Sustainable Driven Grouse Shooting?

A summary of the evidence

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July 2021

Date	Version	Updates
18.07.2021	1.0	First edition

CONTENTS

FOREWORD BY THE INDEPENDENT CHAIR

Often referred to as the 'King of Gamebirds', the red grouse is unique to the British Isles and has a shooting season which runs from 12 August – the 'Glorious Twelfth' – until 10 December. The red grouse has been walked-up and shot over dogs since Stuart times. Sportsmen experimented with driven grouse shooting during the early years of the 19th century, but the practice did not come into general use until the Victorian period.

When I was invited to Chair the production of this Report on Sustainable Grouse Shooting, it quickly became apparent to me that both the grouse and grouse shooting were just small parts of a much bigger picture involving ecology, conservation, land management, economics, and social impacts of a significant area of our country's land and heritage. It is the evidence underlying that larger canvas that this report seeks to capture and evaluate.

A good definition of sustainability is that it is a long-term goal to achieve a more sustainable world. Sustainable development refers to the many processes and pathways to achieve it e.g., sustainable agriculture and forestry, sustainable production and consumption, good government and governance, research and technology transfer, education, and training[1]. The International Union for Conservation of Nature (IUCN) has stated that "the core of mainstream sustainability thinking has become the idea of three dimensions, environmental, social and economic sustainability." These three dimensions underpin our Report.

We have collected much evidence underlying these three dimensions; 25 pages of our 242-page report - over 10% - details the literature we have studied and evaluated. Because grouse shooting can be such an emotive subject, we have endeavoured to be as objective as possible in looking at all sides of any argument, and always at the 'bigger picture' I alluded to above. We feel that the recognition and understanding of the evidence within our report will be of vital importance in both driving improvements in sustainability, and in ensuring that irreversible negative environmental, economic or social impacts do not occur. Despite – or because of – our research-led approach, it is clear that there are a number of areas

[1] Li, R.Y.M., Li, Y.L., Crabbe, M.J.C., Manta, O. and Shoaib, M. (2021) The Impact of Sustainability Awareness and Moral Values on Environmental Laws. *Sustainability*. **13**, 5882. https://doi.org/10.3390/su13115882.

that need significantly more research in order to come to a valid evidence-based conclusion. Those areas are detailed in the Report.

This is not the end of the story. From the outset we intend our report to be a 'living document' that will be updated regularly. We therefore hope that this Report will be an important resource now, and in the future, for policy-makers, and for anyone who cares, not only about driven grouse shooting, but about the sustainable development of our rural communities and of the people that they serve.

James Crabbe, Emeritus Professor & Supernumerary Fellow, Wolfson College, Oxford University

1 INTRODUCTION

In December 2020 the authors were commissioned by the Uplands Partnership to produce a detailed report reviewing the evidence on whether driven grouse shooting was sustainable. The definition of 'sustainable' was to be based on that produced by the International Union for Conservation of Nature. The intention was to complete the research so that the report could be published in July 2021. The target audiences for this document were specified as being policy makers, people directly involved in driven grouse shooting, people with a vested interest in the activity, and other stakeholders and interest groups.

1.1 AIM OF THE REPORT

On 26th November 2020 the Scottish government announced that work would begin to licence grouse shooting in Scotland. In making this decision, the Scottish government ignored the advice of its own review, which had been set up to advise on licensing of grouse shooting businesses in Scotland, (Scottish Government, 2017a) and which had recommended:

> "that a licensing scheme be introduced for the shooting of grouse if, within five years from the Scottish Government publishing this report, there is no marked improvement in the ecological sustainability of grouse moor management, as evidenced by the populations of breeding Golden Eagles, Hen Harriers and Peregrines on or within the vicinity of grouse moors being in favourable condition."
>
> (Grouse Moor Management Review Group, 2019, p.8)

The aim of this report is to present the current evidence-based knowledge relating to the economic, ecological and social sustainability of driven grouse shooting (DGS). The report is intended to enable policy makers, those involved in DGS, and other stakeholders to consider all aspects of sustainability before making policy or management decisions about DGS. We also hope that the report will suggest new topics for research by academics.

Subsequent to its initial publication in July 2021, our full report will be updated on a regular basis. It will be a 'living document' continually available as a resource for policy makers and other interested parties.

1.2 RELEVANCE AND AUDIENCE

The International Union for Conservation of Nature (IUCN) has stated that:

> "The core of mainstream sustainability thinking has become the idea of three dimensions, environmental, social and economic sustainability"
>
> (Adams, 2006, p.3).

These three dimensions should be carefully considered by anyone making political or management decisions about the current and future use of moors on which DGS takes place. If a change in land use is contemplated, then it should either deliver net improvements to current levels of environmental, social and economic sustainability, or be at least as beneficial as existing practices. The recognition and understanding of the evidence within this report is of vital importance in driving improvements in sustainability, and in ensuring that irreversible environmental, economic and social *negative* impacts do not occur.

DGS has economic, environmental and social impacts within the UK. This report points out that these impacts (particularly the social and economic impacts) are more widespread than most people realise and affect more people than those directly involved in the activity. Importantly, **we highlight the fact that DGS is not an activity that occurs in isolation; rather it is part of a complex 'web' of activities that together comprise what we have called 'integrated moorland management'.**

There are people that are opposed to DGS. These opponents, most of whom hold sincere beliefs, have traditionally used emotive language to appeal to policy makers and the general public. However, in recent decades they have become more skilful at influencing policy makers and in using judicial challenge to attack DGS. Some opponents of DGS have been very selective in their use of research findings or misused these findings to support their case. Some have even resorted to falsehoods. Such practices are regrettable.

There is a wealth of valid and reliable evidence relevant to the question of whether DGS is sustainable. There is also much that is not yet known. This report brings together widely dispersed evidence and also highlights gaps in current knowledge. By presenting the evidence relevant to the sustainability of DGS we hope we have provided a valuable resource to policy makers and other audiences.

1.3 THE LOGIC OF OPPOSITION TO DRIVEN GROUSE SHOOTING

Hundreds of products used by people derive from animals, in most cases from animals that have been killed. The Peta website[2] lists an impressive number of such products, from Adrenaline and Alanine, to Wool Fat and Wool Wax. These products are used in medicine, cosmetics, household products, clothing as well as food and drink. Yet there do not seem to be UK-based pressure groups advocating that policy makers should ban the production of lanolin (derived from both living and dead sheep) or keratin (derived from horns, hooves, feathers and hair of living and dead animals), both of which are used in hair-care products, among other items.

