The Second State of Natural Resources Report (SoNaRR2020)

SoNaRR2020 Register mountains, moorlands and heaths evidence

Natural Resources Wales

Final Report

About Natural Resources Wales

Natural Resources Wales's purpose is to pursue sustainable management of natural resources. This means looking after air, land, water, wildlife, plants and soil to improve Wales's well-being, and provide a better future for everyone.

Evidence at Natural Resources Wales

Natural Resources Wales is an evidence-informed organisation. We seek to ensure that our strategy, decisions, operations and advice to Welsh Government and others are underpinned by sound and quality-assured evidence. We recognise that it is critically important to have a good understanding of our changing environment.

We will realise this vision by:

- Maintaining and developing the technical specialist skills of our staff;
- Securing our data and information;
- Having a well resourced proactive programme of evidence work;
- Continuing to review and add to our evidence to ensure it is fit for the challenges facing us; and
- Communicating our evidence in an open and transparent way.

Title: **SoNaRR2020 Register mountains, moorlands and heaths evidence**

Peer Reviews: Internal and external peer review

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The Second State of Natural Resources Report (SoNaRR2020) contents

This document is one of a group of products that make up the second State of Natural Resources Report (SoNaRR2020). The full suite of products are:

Executive Summary. Foreword, Introduction, Summary and Conclusions. Published as a series of webpages in December 2020

The Natural Resource Registers. Drivers, Pressures, Impacts and Opportunities for Action for eight Broad Ecosystems. Published as a series of PDF documents and as an interactive infographic in December 2020

Assessments against the four Aims of SMNR. Published as a series of PDF documents in December 2020:

SoNaRR2020 Aim 1. Stocks of Natural Resources are Safeguarded and Enhanced

SoNaRR2020 Aim 2. Ecosystems are Resilient to Expected and Unforeseen Change

SoNaRR2020 Aim 3. Wales has Healthy Places for People, Protected from Environmental Risks

SoNaRR2020 Aim 4. Contributing to a Regenerative Economy, Achieving Sustainable Levels of Production and Consumption

The SoNaRR2020 Assessment of Biodiversity. Published in March 2021

Assessments by Broad Ecosystem. Published as a series of PDF documents in March 2021:

Assessment of the Achievement of SMNR: Coastal Margins

Assessment of the Achievement of SMNR: Enclosed Farmland

Assessment of the Achievement of SMNR: Freshwater

Assessment of the Achievement of SMNR: Marine

Assessment of the Achievement of SMNR: Mountains, Moorlands and Heaths

Assessment of the Achievement of SMNR: Woodlands

Assessment of the Achievement of SMNR: Urban

Assessment of the Achievement of SMNR: Semi-Natural Grassland

Assessments by Cross-cutting theme. Published as a series of PDF documents in March 2021:

Assessment of the Achievement of SMNR: Air Quality

Assessment of the Achievement of SMNR: Climate Change

Assessment of the Achievement of SMNR: Energy Efficiency

Assessment of the Achievement of SMNR: Invasive Non-native Species

Assessment of the Achievement of SMNR: Land use and Soils

Assessment of the Achievement of SMNR: Waste

Assessment of the Achievement of SMNR: Water Efficiency

Updated SoNaRR evidence needs. Published in March 2021

Acronyms and Glossary of terms. Published in December 2020 and updated in March 2021

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Mountains, Moorlands and Heaths Natural Resource Register Evidence List

SoNaRR2020

The evidence below has been extracted from the mountains, moorlands and heaths chapter unless otherwise stated.

If the original piece of evidence is not cited within this document then it can be found in the mountains, moorlands and heaths chapter or associated chapters, which will be published in March 2021. At that point this document will be superseded.

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Evidence List: Drivers, Pressures and Impacts Table

Climate Change

1. **Changing Weather Patterns**

1.1. Loss of carbon and habitat deterioration from drained / drought soils, more surface run-off and erosion

Direct impacts include summer drought on peatlands and heathlands. These impacts are likely to be most significant on soils which are prone to desiccation such as thin peats (wet heath and Rhynchopspora depressions) and skeletal mineral soils (dry heath and juniper heath). Habitats which are in poor condition as a result of other pressures such as degraded raised bogs are also likely to be sensitive to drought.

