities

Long spells of hotter, drier weather of the type anticipated for Exmoor's future climate will increase the risk of moorland fires and could potentially result in serious forest fires posing a threat to biodiversity, a danger to the public, buildings, livelihoods. It could also reduce the amount of carbon stored in both the Exmoor's moorland soils and peat and in its woodland.

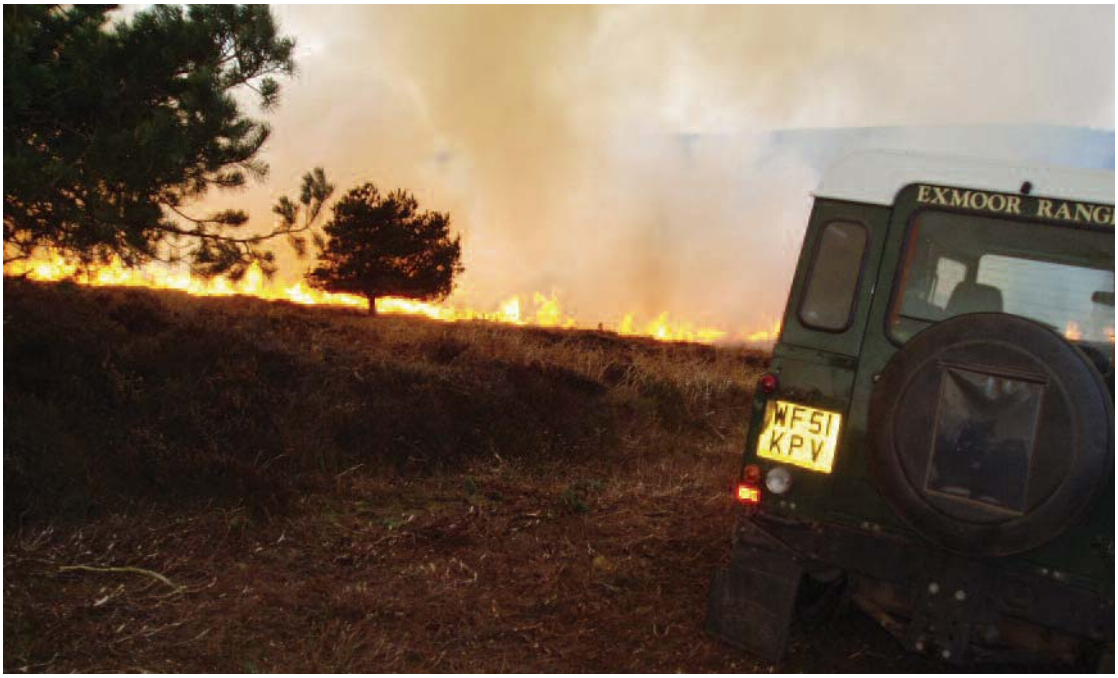
Effective swaling and moorland management can help to mitigate these risks. Maintaining a high water table for peat bogs through the Exmoor Mire Restoration Project should also help to protect peat.

[2] The heather and grass burning code (Natural England 2007)

# 6. INTEGRATION OF THE FINDINGS OF THIS REPORT INTO THE NATIONAL PARK MANAGEMENT PLAN

6.1 The Exmoor National Park Management Plan 2007 – 2012 named 'responding to climate change' as one of its four key priorities. Adapting to climate change has once again been highlighted as a key issue during the early phase of consultation for the new plan. It is highly likely that 'adapting to climate change' will as a consequence be dealt with as a cross-cutting theme, ensuring that due consideration Is given to its impact on all priorities and actions outlined in the new 'Partnership Plan for Exmoor' (its National Park Management Plan).

6.2 A Sustainability Appraisal will be undertaken of the consultation draft 'Partnership Plan for Exmoor' providing a further opportunity to screen the plan against a set of sustainability criteria. It has been agreed that climate change adaptation will be one of the criteria used as part of this assessment.



# 7. RECOMMENDATIONS

The following recommendations are made in response to the findings of this report:

7.1 A strategic approach to monitoring the impacts of climate change should be developed taking account of the resource implications of such activity and existing monitoring programmes. Gaps in the evidence base may result in research being commissioned or instigated through other means. The Partnership Plan for Exmoor Implementation Board could provide oversight and direction for such an approach.

7.2 Learning from the Defra Multi Objective Flood Management Demonstration Project taking place in the Holnicote Estate, Porlock, needs to be shared and utilised to enable a suitable approach to managing other catchments across Exmoor to be developed. The project aims to research and demonstrate the impacts of land management change on flood dynamics and runs from 2009 to 2013.

7.3 As has been highlighted in section 6 of this report, the findings will need to be integrated into the emerging Partnership Plan for Exmoor and Local Development Framework. In particular:

- the existing and potential actions suggested will need to be reviewed to ascertain whether they represent an appropriate response to the risk or opportunity identified - further actions may be identified as a consequence and existing actions may be subject to modification; and
- consultation with interested parties to the Partnership Plan will be required with relation to the risks/opportunities identified and the proposed responses set out in this report.

7.4 There is a need to communicate the risks of climate change to the community within Exmoor. This should be implemented through actions within the emerging Partnership Plan for Exmoor and can involve a number of partners including amongst others, Exmoor National Park Authority, Natural England, Environment Agency, Royal Society for the Protection of Birds, Climate South West, Forum 21, Fire Service, and District and County Councils covering Exmoor.