The UK fishing fleet lands around 400,000 tonnes of fish each year in the UK, and between 200,000 and 300,000 tonnes abroad[3]. There is no humane slaughter requirement for wild fish caught and killed at sea nor, in most places, for farmed fish. Fish caught in nets by trawlers are dumped on board the ship and allowed to suffocate.[4] The most common methods of slaughtering fish expose them to substantial suffering over a prolonged period of time. Many species of farmed fish are typically killed by being taken out of water and left to asphyxiate in air, or fish might be frozen or gutted whilst conscious[5]. There seems to be no concerted outcry against these practices. Nor are there concerted protests against the bycatch from the UK fishing industry which, according to a Freedom of Information request, could have led to as much as 10,500 tonnes of 'waste' fish being discarded in 2019, in the waters of the North Sea around the west coast of Scotland alone[6].

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[2] https://www.peta.org/living/food/animal-ingredients-list/ sourced 18 April 2021

[3] UK Fishing Statistics Research Briefing published 23 November 2020, House of Commons Library

[4] https://www.theguardian.com/commentisfree/cif-green/2010/sep/14/fish-forgotten-victims#:~:text=Not%20for%20fish.,ship%20and%20allowed%20to%20suffocate.

[5] https://www.hsa.org.uk/news-events/news/post/61-fish-welfare-at-slaughter

[6] https://www.communitiesforseas.scot/tonnes-of-fish-discarded-as-bycatch-in-the-uk-foi-finds/

Every year in the UK approximately 2.6 million cattle, 10 million pigs, 14.5 million sheep and lambs, 80 million fish and 950 million birds are slaughtered for human consumption[7]. Millions of live birds are imported into the UK from countries thousands of miles away[8]. There are no large petitions opposing this slaughter, nor the intensive production of animals that is required to provide these animals for consumption, despite the concerns raised about the welfare of farmed animals[9]. The intensive production of animals for human consumption has grossly changed landscapes and had widespread negative impacts on biodiversity.

Yet Wild Justice was sufficiently opposed to driven grouse shooting to organize a petition with over 100,000 signatories to be debated in Westminster Hall in June 2021[10]. The RSPB claims that DGS causes significant damage to both biodiversity and ecosystems services[11].

Why does driven grouse shooting stimulate such passionate opposition? We examine some of the claims made about integrated moorland management practices and their impact on wildlife and vegetation in the report and suggest that the claims of those opposed to driven grouse shooting are not, perhaps, based on a full understanding of the evidence. We also wonder if some opponents of DGS might understand much of the relevant evidence but deny or ignore it. However, looking at the issue of killing a grouse dispassionately, it seems not entirely logical to single out DGS for such opposition in a country that seems happy for more than a billion animals to die each year so they can be consumed as food or used in products. As we point out in the report, the dead grouse is a valuable commodity that is eaten in the UK and exported to restaurants abroad. It is claimed that grouse moor management, along with other gamekeeping practices, kill predators. This is correct, but grouse moor managers are not alone in killing predators. Others engaged in this activity are the RSPB, WWT, National Trust, many County-based Wildlife Trusts and every local authority in the country[12]. We accept there are many reasons why different people are vehemently, and genuinely, opposed to driven grouse shooting. We do wonder though if one of the main, often unspoken, reasons for opposing the activity is because it is associated with the rich enjoying themselves. The 'Grouse Moor Image', "of a fattish plutocrat being lowered reverently down from his well-groomed sturdy pony by willing hands, and then seated in his butt, mowing down the poor deluded birds which are herded up to him" (Stanford, 1968), may be deeply rooted in some psyches.

The evidence we have reviewed in our report suggests that this caricature is a gross over-simplification that fails to recognize the complex and integrated nature of moorland management that includes DGS. Furthermore, it takes no account of the evidence about the sustainability of the practice, or the evidence of the impacts that it, and alternative uses of the UK moorlands, have on people, the economy and the environment.

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[7] https://www.hsa.org.uk/faqs/general#n1

[8] https://www.poultryworld.net/Meat/Articles/2020/5/Thailand-to-boost-chicken-exports-after-50-fall-in-domestic-576398E/

[9] See for example, the Farmed Animal Welfare Council report of 2009, https://www.ongehoord.info/wp-content/uploads/2017/12/11-1.pdf

[10] https://petition.parliament.uk/archived/petitions/266770 Ban Driven Grouse Shooting: willful blindness is no longer an option.

[11] https://www.rspb.org.uk/our-work/policy-insight/agriculture-and-land-use/farming-land-use-and-nature/uplands/driven-grouse-shooting/

[12] If rats are included.

1.4 ABOUT THE AUTHORS

Professor Simon Denny BA, MA, PhD

Simon Denny served in the British Army from 1976 – 1986. He then joined Tesco where he rose to become head of corporate management development. He was also head of training support for major corporate projects. He moved into Higher Education in 1992 and worked at the University of Northampton until 2018. At Northampton he initially specialized in designing bespoke development programmes for companies; three of these schemes won National Training Awards. He also designed, won funding for, and managed numerous large-scale projects aimed at helping disadvantaged people develop the confidence and skills necessary for employment, or self-employment. In 2006 Simon was awarded the University's Court Award for services to local enterprise. He became Professor of Entrepreneurship in 2007. In 2010 he was granted The Queen's Award for Enterprise Promotion. From 2015 to 2018 he was Executive Dean for Research, Impact and Innovation. In this role he established two research institutes, including the Institute for Social Innovation and Impact.

Since 2018 he has worked as an independent researcher and consultant. His clients include the Ministry of Defence, the Royal College of Nursing, the Motivational Preparation College for Training, CVQO and the Uplands Partnership. He is an external associate of the Institute for Social Innovation and Impact at the University of Northampton. He is a member of two wildlife trusts, a keen birdwatcher both in the UK and abroad, and enjoys gardening, fishing and shooting.

Dr Tracey Latham-Green BA, MBA, PhD

Tracey Latham-Green has worked in the private, third, and public sectors in both central and local government. She also spent two years as a volunteer Police Constable with Lincolnshire Police, based in a community policing team. Working as a Freelance Research and Business Consultant since 2004, she runs her own business consultancy, where her work includes research projects, project management services (including grant management), feasibility studies, evaluations, quality accreditation, and business planning and support. From 2013 to 2020 she was Deputy Chair and Lay Board Member for Governance and Audit on the Governing Body of the NHS Lincolnshire East Clinical Commissioning Group. She is an Associate Lecturer with the Open University. She is an external associate of the Institute for Social Innovation and Impact at the University of Northampton.

Tracey's research interests are around the wider determinants of health, in particular relating to identity, communities and social networks and how these can impact on individuals' health and well-being. In 2020 she graduated with her PhD, 'Understanding the Social Impact of Participation in Driven Game Shooting in the UK'. Prior to the PhD study she had no knowledge of any form of game shooting or rural field sports of any kind. She does not shoot and has no links to organisations either for or against Driven Grouse Shooting.