The montane and alpine habitats are most susceptible to high temperatures. Currently other pressures, notably grazing and nitrogen deposition, are considered to be more significant on these habitats but climate change is likely to become an increasing threat with wetter, warmer winters resulting in more surface run-off and erosion and impact on species which thrive under snow cover (Natural England 2013).

Evidence from Climate Change Chapter
Drought's impact on soils, and the ecosystem services that they provide, is likely to be severe. The majority of projections suggest reductions in soil moisture are likely across the UK with climate change (Brown et al., 2016). Climatic moisture (and soil moisture) has been found to be positively related to topsoil carbon (Alison et al., 2019), so drought conditions could reduce carbon storage in soils. Peatland formation needs cool and wet conditions, so climate change could further impact peat, which is already subject to degradation. Degraded soils, particularly in wetland ecosystems, could be a net source of greenhouse gases (ASC, 2016). Drier summers followed by wetter autumn and winter conditions are likely to increase soil erosion.

Evidence from Climate Change Chapter
These projected changes to soils are likely to constrain land use in certain areas. Land quality could reduce, changing the areas that are the most productive (medium confidence) (Brown et al., 2016). The agricultural quality of some lands is projected to decrease due to drought (Keay et al., 2014) and some will be lost due to sea level rise [Link to Land Use and Soils Chapter] However, there is still significant uncertainty over how soils will respond to climate change (Rollett and Williams, 2019).

Evidence from Land Use and Soils Chapter
Areas with peat and peaty soils (organo-mineral soils) currently accumulate and maintain soil carbon because they are under specific (bio)climatic conditions (low temperatures and high rainfall). These areas may be vulnerable to carbon loss due to increased temperatures, reduced soil wetness and increased dry periods with a potential increase in GHG emissions. Areas with peat and peaty soils may support a range of specialised habitats (e.g. those underpinned by organic-mineral soils and peats). The climatic shift may change soil conditions, impacting on the condition and function of these habitats in the future.

Evidence from Land Use and Soils Chapter
The reviews of soil erosion in England and Wales (Boardman and Evans, 2006 and Morgan 1985, Rollett & Williams, 2020) indicate that soil erosion in Wales is mainly attributable to upland erosion processes, e.g. peat, organo-mineral soils, landslips and stream bank erosion, and water erosion along the border with England. Large areas of Wales are assumed to have low erosion rates due to the predominance of grassland and rough grazing, although this has not been quantified by measurements or observations (Cranfield University, 2016a). Estimates of annual rates of erosion were 0.54 – 1.37 t/ha/yr in UK grassland, 0.1-10t/ha/yr on UK cultivated land and 10-200t/ha/yr on UK bare soils (Nicholson et al., 2020) require further validation before they can be assumed to be applicable to Welsh soils. As long as soil formation rates exceed soil erosion rates, soil will not be lost to future generations. Soil losses exceeding 1 t/ha/year are considered irreversible and unsustainable within a time span of 50-100 years (Rollett and Williams, 2020).

Berry et al. 2019 . LANDMAP, Landscape and a Changing Climate

Predicted drying out of wetlands, peatland boggy ground and reduced surface water, although effects may be localised and dependent on rainfall pattern through the summer months. Erosion of peat post desiccation, leaving features like peat hags in the landscape. Drying out of peatbogs and reduced summer rainfall will cause changes in upland vegetation such as loss of mosses and peat forming species. Coarse grass species are likely to increase but bare ground may develop where peat is exposed to wind and water erosion, and the surface too friable for vegetation to take hold.

1.2. **Higher natural tree-line and northern drift of species. Reduction of montane habitat climate envelope, Likely to cause the loss of plant and bird species including loss of C-sequestration potential from peat forming species**
The catastrophic declines in golden plover and curlew (curlew 75% loss from 1995-2015) raise questions about the health of these habitats. Golden plover breeding in the Welsh uplands are among the most southerly populations in their global range; their decline may be due to climate change and the loss of synchronicity with invertebrate prey (Pearce-Higgins et al 2005) or changes in grazing practice and vegetation structure (Johnstone et al 2017).

Relict arctic-alpine flora of the North Wales mountains may be constrained by a diminishing climate envelope but also by habitat fragmentation produced by land-use or land-management.