# CASE STUDY

A highly successful programme of mire restoration works has been untaken and is ongoing in Exmoor National Park through the 'Exmoor Mire Restoration Project' which ran from 2006 to 2010 and the new 'Exmoor Mires Project'.

The first stage of the project was hosted by Exmoor National Park Authority and involved a partnership between ENPA, the Environment Agency, South West Water, Natural England, English Heritage and local farmers and landowners.

The project aimed to address the problems caused by peat degradation, which include habitat and species loss; carbon emissions; damage through drying to archaeology and palaeo-ecology; and damage to moorland river hydrology and ecology

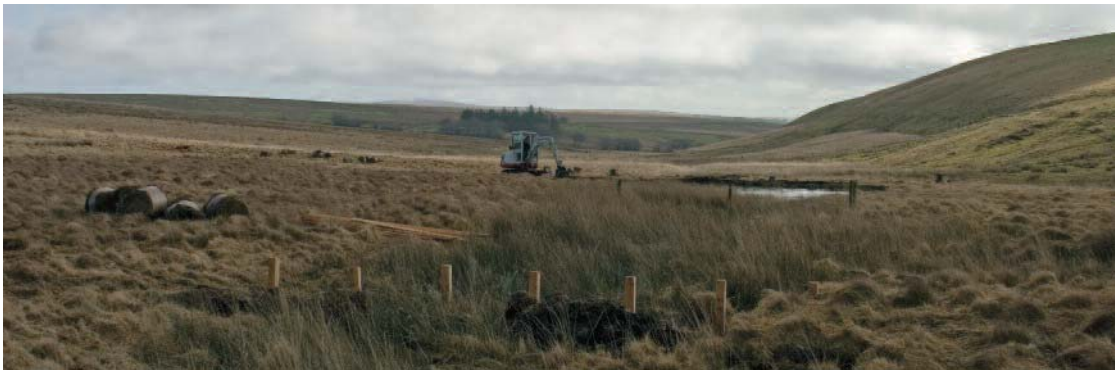
It achieved this by blocking drainage ditches which results in rainwater staying on the moors for longer leading to re-wetted peat, reduced flood risk downstream, improved river quality, a reduction in wildfire risk and a summer drinking water source for livestock on the moor.

The restoration work has also improved access through making pathways dryer by diverting water away from them. To date over 50 km of ditches have been

blocked with 4,300 dams made from bales, wood and peat. Consequently, over 300 ha of damaged mire has been re-wetted and is now accumulating instead of losing peat.

The project's achievement in helping to devise a new way of reducing flooding was recognised by the water industry in a prestigious award for the best "Sustainable Urban Drainage & Flood Management Initiative of the Year - 2009".

The project is now hosted by South West Water and is part of its £3.4m 'Upstream Thinking' programme and will continue work to rewet Exmoor's Mires until at least 2015, helping build the resilience of Exmoor to climate change.



Appendix A

# METHODOLOGY:

The report has been compiled internally by Exmoor National Park Authority (ENPA). ENPA has also had involvement in the development of climate change adaptation reporting undertaken by district and county councils.

The risk assessment has been undertaken through a series of workshops and meetings held with staff throughout ENPA.

The English national park authorities have jointly developed a risk/opportunity template tool to guide the adaptation reporting/risk assessment process.

The template comprises thematic Excel spreadsheets linked to common themes in NPMPs across the English NPAs namely:

- landscape;
- biodiversity;
- historic environment;
- cultural heritage;
- farming and land management;
- access, recreation and tourism;
- culture, community and the economy; and
- business continuity (for the National Park Authority).

The themes are each subdivided into 'aspects'. For example, historic environment is broken down into 'historic buildings', 'archaeological remains' and 'historic settlements, landscapes, parks and gardens'.

For each aspect of the themes considered, the UKCP09 projections of 'hotter, drier summers', 'warmer, wetter winters', 'more extreme weather events', and 'sea level rises' are considered using the medium emissions scenario projections for the 2020s, the 2050s and the 2080s. The data used is specific to Exmoor.

This process enables projected impacts to be identified, which in turn are used to highlight any potential risks and opportunities that might arise as a consequence of those impacts.

To ascertain the long term risk or opportunity score, the likelihood of the risk/opportunity manifesting itself is multiplied by the impact of any given risk/opportunity. The scale of likelihood runs from 1 (rare) to 5 (almost certain). The scale of impact runs from minus 5 (catastrophic) through to plus 5 (fantastic).

Appendix A

The resultant spectrum of risk runs from minus 25 (maximum risk/impact) to plus 25 (maximum opportunity/impact). This scoring is carried out for three different decades (2020s, 2050s and 2080s) to examine how the risk/opportunity evolves over time.

The climate change impact assessment process has been informed by various local and national resources, combined with the expert opinion of specialist officers within Exmoor National Park Authority. Resources used include:

- "Responding to climate change in Somerset" (Somerset County Council 2008)
- "Warming to the idea: Building resilience to extreme weather and climate change in the South West" (Climate Southwest 2010)
- Somerset WAVE (Water Adaptation is Valuable for Everyone); www.somersetwave.co.uk
- "A warm response; Our climate change challenge" (Devon County Council 2005)
- South West Water Climate Change Adaptation Report (2011)
- "The natural environment adapting to climate change" (Natural England 2008)
- Exmoor National Park Management Plan 2007 – 2012