Professor Richard Hazenberg BA, MA, PhD

Professor Hazenberg (BA MA PhD) is the Director and Research Leader of the Institute for Social Innovation and Impact at the University of Northampton. He has contributed to international/national government policy through papers, conferences and roundtable meetings (including for the European

Commission; OECD; Cabinet Office; and HM Treasury). Professor Hazenberg is on the editorial board of the Social Enterprise Journal and is a reviewer for a number of international peer-review journals. Professor Hazenberg is the University's leading researcher for social innovation and impact. He has had no involvement in shooting of any kind and has no links to organisations either for or against Driven Grouse Shooting.

1.5 INDEPENDENT REVIEW

The authors were assisted in the production of the full report by a committee of individuals with detailed knowledge of the UK moorlands, including DGS. This committee was chaired by Professor James Crabbe, Emeritus Professor & Supernumerary Fellow at Wolfson College, Oxford University. Professor Crabbe is a Consultant and Red List Assessor with the International Union for the Conservation of Nature (IUCN) and is involved with a wide range of universities worldwide. His research, spanning environmental and biomedical sciences, education, and the humanities has resulted in 291 research publications in refereed journals and books, plus 14 items of commercial molecular modelling software produced by Oxford University Press. He has won several awards for his research including the Annual Scientific Award of the International Engineering and Technology Institute (IETI) in 2018 and the 6th Aviva/Earthwatch International Award for Climate Change Research in 2006. Professor Crabbe has no links to organisations either for or against Driven Grouse Shooting and has therefore provided independent oversight to the completion of the full report and this summary.

2 SYNOPSIS

Driven grouse shooting is not a stand-alone activity. It exists as part of a complex system of integrated moorland management that delivers ecological, economic, and social impacts. The critical questions are whether these impacts deliver benefits to society and the environment, and whether alternative uses of the UK's moorlands would deliver greater benefits.

2.1 ECONOMICS

Viewed as an isolated activity, driven grouse shooting is not always profitable. The majority of moorland owners and tenants do not set out to make a profit from driven grouse shooting. It is important to recognise that Driven Grouse Shooting (DGS) is not practiced in isolation. Moor owners want to leave a better environment on the moor for future generations. There is an essential, symbiotic relationship between land management for farming and shooting (Denny and Latham-Green, 2020)***.***

The Grouse Moor Management Group Report[13] pointed out, "the economic contribution from grouse moors undoubtedly makes a valuable contribution to some remote local communities. The long-term private investment attracted by grouse moors, and willingness to bear financial losses, is unlikely to be repeated for other activities. Unlike other upland land uses, neither grouse shooting (nor deer stalking) are subsidised from the public purse."

A 2020 study identified six different economic impacts resulting from moorland managed for DGS (Denny and Latham-Green, 2020). This study is the most comprehensive of its type yet published. Measuring and quantifying all these impacts exactly is not possible. However, the fact that it is not possible to measure an effect does not mean that it is not present, and that it is not important. The more remote the area, the greater the economic importance of DGS (McMorran, Thomson and Glass, 2020).

2.1.1 ECONOMIC IMPACT 1

- Employment of keepers: salaries; housing; vehicles; equipment (year-round)
- Expenditure of Guns: hotels/inns/pubs; shops; garages; vehicle hire (seasonal)
- Casual labour on shoot days: beaters; flankers; pickers-up; loaders; drivers; catering (seasonal)

First order economic impacts directly result from the activities involved in the shooting of grouse; the employment of keepers (the great majority of who are employed full time) and the engagement of casual labour in the form of beaters, loaders, pickers up, drivers, caterers etc. Included in this first order impact is the money spent by people shooting (the Guns), both the money they pay to the estate, and the money spent with local hotels and businesses during the season.

[13] This group was commissioned by the Scottish Government to advise on the licensing of grouse shooting in Scotland. The group was chaired by Professor Alan Werritty from the University of Dundee.

The first order economic impacts are significant. The cash and employment generated by these impacts can have a very great importance to remote communities where there is limited alternative employment.

2.1.2 ECONOMIC IMPACT 2

- Engagement of outdoor contractors: roads; fencing; butts; peat restoration; bracken control; blocking drainage channels etc. (annual cycle)
- Engagement of indoor contractors: builders; carpenters etc. (annual cycle)
- Expenditure with community shops, restaurants, pubs etc.: keepers, estate staff (year-round)
- Engagement of professional services: legal; land agent; sporting agent (as required)

The grouse shooting season normally lasts no more than two and a half months. In some years there may be an insufficient stock of grouse to allow shooting to take place. However, maintaining a moor so that shooting can take place is a year-round activity. Estates are significant economic entities that do not only run grouse moors (McMorran, Thomson and Glass, 2020). They also generate income from other activities including agriculture, forestry, alternative energy, property, and land rental.

Most estates employ local contractors all year-round. The money spent on contractors can be considerable.

In a survey of moor owners, all 'agreed' or 'strongly agreed' a) that it was important that they left the moor a better environment for future generations, b) that there was an essential, symbiotic relationship between shooting and farming, c) that they did not set out to make a profit from DGS (n=73) (Denny and Latham-Green, 2020). Grouse moors can also stimulate significant inward investment to the UK from foreign owners[14].

There is a strong market for grouse. Whereas some pheasant and partridge shoots struggle to find a market for the birds, grouse command a premium price. To meet the demand for grouse, game dealers operate substantial businesses, often in remote areas.

Estates can be major employers in remote areas, for example 15 estates surveyed by the authors of this report (in North Yorkshire, Northumberland, and Scotland) employ between them c. 80 keepers and c. 175 other full-time staff[15]. All of these people live, many with their families, in remote (in some cases very remote) areas. In some instances, these employees make up the majority of the inhabitants of rural communities.

[14] Money spent by foreign tenants is equivalent to export earnings in that foreign money enters the UK economy.

[15] These estates employ more than the average number of staff. They are cited as examples as they illustrate the size of some estates. Estates can be very significant economic entities in remote, upland areas.

Estates are also purchasers of professional services. As well as employing land and sporting agents, many of them use lawyers, accountants etc. Although professional service providers are seldom local, they are an element of the economic impact of grouse moorlands.

2.1.3 ECONOMIC IMPACT 3

- HLS/Countryside Stewardship scheme: tenants/owners financial facilitation role enables HLS/Environmental Land Management (ELM) scheme to operate to benefit of estate and farmers

Third order economic impacts result from the part that some sporting tenants and estate owners play in enabling Higher Level Stewardship (HLS) and Countryside Stewardship schemes (now the Environmental Land Management (ELM) scheme) to be delivered in upland areas.

Many estates operate as a partnership: the estate owns the land, the sporting tenant has the shooting, the graziers put sheep and cattle on the land. All three parties work together and all benefit from the Stewardship scheme, as do contractors and, as a result of shooting, the casual labour[16].

Many farmers and their families work closely with gamekeepers and moor owners and earn additional income from shooting.