1.3. **Increase threat of wildfires**
Climate change can also have indirect effects, one of the most significant being the increasing threat of uncontrolled damaging wildfire on moorland vegetation in dry periods as experienced on Llantysilio mountain in 2018 (Longden 2019).

There is a general presumption again the burning of blanket bog which may damage the Sphagnum moss component essential for its restoration and growth, but the increasing fuel loads on drier habitat or on drained blanket bog has led to calls for more regular burning to avoid catastrophic wildfire (Natural England 2013).

Evidence from Climate Change Chapter
Drier summers and increased drought could also increase the wildfire risk in Wales. Using the McArthur Forest Fire Danger Index, increases of fire risk of 30-

40% are projected for the Pembrokeshire Coast and Brecon Beacons and 40-50% for Snowdonia by the 2080s compared to 1980s (Defra, 2012).

1.4. Increased risk of flooding

Climate change in Wales will be characterised by greater unpredictability and variability of weather pattern, including rainfall events. Droughts and floods will become more common, imposing greater stress on ecosystems.

More frequent and intense storms are expected as a result of climate change which are likely to have more impact at higher elevations (Berry et al 2019).

Evidence from Land use and soils
The UKCP18 climate change impact predicts wetter winters, warmer summers, increased incidence of storms, extreme weather and rising sea levels (Lowe et al. 2018).

Pollution

2. Air Pollution

2.1. Leads to profusion of nitrophilous species, direct toxicity effects on some species, reduction in plant species richness and changes to vegetation structure which may enhance carbon loss

Mixed source air-pollution was assigned a pressure score of 'high' for 19 of the 21 Annex 1 MMH habitats and is the highest ranked pressure across all categories. Nitrogen pollution is the most widespread pressure on MMH habitats, with 95% of bog, 98% of dwarf shrub heath and 100% of montane habitats exceeding their critical load (Rowe et al 2020), some by a very wide margin. While there has been some improvement in average annual exceedance values (i.e. total N load) in all these habitats, the extent of the impact shows little change. Despite modest projected reductions in the overall deposition loads of reactive nitrogen in the UK, air pollution is expected to remain a high pressure and threat to MMH habitats in Wales. For example, analysis using projected exceedance data for 2030 indicates that the area of blanket bog where deposition is above the relevant critical load will not fall at all from the 2013-2015 estimate (JNCC, 2018).

In peatlands nitrogen deposition is associated with a reduction in plant species richness, changes to vegetation structure and changes in carbon cycling which may enhance carbon loss (Kivimäki et al. 2013). It is estimated that nitrogen will continue to accumulate in peat until at least 2030 (Payne 2014).

Research on heathlands shows strong evidence of a link between nitrogen deposition, the decline of species diversity and changes to habitat structure and function (Southon et al 2013), and with heavy grazing, nitrogen deposition can result in the spread of grass-dominated vegetation (Alonso et al 2001). An interaction between grazing pressure and nitrogen deposition (from aerial deposition and animal emissions) on montane habitats results in the decline of key species such as woolly hair moss and grass domination, which attracts further grazing (Armitage et al (2005), Britton and Pearce (2004), Britton and Fisher (2007).

An assessment (Hodd, 2018 and 2020) of six north Wales sites supporting liverwort-rich scree slope vegetation (H8110 silicious scree) recorded algal masses ('algal gunk') smothering rare and scarce bryophyte species on 67% of 42 surveyed plots. Similar accumulations of algae are notable on calcareous lowland flushes across the Anglesey Fens SAC.

3. **Water Pollution**

3.1. **Inorganic nitrogen concentrations in groundwater is an issue for many lowland peatlands leading to profusion of nitrophilous species, reduction in plant species richness and changes to vegetation structure which may enhance carbon loss**
Excess inorganic nitrogen in groundwater is an issue on all lowland peatlands. The impacts of diffuse pollution are similar to those from aerial deposition; The usual source of diffuse pollution is agricultural run-off, particularly where peatlands are surrounded by intensively managed farmland.