2.1.4 ECONOMIC IMPACT 4

- Maintenance of accessible, attractive landscape encourages tourism (year-round)

The management regimes practiced on moors that include DGS as an activity have resulted in an accessible landscape that many people find attractive, resulting in year-round tourism and leisure activities, for example the North York Moors National Park website[17] states that, "tourism is vital to the North York Moors National Park. We currently have 8.38 million visitors annually, generating spend of £730m and supporting 11,290 full time equivalent jobs. The 2018 survey[18] of visitors to the North York Moors identified that 99% rated the moors good or very good, and 75% were very likely to return. *Between 80% and 85% of the area of the North York Moors is managed for activities that include DGS.* In many areas the moors look as they do because of the way they have been managed for activities, including DGS.

The presence of some high-quality facilities (hotels, restaurants etc.) that target the high-value DGS market means that many levels of tourists can be catered for, from the day-trippers going walking or birdwatching and taking their own sandwiches, to those wanting a holiday in a privately run, luxury hotel.

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[16] Some opponents of DGS object to moor owners receiving subsidies for activities that are associated with the recreational killing of grouse. Illogically, they do not seem to object to the same subsidies enabling sheep and cattle production, although these animals are killed.

[17] https://www.northyorkmoors.org.uk/looking-after/advice-and-grants/tourism accessed 18 April 2021

[18] https://www.northyorkmoors.org.uk/looking-after/advice-and-grants/tourism/North-York-Moors-Visitor-Survey-2017-and-2018-infographic.pdf

An area with integrated moorland management, including grouse shooting, results in a year-round living landscape with economically resilient communities.

Given the impact of the Covid pandemic on international travel and the consequent rise in 'staycations', the value of tourism to attractive moorland areas is very likely to increase.

2.1.5 ECONOMIC IMPACT 5

- Bracken and tick control: reduced cost of health risk to human, farm animal and wildlife (annual cycle)

The fifth order economic impact is derived from the land management practices employed on grouse moors. Game keeping practices reduce bracken coverage and tick numbers, both through direct bracken control and through use of sheep to act as tick 'mops' Controlling bracken and ticks is important for animal health, and increasingly important for human health, both of which have economic impacts[19].

2.1.6 ECONOMIC IMPACT 6

- Carbon sequestration: reduction in wildfires; peat formation (year-round)
- Flood reduction: drain blocking and watercourse engineering (annual cycle)

Sequestering and storing carbon, reducing wildfires, and mitigating flooding have positive economic values that are being quantified by organisations such as the Office for National Statistics.

It will be interested to see if, in the next few years, work on ecosystems services will have advanced sufficiently for the impacts of current and alternative moorland management regimes can be compared in more objective terms.

[19] We are not, of course, suggesting that only moors managed for grouse shooting control bracken and ticks.

2.2 BIODIVERSITY

The majority of areas where DGS takes place have developed a sustainable model of operation. These moorland areas have developed over the centuries a unique, diverse and apparently sustainable flora and fauna, the extent and richness of which has been (and presumably will continue to be) influenced by government policy and funding regimes. Legislation protecting raptors and other species has resulted in their reappearance or increase on many moors. Alternative uses proposed for UK moorlands would not maintain the current landscape and biodiversity but result in very different impacts. There are threats to the sustainability of the integrated moorland management model from both rising temperatures and diseases that are either new, or become resistant to treatment.

2.2.1 INTRODUCTION

Few, if any, moorland estates or moor owners solely depend on grouse shooting for their income. They are engaged in year-round operations and have several income-generating activities in addition to shooting and other sporting activities, typically livestock grazing, commercial forestry, renewable energy generation, and tourism. Different economic ventures, and the management regimes that result from them, combine to impact the classic moorland landscape with its associated flora and fauna. Disentangling the impacts resulting from integrated moorland management is difficult and has not been accomplished so far.

Historically, a landowner's commitment to grouse management may have dissuaded them from converting moors to other land uses such as forestry or agriculture. As a simplification, in England, the loss of heather moorland was mostly due to agricultural improvement and overgrazing; whereas in Scotland, heather moorland was mostly lost because of agriculture, grazing and forestry.

Shooting estates account for 29% of upland Sites of Special Scientific Interest (SSSI), compared with an expected 16% if grouse moors were randomly distributed. Many SSSI designations in the uplands were originally made because of the habitats and species on moorland, which are typically delivered because of management for DGS. Some of the best examples of heather moorland in the UK are designated as SSSIs and 'Natura' sites – Special Protection Areas (SPA) and Special Areas of Conservation (SAC) – in recognition of their importance. In England, 74% of upland SPAs are managed as grouse moors.[20]

On some grouse moors inappropriate burning or the lack of agreed heather management plans have led to the classification of the site as being in unfavourable condition.[21]

[20] GWCT, The Moorland Balance https://www.gwct.org.uk/media/1153026/Moorland-Balance-2-1-.pdf

[21] Ibid.

While many upland species have poor conservation status, uplands generally retain more complete mammal assemblages than lowlands, because variously of their remoteness, lower human population density or better protection status[22].

2.2.2 IMPACT OF POLICY DECISIONS

During the twentieth century, government funded schemes promoting afforestation and intensification of sheep grazing in the British uplands led to widespread declines in globally rare heather moorland. Since World War 2 government policy and funding regimes have largely determined the number of livestock grazing on heather moorland. As priorities have changed from maximising food production to maximising biodiversity and mitigating climate change, upland farmers and landowners have responded as they seek to generate income.

Since World War 2 commercial forestry has caused a great loss of moorlands and heathlands. Most of this destruction occurred prior to 1990 and was most evident in Scottish and Welsh Mountains, Moorlands and Heaths (MMH). Many extant moors were sustained by the interest and capability in investing in shooting grouse. Since 1990, due to removal of tax incentives, there has been a steep decline in afforestation on organic soils.[23]

2.2.3 RENEWABLE ENERGY

The world's first use of renewable energy was by a Northumbrian upland estate and grouse moor owner in 1878.

The UK's commitment to increasing renewable energy production is critical for reaching net zero carbon emissions. The funding available (subsidies funded by taxpayers) to install renewable energy schemes, and the income that can be made from operating them, can be an important part of a diversified income for upland landowners[24]. However, while hydro-electric schemes installed on moorland are typically small scale (being the size of a small barn) and are claimed to have little negative impact on the environment[25], building wind farms on moorland is shown to affect its habitats, soil, and the wider landscape. The main impacts on moorland habitats from wind farms are from the loss of moorland for tracks[26], crane hard standings, turbine bases, control buildings, borrow pits and changes in drainage.

[22] Yalden (2008)

[23] https://backup.ons.gov.uk/wp-content/uploads/sites/3/2017/07/UK-natural-capital-developing-UK-mountain-moorland-and-heathland-ecosystem-accounts-2.pdf

[24] One owner of a 5,000 acre moor in North Yorkshire claimed that his small hydroelectric power scheme brought in c. £40,000 p.a. to the estate, the same income as he got from his 1,200 sheep. Interview with S Denny 15 May 2020.

[25] See, for example, https://cairngorms.co.uk/hydro-schemes-given-go-ahead/ https://en.wikipedia.org/wiki/Ruswarp_Hydro

[26] Although new tracks can facilitate activities such as peatland restoration.

The manufacture, decommissioning and recycling of wind turbines has many environmentally negative impacts.

Where income from a windfarm is reinvested in surrounding moorland the increased management and small-scale scrub planting could benefit some species, assuming they are not negatively impacted by neighbouring windfarms. Providing renewable energy is a main priority for the country with clear environmental and economic benefits. However, in an integrated economic and ecological system there are no actions without consequences, and these must be weighed up against negative effects.

2.2.4 TOURISM

The potential for generating tourism revenue on a large scale to replace the current main land uses is not yet known, nor are the possible ecological impacts. More tourism can generate higher incomes for people and businesses in an area, but increased numbers of visitors will require more infrastructure, and are associated with increased disruption to both people and wildlife. Tourism is also seasonal, occurring mainly between April and September. Other concerns for the upland environment include higher risk of wildfires, which are already considerably more likely in spring and summer.

2.2.5 INTEGRATED MOORLAND MANAGEMENT

Grouse moor management comprises of a range of management practices, including predator control, muirburn[27], grazing management and disease management (Newey et al., 2016; Thompson et al., 2016; Mustin et al., 2018)[28].

These management practices are carried out to maximise red grouse *Lagopus lagopus scotica* numbers for sport shooting. Grouse moor management has been demonstrated to have positive and negative effects on the distribution and abundance of different species and biodiversity (Thompson et al., 2016; Brooker et al., 2018; Mustin et al., 2018).

2.2.6 PREDATOR CONTROL

Predator control, the legal killing of feral cats, crows *Corvus corone*, foxes *Vulpes vulpes*, stoats *Mustela erminea* and weasels *Mustela nivalis* undertaken as part of grouse moor management to minimise predation of red grouse has been shown to benefit other ground nesting birds (Fletcher et al., 2010; Newey et al., 2016; Littlewood et al., 2019; Mustin et al., 2018), and probably benefits mountain hares (Patton et al., 2010; Brooker et al., 2018; Hesford et al., 2019). Predator control will suppress the local population of controlled species. However, the wider biodiversity impacts of predator control on the controlled species are poorly understood (Brooker et al., 2018).

[27] Muirburn is covered in detail in the section on Natural Capital and Ecosystem Services.

[28] https://sefari.scot/sites/default/files/documents/Part%204%20-%20Biodiversity%20Impacts.pdf

2.2.7 MOUNTAIN HARES

Mountain hares benefit from DGS through improved food quality, cover and reduced predation pressure. The only place in the British Isles where mountain hares thrive at the uniquely high densities associated with the UK is on grouse moors. Elsewhere mountain hare abundance has declined as grazing has been improved, woodland cover has expanded, and predation pressure increased as gamekeepers' efforts have declined and predator numbers increase. The evidence base for mountain hare range is extensive, including 100 years of bag data, 30 years of presence-absence surveys and three years of abundance estimates. These estimates have been generated by moor managers with no financial support from SNH/NatureScot. Despite this evidence base, mountain hare conservation status was deemed by NatureScot to be unsatisfactory-unknown.

The inconsistency in claiming that there is not enough data on mountain hares to assess their status is evidenced by research[29] which has established that trends in mountain hare abundance indices vary with region and grouse management intensity. Hare populations are higher and relatively stable on moors where driven grouse shooting is practised relative to lower indices and greater declines on moors where grouse were either walked-up or not shot. Mountain Hare numbers fluctuate over time[30] in a quasi-cyclical manner, fluctuations being more pronounced where hares are more abundant, i.e. on driven grouse moors. It is not clear whether these fluctuations are due to resource competition, parasitism or shooting.

2.2.8 BIRDS

Declines in national populations of upland bird species, including raptors, red and black grouse, golden plover, lapwing and curlew can now often be linked to large-scale changes in land use, including afforestation, more intensive farming, the use of pesticides, and reductions in grouse moor management(Whitehead, Hesford and Baines, 2018).

Lapwing, golden plover, curlew, red grouse, and meadow pipit bred on average three times more successfully when predator control was performed, compared to the same moorland when predators were not controlled. Predation of the nests of oystercatcher, lapwing, black-tailed godwit, curlew and redshank, had increase by around 40% since the 1970s(Roodbergen, van der Werf and Hötker, 2012).

Range contraction for curlew, golden plover, lapwing, and dunlin was smallest where grouse shooting was retained and greatest where it had disappeared completely[31]. Legal predator control would seem to be increasingly important if some species of bird are to thrive.

[29] Hesford et al (2019)

[30] Mountain Hares have the potential for high population growth.

[31] Aebischer, Ewald and Tapper, 2010

The maintenance of a mosaic of moorland vegetation as a result of management, and legal control of predators (chiefly fox, stoat, weasel and crow) results in a habitat that is important for the survival of many rare (IUCN Red Listed) bird species.

2.2.9 INVERTEBRATES

The understanding of the effects of grouse moor management on moorland invertebrates is limited. Different management regimes suit different species of invertebrate; butterflies and moths tend to be more diverse and abundant on moorland areas when heather is older, compared to recently burnt areas, while bees value younger heath vegetation that has a high flower abundance. Importantly, while the number of species of plants or animals found on heather moorland can be low, those species that thrive are often specialist species not found elsewhere, highlighting the importance of maintained heather moorland for their conservation.

Integrated moorland management, including management regimes to enable grouse shooting to take place, by producing a patchwork of heather and other vegetation, is likely to support a richer population and diversity of invertebrates than a heather dominant moor without regenerating burnt, cut or grazed heather patches.

2.2.10 TICKS

The number of tick-borne diseases is increasing dramatically (seven diseases currently pose serious health risks to birds, mammals, and people in the UK). The rates of infection in ticks and multiple pathogen loads are also increasing. New pathogen strains (e.g. the *Flavivirus* causing Tick Borne Encephalitis [TBE]) have become 'native' in the UK in the very recent past. " Lyme Disease is a 'headline' problem but there are several other chronic (as well as acute) tick transmitted infections affecting a much larger number of people, as well as companion animals, stock and wild mammals and birds."

As well as being a host for ticks, bracken, through its spores, can cause disease problems in its own right.

On estates where grouse shooting occurs, landowners, gamekeepers and farmers/graziers combine activities to control both bracken and tick numbers. The reduction in tick burden on managed moors reduces the health risks for both wild and domesticated animals, and humans. However, the steady increase in the distribution and numbers of ticks means that their impact on animals, including humans, could become a significant problem.