Land Use Change

4. **Insufficient Management**

4.1. **Causing changes in species composition and structure, e.g. profusion of dominant species at expense of delicate species, but also including natural colonisation of woodland and carbon sequestration.**
Over-grazing is particularly associated with upland MHH habitats and impacts are recorded on a range of habitats including heathland, montane heath, blanket bog and rock-based habitats. Recent declines in grazing levels in the uplands have initiated the slow recovery of vegetation in some areas (Sherry 2019(1), Sherry 2019(2)) but many habitats still show long-term impacts of heavy grazing including the suppression or loss of ericoids, the prevalence of graminoid dominated vegetation and loss of plant species diversity. These impacts may result from continuing high grazing levels, localized over-grazing or the time-lapse between reduction in grazing and recovery of vegetation in the harsh upland environment. GMEP modelling suggests that vegetation response can take between 10-23 years after management change. This was highlighted by upland heath monitoring in Tir Gofal (Emmett et al 2017).

In the uplands, afforestation, grazing pressures and predation are likely key drivers of change for birds. The decline in the curlew is of greatest conservation concern and is now considered to be the most pressing bird conservation priority in Wales (P. Lindley pers com), declining at a rate of 5% per year, with a predicted extinction as a breeding species as soon as 2035.

In the lowlands insufficient grazing is the key problem and is recorded on both the heathland and peatland MMH habitats. On heathlands, the reduction in grazing has led to the spread of very species-poor gorse-dominated vegetation, bracken and scrub. This creates a negative feedback loop with rank vegetation becoming more difficult to graze and resulting in either localised over-grazing of remaining open habitat or the complete withdrawal of grazing. Consequential soil changes may preclude any easy return to the original valued heathland state. On peatlands, insufficient grazing typically results in scrub invasion and the over-dominance of graminoids, particularly Molinia, to the detriment of more diverse low-growing shortsedges, forbs and bryophytes. On calcareous fens lack of grazing or mowing can lead to the over-dominance of great fen-sedge *Cladium mariscus*. The impacts of under-management are amplified when combined with drainage and atmospheric nutrient deposition (Tomassen et al., 2004). This also has an important impact on a wide range of specialist and often rare invertebrate species, particularly those which require some exposed wet substrate such as southern damselfly.

5. **Agricultural Intensification**

5.1. **Causing simplification of ecosystem for singular productive use, but general loss of biodiversity. May affect soil and hydrological properties, aesthetics and other land uses.**

Peatland under improved pasture or cultivation emits extraordinary levels of greenhouse gases (Evans et al., 2017).

Continuing loss of small fragments of lowland heathland occurs; for example, there is anecdotal evidence on Anglesey of habitat fragments on rocky hummocks within improved fields being converted to agricultural grassland by targeted stock feeding.

Diffuse pollution usually from agricultural run-off where peatlands are surrounded by intensively managed farmland can cause increased growth of more aggressive species, leading to smothering of sensitive species.

Livestock grazing has been a key driver of change in extent and condition of MMH habitats since 1945 (UK NEA, 2011).

Self-seeding of conifers from plantations is a continuing threat to upland peatlands requiring regular intervention.

6. **Historic Inappropriate Afforestation**

6.1. **Causing simplification of ecosystem for singular productive use, but general loss of biodiversity. May affect soil and hydrological properties, aesthetics and other land uses.**

This pressure refers primarily to the legacy impact of past conversion of lowland raised bog and fen habitats to agricultural land which continues to impact the remaining peat body. The last Article 17 report also recorded three cases of attempted agricultural intensification on alkaline fen (contrary to EIA (Agriculture) (Wales) Regulations 2017 (Welsh Government 2017). Peatland under improved pasture or cultivation emits extraordinary levels of greenhouse gases (Evans et al 2017).

In the uplands, afforestation historically occurred on blanket bog, with an estimate of nearly 7,000 hectares of conifer planting since WWII. Though the UK Forestry Standard does not support planting on deep peat, planting may still occur on shallow peat (<50cm) and there are legacy issues to address.

Evidence from Aim 2: Resilient Ecosystems Chapter
The amount of lowland habitat, especially freshwater, grassland, heathland and peatland, has declined considerably due to hard engineering, water abstraction

and changes in management that modify plant communities and change the type of habitat.