2.2.11 MEDICATED GRIT

Medicated grit, when used correctly, is a widespread treatment that has proved highly effective in reducing endemic strongyle worm levels in grouse guts. Medicated grit must be removed from an area at least 28 days before shooting starts. When used correctly, its residues in grouse for human consumption should present no risk. The use of medicated grit can be key factor key factor in producing a sustainable

surplus of grouse for shooting, a driver of sustaining economic investment in moorlands.[32] Best practice guides for the use of medicated grit are readily available[33]. In common with nearly all aspects of integrated moorland management, there are several important evidence gaps in the use of medicated grit.

2.2.12 HEATHER BEETLE

The impact of severe outbreaks of heather beetle on grouse numbers is significant and, in some years and in combination with other factors, results in too few birds to enable shooting (either driven or walked-up) to take place.

2.2.13 STAKEHOLDERS

Integrated moorland management involves multiple stakeholders. At a very local level there can be different stakeholders trying to make a living from an area of land. Disputes between stakeholders are not inevitable and multi-stakeholder initiatives can be successful in tackling complex sustainability issues, provided that different perspectives can be reconciled, which is not always possible. At a local level, it is clear that very often there is close collaboration between stakeholders.

The criminal damage[34] and threatening behaviour of some individuals opposed to grouse shooting suggest that they are not interested in developing shared outcomes with other stakeholders. Where people and groups are prepared to discuss their points of view, share information about what they do and the impacts they have, accommodation and cooperation are common. Multiple stakeholder working is sustainable, provided that people act in accordance with the law.

[32] Grouse Moor Management Review Group Report 2019

[33] See for example, https://www.gwct.org.uk/media/502626/medicated-grit-guidelines.pdf

[34] In 2021 a single moor in the North of England had over 60 legal predator traps destroyed by people opposed to grouse shooting.

2.3 NATURAL CAPITAL AND ECOSYSTEMS

It would be helpful for policy makers, practitioners, and others if researchers were able to construct a 'league table' ranking the alternative uses of moorland in terms of their impact on carbon capture and release, water quality and flood risk, and wildfire mitigation. However, the current state of the evidence is neither robust nor extensive enough for the impacts of management practices associated with grouse shooting activities, and alternative uses of moorland, to be identified and ranked. The current evidence certainly does not encompass the reality of integrated moorland management. The limited objectives of much existing research have resulted in people selecting findings to support prejudiced positions. It is essential that ecosystem functions are the basis for decisions, for the problems in nature are mostly problems of the ecosystem rather than of soil, animals or plants[35]. There is no 'golden ticket' solution that results in all aspects of natural capital being improved. Systems that measure natural capital will have to identify how to maximise net gain.

2.3.1 INTRODUCTION

Ecosystem services are services that people derive from natural capital and which make human life possible. Therefore, ecosystems services include food, water, plant materials used for fuel, building materials and medicine, but also climate regulation and natural flood defences provided by forests, carbon stored in peat, and pollination of crops by insects. Additionally, and importantly, there are cultural ecosystem services resulting from the cultural, educational and amenity-based social impacts people get from the environment.[36]

Ecosystem services measurement systems are being developed, but there is a long way to go. Moreover, the research on which ecosystems accounts are based do not always consider all the evidence, and inevitably they are not up-to-date.

The concept that natural capital results in benefits to mankind is helpful. Furthermore, applying (albeit with caveats) the indicators and measurements that are being developed may enable indicative comparisons between different land-management regimes to be made in the future.

The main focus on ecosystem services in moorland areas has been on the key natural capital indicators of air, water and carbon sequestration and the way they are impacted by burning and particle emission, water quality and water levels, and peat formation, topics which are intimately integrated with each other.

[35] Watt, 1947

[36] We present the evidence for the cultural ecosystem services provided by integrated moorland management, including DGS, in the section on Social Impacts.

2.3.2 DEFINITIONAL ISSUES

In England deep peat and blanket bog are not synonymous – almost all blanket bog is deep peat, but there are large areas of deep peat in the lowlands that are fens (often badly degraded)[37]. Moorland is a term which is often, and incorrectly, used interchangeably with peatland. In fact, moorland includes upland heathland, blanket bog, upland grassland, bracken, scrub, native woodland and exposed rock as well as peat. There is peat, including deep peat, on moorland, but not all moorland is peatland. Most peatland in the UK is not found on moorland.

The UK has is 'no single formal definition of 'peat', 'deep peat' and 'peatland', differing interest groups having differing definitions[38].

It is estimated that England's total upland peat area emits around 603,000 tonnes of CO_2 per year, which is 5.6% of the total peatland greenhouse gas emissions in England. The remaining 94% of England's peatland emissions come from lowland peat[39].

Estimates put the amount of carbon stored in peat on grouse moors at between 66 and 205 million tonnes, which is 11-35% of the total carbon stored all English peatlands. English grouse moors emit around 1-5% of the net CO_2 emissions from England's peatlands per year. Therefore, English grouse moor CO_2 emissions are proportionally well below the proportion of carbon that they store, compared to other peatland uses[40].

There have been considerable efforts made over the last couple of decades to reverse blanket bog degradation and increase resilience to climate change through restoration measures including blocking of grips[41] and gullies, revegetating bare peat, reintroducing *Sphagnum* and other vegetation species, removing trees and scrub, and use of mowing to encourage an active blanket bog vegetation. The Environmental Land Management (ELM) scheme provides a significant incentive to continue and expand this work.

2.3.3 FIRE

Firstly, despite its climate, fire is an important natural force in Scotland (Montiel and Kraus, 2010) and England. If fire is ignored, rather than studied, there is a risk that an important ecological process is not recognized.

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[37] http://publications.naturalengland.org.uk/publication/5419124441481216

[38] https://www.iucn.org/

[39] https://www.gwct.org.uk/policy/briefings/carbon-storage-on-grouse-moors/

[40] https://www.gwct.org.uk/policy/briefings/carbon-storage-on-grouse-moors/

[41] A 'grip' is an open drain, or small ditch, on moorland.

Inappropriate burning, or lack of it, can alter the MMH habitat. Encroachment of trees and the 'simplification' of vegetation structure can be caused by the lack of controlled burning, while too frequent burning can lead to the alteration of a moor to grassland[42].

Wildfires are a major source of CO_2 emission. Wildfires are typically large, burn out of control and can cover extensive areas. They are frequently described as 'hot burns' as opposed to prescribed fires which are described as 'cool burns' and can emit many times more CO_2 as a controlled /prescribed/manged burn of the same size.

Wildfires occasionally result from lightning strikes, but the vast majority are due to either accidental[43] or deliberate actions, which tend to be in the spring or summer, often at weekends or on Bank Holidays.
In 2018 Scottish Natural Heritage and the Scottish Fire and Rescue Service (SFRS) examined the correlation between the number of wildfires that the SFRS was called out to and heather burning. Out of a total of 153 fires, only four were in areas of moorland managed for grouse, and none were during the burning season, but were rather the result of accident or arson.[44]

The 2018 wildfire on the RSPB's Saddleworth Moor was partly enabled by a spell of dry weather and heather vegetation that had become 'leggy' as it had not been managed. Professor R Marrs, Liverpool University, claimed that the fire would not have spread soeasily or penetrated the underlying peat if the vegetation had been managed by occasional burning. He was quoted as saying, "leaving the land alone causes much more damage than controlled burning because there's more heather to burn so it gets hotter and spreads to the peat, which in turn spreads the fire."[45] It is estimated that the fire resulted in seven centimetres of peat being lost, which could take c. 200 years to replace.

Wildfires can dramatically alter vegetation but should not be confused with impacts of prescribed burning on deep peat with high water tables.

Wildfires can lead to far greater losses of peat and carbon that prescribed burning. Any assessment of burning impacts on carbon and greenhouse gas emission must consider methane fluxes. Low severity fires may suppress peatland methane emissions.

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[42] Ibid.

[43] Such as the wildfire on Marsden Moor of April 2021. A box of fireworks was discovered at the scene of the fire https://www.bbc.co.uk/news/uk-england-leeds-56901934 Police interviewed a man and a woman and subsequently submitted a file to the Crown Prosecution Service https://www.bbc.co.uk/news/uk-england-leeds-56931147

[44] Countryside Alliance Briefing Note: Grouse Shooting Petitions Committee - Westminster Hall Debate, Monday 21 June 2021

[45] https://www.bbc.co.uk/news/uk-england-manchester-44648348

Appropriate prescribed burning can both mitigate wildfire risk in a warmer world and produce relatively fast peat growth and sustained carbon sequestration (Marrs et al., 2019).

The evidence base for muirburn and wildfire in the UK does not enable robust conclusions about ecosystem services impacts to be made, particularly in relation to carbon storage, greenhouse gas (GHG) emissions, flooding, and water quality.[46]

To date, no study has assessed rotational burning impacts using a real-world approach, with measurements made across active grouse moors and extending over a complete management cycle.

The results of many burning studies are unreliable because they use experimental designs that are unable to detect causal relationships and/or make significant statistical errors.

Due to the uncertainties within the evidence base, the precautionary principle is often cited as a reason to halt prescribed burning on peatlands. However, it is rarely (if ever) applied when considering other even more understudied or unproven peatland management options, for example mowing or cutting of heather; or no management leading to tree encroachment; or restoration measures like rewetting. These management options are also likely to cause negative impacts when applied in certain contexts. The precautionary principle should not be used as a basis for decision-making solely for burning.[47]

There is no consensus in the current literature that prescribed burning is damaging to peatlands. The overall effect of burning on peatlands is unclear due to insufficient, contradictory, or unreliable evidence on carbon, water quality and biodiversity. Bare ground resulting from muirburn is short lived and small scale. Large carbon emissions data cited are largely based on lowland arable peatlands. There is no net greenhouse gas data from managed grouse moors.[48]

Burning was historically associated with drainage. Habitats and plant communities typical of drier conditions were likely to be due to lowering of water tables due to drainage and burning. Many drainage ditches (grips) are now blocked (or are being blocked) or have naturally infilled.

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[46] Ashby, M. and Heinemeyer, A. (2021) A Critical Review of the IUCN UK Peatland Programme's "Burning and Peatlands" Position Statement, *Wetlands* 41:56 https://doi.org/10.1007/s13157-021-01400-1(Ashby and Heinemeyer, 2021) and

A. Heinemeyer & M.A. Ashby (2021) An outline summary document of the current knowledge about prescribed vegetation burning impacts on ecosystem services compared to alternative mowing or no management. https://ecoevorxiv.org/qg7z5/ [Preprint not yet submitted](Heinemeyer and Ashby, 2021).

[47] Ibid

[48] Ibid

2.3.4 BURNING VS. MOWING

Moss and peat layer in wet blanket bog ecosystems are generally buffered from the effects of prescribed burning (minimal moss damage, no peat ignition)[49]. Prescribed burning converts c. 5 – 10% of biomass carbon into charcoal, a long-term carbon store resulting in high soil carbon accumulation. Mowing allows nearly all biomass to decompose over time, locking away only c. 1 – 2% of biomass carbon.

Mown and unmanaged sites emit far more methane that sites managed by prescribed burning.

Ecosystem function is the critical issue. There is a lack of specific evidence in support of burning and alternative management in relation to ecosystem functioning factors.

2.3.5 WATER

There is little evidence that peatlands in their natural state only ever provide ecological and environmental benefits. Rain falling on saturated peat will pool or run off. Runoff from saturated peat can exacerbate downstream flooding. Peatland with high water tables emit large amounts of methane[50], especially in high temperatures.[51]

There is no evidence that burning increases flood peaks. The slightly lower water tables (about 2 – 3 cm) in burnt areas might beneficially offer additional water storage under conditions when wet sites are saturated.

Isolated, relatively small-scale studies, even if carried out over 10 years or more, do not provide an evidence base for decision-making about the ecosystem services provided by different moorland management regimes.

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[49] For a fascinating, if not entirely scientific, demonstration of the impacts of prescribed burning on sub-surface temperatures, see the 'Mars Bar vs Muirburn' film at https://m365.eu.vadesecure.com/safeproxy/v4?f=r4GS8Rc2mPXY6Bxq4p_m4BAkHPGUt2NEhZQLKVVvE9Q12OKupP0hEmRHY9RRKRYf1zuIP_WU60W3AOIDglts2A&i=lrcKD8tORo1HXwDa5hMlVTKOiPOqHGxBkGU1ONT9V0d6qg0_cNbVnnfTAW3_o32ibH2KernAJEwBPDOdeSXcag&k=9CRQ&r=EnlIGYTA4jHJUjNRrTgWj2nZVNDQRQWxGE-r90jiaA5uNjlvfPnUCbTY7GnJB4hFMquD3FRArV2TybWotH6tIg&s=a5b8b0f944058279324d7b4d32ce9b6ab1add0bc441948169122af6b07dbc760&u=https%3A%2F%2Fwww.facebook.com%2FTomatinMG%2Fvideos%2Fm-a-r-s-b-a-r-vs-m-u-i-r-b-u-r-n%2F379362616482584%2F

[50] Methane is a powerful greenhouses gas with a 100-year global warming potential 28-34 times that of CO_2. Measured over a 20-year period, that ratio grows to 84-86 times. https://unece.org/challenge#:~:text=Methane%20is%20a%20powerful%20greenhouses,are%20due%20to%20human%20activities.&text=Coal%20is%20another%20important%20source%20of%20methane%20emissions.

[51] Heinemeyer and Asbhy 2021 op. cit.