Evidence from Land Use and Soils Chapter
The main changes (2016-19) in land use area are an increase in tree cover on farms, more woodland (Welsh Government 2018) , more permanent grassland (5%), more arable (5%), more grass leys (2%), whilst a decline in sole rights rough grazing (-2%) and horticulture (-13%) occurred. (Emmett et al 2017)
Land utilised for renewable energy development has continued to increase to meet the target of 70% of Wales' electricity consumption from renewable energy sources by 2030 (48% in 2019). This includes wind, solar, hydropower, energy from waste and bioenergy projects plus the required electricity supply infrastructure. For example solar generation requires 0.5MW/ha (National Assembly for Wales, 2015)10ha of land for every 5MW installation and ground source heating requires 0.2MW/ha (Centre for Alternative Technology, 2020). Bioenergy requires the conversion of land to produce energy crops rather than food or fodder for livestock. According to Forest Research, in 2017 there was estimated to be 92,700ha[1] of tree cover (urban & rural) outside National Forest Inventory (NFI) defined woodlands. This is comprised of small woods less than 0.5 hectares in size (49,200ha), groups of trees (33,400ha) and lone trees (10,100ha) (Soudzilovskaia et al 2019). The total woodland as a percentage of land cover is 15%, including trees outside woodland brings the total land cover of woodlands and trees in Wales to 19.4%.

Evidence from Aim 2: Resilient Ecosystems Chapter
Mid-altitude rivers and upland heath, peatland, lakes and rock habitats have been lost through past and current management practises and there now remains only moderate extent.

7. **Unmanaged Access, Sport and Recreational Activity**

7.1. **Creating localised disturbances, changes and degradation, GHG emissions associated with ancillary actions (transport, accommodation).**
Impacts recorded on rock-based habitats include footpath erosion across scree fields and localised damage to sensitive cliff and ledge vegetation from climbing and (occasionally) ice climbing. Caves have more specific issues which include the impact of increased CO2 levels associated with respiration on delicate cave formation (Baker & Genty, 1998). Recreational impacts on subterranean fauna are generally poorly understood but hibernating bats are particularly sensitive to human disturbance.

Access and recreation pressures have been recorded on heathlands; impacts include footpath erosion, vehicle damage, disturbance, especially by dogs, to livestock and breeding birds and fouling causing localised soil enrichment. Some of these effects are positive; e.g. footpaths can create firebreaks and maintain open ground micro-habitats on heathland, but dogs can discourage graziers. Taylor et al (2005) found 25-50% of walkers on lowlands (but only 5-7% on uplands) are accompanied by dogs. Most fouling occurs close to car parks and access points but the resulting N and P enrichment can locally exceed intensive agricultural soils and alters the vegetation.

Impacts on rock-based habitats include footpath erosion across scree fields and localised damage to sensitive cliff and ledge vegetation from climbing and (occasionally) ice climbing (BMC 2011). Caves have more specific issues which include the impact of increased CO2 levels associated with respiration on delicate cave formation (Baker & Genty, 1998).

Evidence from Land Use and Soils Chapter
Snowdonia has seen a 15% rise in visitor numbers over 5 years (2015-2020) and across all our National Parks the visitor economy generated over £1.2 billion in 2018. With increasing visitor numbers come economic and health benefits but risks of 'over-tourism' in certain locations can have a negative impact on biodiversity and requires careful management and investment to respond to the pressure.

Invasive Non-Native Species

8. **INNS**

8.1. **Threatening the condition, extent and, connectivity and condition of the ecosystem. Threaten ecosystem service delivery.**
Significant invasive non-native species (INNS) include rhododendron and some conifers on upland heathlands and peatlands. On rock-based habitats and in alpine flush mires New Zealand willowherb has continued to spread on lowland peatlands Himalayan balsam is a particular threat.

Evidence from INNS Chapter
The heat map of occurrence records of INNS of interest to Wales which impact on the mountain moor and heath ecosystem in Wales (Fig 8h) shows that records are evenly distributed across the uplands of Wales; however, there is a higher concentration of records on the Berwyn, mid Wales and in the Brecon Beacons. The INNS of interest to Wales that primarily affect the mountain moor and heath ecosystem impact biodiversity by predating or by outcompeting and replacing native flora and fauna and also lead to a reduction in grazing areas. It should be noted that there are non-native plant species which primarily affect freshwater, woodland and semi-natural grassland ecosystems which could also adversely affect habitat in mountain, moor and heath. Their impacts include outcompeting native flora and the knock-on effects on the different trophic levels, scrub and woodland encroachment, peatland degradation and inhibiting the formation of peat.

Over-exploitation

9. **Drainage**

9.1. **Habitat change, increased run-off, Greenhouse Gas emissions, grazing stock losses**

Drainage and related activities remain as either high or medium priority pressures and threats for eight of the nine peatland and related Annex 1 types (JNCC, 2019), with agricultural drainage cited for the six priority habitats most closely associated with deep peat deposits. Impacts are the result of both past drainage activity, i.e. internal drainage channels, and current drainage activity, which largely refers to the management of marginal drains where peatlands abut agricultural land. In uplands, drainage largely refers to historic moor-gripping. While >770km of grips have been blocked, an estimated 1,500km still remain (Williamson, 2019).

This poses significant adverse impacts on floristic quality and hence peatland feature condition. Furthermore, a study of the drained Migneint peatlands (Migneint-Arenig-Dduallt SAC, north Wales) suggests that drainage may have resulted in the loss of 3 t CO2-e yr-1 /ha (Williamson et al., 2017). Assuming (i) that this estimate can be scaled up to all drained peatlands, and (ii) that drainage exerts an effect 10 m either side of a ditch, this would result in a total carbon loss estimate of 9,073 t CO2-e yr-1 for the remaining drained resource for marginal agricultural benefit and frequent loss of livestock in ditches. The effects of this past drainage will be accentuated by climate change since the hydrological resilience on these areas is compromised.

Lowland peatlands often occupy a fragment of their original footprint and are typically surrounded by intensively managed agricultural land making them vulnerable to drainage and diffuse pollution.

Draining also amplifies the impacts of under-management (insufficient grazing) in the lowlands (Tomassen et al., 2004) such as scrub invasion and over-dominance of certain species.

Evidence List: Assessment of SMNR

Aim 1: Stocks of Natural Resources are safeguarded and enhanced

Aim 1: Progress towards meeting the aim

1.1 Section 16 Management Agreements and Glastir Commons Agreements have had some positive outcomes for upland heath, particularly as a result of reduced winter grazing (Sherry 2019).

1.2 On-going conservation actions underway or planned as part the EU funded LIFE for Welsh Raised Bogs project and the Welsh Government Peatland Action Programme have led to positive assessments of some lowland peatland habitats (2 out of 7) (JNCC 2019) and positive future prospects for blanket bog in upland peatland.

Aim 1: Obstacles remaining to meeting the aim

1.3 Upland landscapes are dominated by large, often rather species-poor relatively homogeneous semi-natural vegetation, reflecting the influence of a range of long-standing environmental and land management pressures. Draining water from these habitats also amplifies the impacts of under-management (insufficient grazing) in the lowlands (Tomassen et al., 2004) such as scrub invasion and over-dominance of certain species.

1.4 Despite modest projected reductions in the overall deposition loads of reactive nitrogen in the UK, air pollution is expected to remain a high pressure and threat to MMH habitats in Wales. For example, analysis using projected exceedance data for

2030 indicates that the area of blanket bog where deposition is above the relevant critical load will not fall at all from the 2013-2015 estimate (JNCC, 2018).

1.5 Substantial loss of lowland heathland occurred pre-and post WW II. On the Llyn Peninsula 51% dry heath and 95% wet heath were lost between 1920's and late 1980's (Stevens 1992). On Anglesey, a 47% reduction in heath was recorded between 1940 and 1993 (Norris and Stevens 1999). Losses have slowed since the 1980s. In the ffridd, Gritten (2012) showed a 6% loss of wet heath and a 14% loss of dry heath between the late 1980's and 2009-11.

1.6 Drainage and related activities remain as either high or medium priority pressures and threats for 8 of the 9 peatland and related Annex 1 types, with agricultural drainage cited for the 6 priority habitats most closely associated with deep peat deposits (SoNaRR2020 MMH Chapter).

1.7 The Glastir agri-environment scheme and Environment (Wales) Act 2016 Section 16 Management Agreements have been important mechanisms for supporting appropriate management on MMH habitats and therefore the lack of resource could hinder this aim being met. However, agri-environment schemes are of limited effect for lowland peatlands, with little evidence of effectiveness for water quality improvements in lowland catchments (Emmett et al., 2017).

Aim 2: Resilient Ecosystems

Aim 2: Progress towards meeting the aim

2.1 Monitoring undertaken as part of the Glastir Monitoring & Evaluation Programme (GMEP) shows no overall change in either habitat condition or plant species richness for Mountain, Moor & Heath between 1990 and 2013-16 but with a significant increase in both metrics between 2007 and 2013-16 (Maskell et al., 2019).

2.2 Evidence provided in Assessment of SMNR

Aim 2: Obstacles remaining to meeting the aim

2.3 The collated results of 2018 Article 17 assessment for the 21 Annex 1 habitats falling within MMH (JNCC 2019) suggest that only 2,997ha (1.9%) of the resource of these habitats is in good condition , with 44,783ha (29.7%) in 'not good' condition and the remainder of 102,719ha (68.2%) in unknown condition.

2.4 Evidence provided in Assessment of SMNR

2.5 Evidence provided in Assessment of SMNR

2.6 Livestock grazing is essential to maintain the structure and floristic composition of many MMH habitats. However, too much or too little or at the wrong time of year or an unsuitable livestock, cause decline of habitat structure and composition, and increase of species-poor vegetation e.g. acid-grassland or Molinia-dominated peatlands.

Aim 3: Healthy Places for People

Aim 3: Progress towards meeting the aim

3.1 MMH habitats, particularly on peat and organic soils, retain large amounts of surface water, slowing discharge and regulating flow; damage leads to more rapid run-off. EU funded LIFE for Welsh Raised Bogs project and the Welsh Government Peatland Action Programme which will help restore peatland, will help regulate flow and run off from the uplands. Revegetating eroded peat attenuates run-off and reduces peak flows. These effects are roughly doubled if gulley blocking is also undertaken (Shuttleworth et al., 2018). Restoration work has revegetated an estimated 1000 ha of peatland in Wales up to now (Williamson, 2017).

3.2 Peatlands play a vital role in climate regulation through carbon storage and sequestration, occupying around 4% of the land mass in Wales but storing about 15% of the carbon Deep peat soils in Wales are estimated to hold 66Mt of carbon in Wales (Williamson et al., 2019).

3.3 Over the centuries the mountains, moorlands and heaths of Wales have inspired artists, historians, poets, scientists and explorers. Today, there are ever more people enjoy these landscapes, which sees them engaging in a range of artistic, educational, cultural and sporting activities. The ecosystem is of paramount importance as a recreational resource, particularly for energetic outdoor activities such as hill walking, fell running, climbing and mountain biking. The two most popular mountain areas, Snowdonia and the Brecon Beacons, attract 4.27 and 4.15 million visitors per year respectively (Arup 2013). Visitors to the three National Parks spend over £1 billion annually on goods and services, supporting the local economy and providing local employment.

Aim 3: Obstacles remaining to meet the aim

3.4 Excess inorganic nitrogen in groundwater is an issue on all lowland peatlands. The impacts of diffuse pollution are similar to those from aerial deposition; The usual source of diffuse pollution is agricultural run-off, particularly where peatlands are surrounded by intensively managed farmland.

3.5 Evidence provided in Assessment of SMNR

3.6 Livestock grazing is essential to maintain the structure and floristic composition of many MMH habitats. However, too much or too little or at the wrong time of year or an unsuitable livestock, cause decline of habitat structure and composition, and increase of species-poor vegetation e.g. acid-grassland or Molinia-dominated peatlands.

Aim 4: A Regenerative Economy

Aim 4: Progress towards meeting the aim

4.1 There has been a general reduction in livestock numbers in upland areas since the late 1990s (Silcock et al 2012) from the extraordinary livestock numbers (11.8M sheep) then. Clark et al (2019) suggest that a further reduction in stock levels and associated reduction in variable costs can increase profitability, whilst at the same time improving upland ecosystem function and services. MMH habitats in the lowlands are also used for rough grazing but there has been a much greater decline in livestock production with abandonment in some areas.

4.2 Some 6,900ha plantation on peat was identified (Evans et al 2015) of which nearly 900ha will soon have been removed and a further 1162ha is programmed for removal from the Welsh Government woodland estate.

Aim 4: Obstacles remaining to meet the aim

4.3 Evidence provided in Assessment of SMNR

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4.6 Evidence provided in Assessment of SMNR

References: Drivers, Pressures and Impacts Table, Opportunities for Action and Assessment of SMNR

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