2.4 SOCIAL IMPACTS

DGS has important and positive social impacts. Driven shooting, unlike walked-up shooting, involves a wide range of individuals from a variety of backgrounds, not just Guns[52], but also beaters, pickers up, drivers, flankers, caterers, supporters, and others. This extensive 'cast list' facilitates contact between individuals from different backgrounds and maximises the potential for social impacts. Integrated moorland management, including DGS, delivers positive impacts on the social and working lives of both active participants in DGS, and those that use the moorlands for exercise and cultural activities. Communities in areas where DGS takes place receive health and well-being benefits through employment, engagement, and communal activities. The cohesion and resilience of small, often remote, communities are enhanced through the maintenance of social and economic networks. DGS activities are part of the intangible cultural heritage of many people and communities. The social impacts of DGS are positive and sustainable. Some of these impacts can be valued and these values are significant. There is no evidence that alternative uses of UK moorlands would deliver the same level of benefits.

Integrated moorland management, including DGS, enables many remote moorland communities to maintain strong community networks and a vibrant local economy. These benefits result in improved physical and mental wellbeing which is important to both individuals and the taxpayer.

Strong communities exist within areas where upland moorland is managed for DGS which have higher levels of a 'sense of belonging' than the national average. This sense of belonging has a strong link to (Denny and Latham-Green, 2020) cultural heritage (McMorran, 2009; McMorran et al., 2013). Many landowners and Sporting Tenants[53] support their local community both financially and with resources. The presence of gamekeepers and their families helps ensure vibrant communities are maintained (McMorran, 2009; McMorran et al., 2013; Glass, Bryce and McMorran, 2015).

Strong social and community networks reduce the risk of loneliness. Residents in English upland, moorland communities in areas where DGS takes place have statistically lower levels of loneliness than the national average (Denny and Latham-Green, 2020). Participants in driven game shooting of all quarry types were also found to have lower level of loneliness than the national average(Latham-Green, 2020b; a). The societal and health costs of loneliness have been estimated at £6,000 per person over ten years (Mcdaid, Bauer and Park, 2017). We suggest that lower levels of loneliness identified in communities and individuals involved in DGS result in potentially very significant savings to the taxpayer.

[52] We use the term 'Guns' to describe the people that shoot.

[53] A Sporting Tenant is somebody that leases an area of moorland, normally for 10 or more years, in order to have the right to shoot over the land.

Those who live in upland communities often have a strong rural identity and sense of place, which they hold dear (Williams, 2011). This identity has been linked to participation in rural activities such as DGS (Latham-Green, 2020b). Identity has been recognised as a key element in building strong social networks, one of the key determinants of health (Dahlgren and Whitehead, 1991). An individual with strong feelings of identity experiences positive impacts on mental well-being. It can "provide individuals with a sense of meaning, purpose, and belonging (i.e. a positive sense of social identity)"(Haslam et al., 2009, p.1), which usually has positive psychological consequences (Haslam et al., 2009).

Taking part in DGS helps many participants 'connect to their heritage roots'(Denny and Latham-Green, 2020; Latham-Green, 2020b), through an activity representing a form of intangible cultural heritage.[54] In a 2020 study looking at all forms of driven game shooting, including DGS, many respondents felt a strong sense of heritage through their participation in shooting. They believed that taking part in shooting represented a link to heritage and a return to their roots, a seasonal ritual which was often shared across generations. This finding was particularly associated with those who grew up in rural areas but now live in urban areas (Latham-Green, 2020b). In Scotland, people in moorland communities believe that integrated moorland management, including DGS, contributed to the preservation of a 'culturally significant activity and landscape' and was a strong part of a community's culture and heritage (McMorran, 2009; McMorran et al., 2013).

Spending time outdoors has positive mental well-being benefits (Frühauf et al., 2016; Kerr et al., 2012; Ryan et al., 2010). In a comparative study of two upland communites, 69% of respondents agreed that the landscapes resulting from grouse moor management were beautiful (McMorran, 2009). Areas like uplands, even when they are some distance from individuals' homes, have been shown to be areas to which people hold strong attachments (Williams, 2011).

Employment and training are key wider determinants of health (Dahlgren and Whitehead, 1991). The importance of employment and training provided through integrated moorland management in remote, rural areas is particularly high, as alternative employment is often limited, or seasonal (Monk et al., 1999; Scottish Government, 2012). A job can enable people to build relationships and a social network and contacts for future opportunities for themselves or their families (Dreiling et al., 2015). Employment can also contribute to an individual's role identity and sense of purpose and belonging (Stets and Burke, 2000; Walsh and Gordon, 2008), which as noted above has been shown to positively impact well-being (Haslam et al., 2009).

Rural areas lack a wide range of opportunities for training and skills development due to a number of factors, including transport and access to further education (Monk et al., 1999; Scottish Government, 2012; The Commission for Rural Communities, 2012). Development of skills has been shown to positively

[54] Intangible cultural heritage is defined by UNESCO as "living expressions ... such as oral traditions, performing arts, social practices, rituals, festive events, knowledge and practices concerning nature and the universe or the knowledge and skills to produce traditional crafts"

impact well-being through increasing self-esteem and self-efficacy (Denny et al., 2011; Hazenberg, Seddon and Denny, 2015). Careers directly linked to shooting (including game-keeping, gun dog training, gunsmithing, land conservation, ecosystem management and shotgun tuition) are important for many remote, upland communities. Training for these careers is currently widely available e.g. BASC lists 29 colleges offering game-keeping courses (British Association for Shooting and Conservation (BASC), 2018). The tourism and hospitality industries, supported by the presence of grouse shooting in remote, upland areas, provide significant career opportunities (McMorran, 2009; McMorran et al., 2013; Glass, Bryce and McMorran, 2015; Denny and Latham-Green, 2020; Latham-Green, 2020b).

The public has the right of access to land that is open country, including moorland. Most land-owners in areas where DGS takes place facilitate access to the public through the provision of tracks and paths. This provision assists both those who participate in shooting, and those who do not, to easily access the moors. Participation in DGS in any role (beater, picker-up, Gun etc.), facilitates regular and sustained physical exercise. (Latham-Green, 2020b). A 2020 study into upland, moorland communities where grouse moor management is practiced found that 84% of survey respondents regularly exercised on the moors, with seven out of ten of them doing at least 150 minutes of moderate exercise a week, more than the national average (Denny and Latham-Green, 2020).

Taking exercise outdoors has been shown to have a greater positive benefit than exercise indoors (Zhang, 2017; Thompson Coon et al., 2011; Loureiro and Veloso, 2014; Frühauf et al., 2016). Access to green spaces helps increase activity and reduce obesity (Coombes, Jones and Hillsdon, 2010; Countryside Recreation Network, 2006). Physical inactivity and obesity can lead to long term conditions such as diabetes and cardiovascular disease (Leong and Wilding, 1999), which are costly to manage in the NHS. A 2014 study indicated that obesity had a burden of around £47 billion a year on society (circa 3% of GDP), making it the greatest impact after smoking (Dobbs et al., 2014).

A 2020 study into driven game shooting found that 86.7% of participants were male, with a median age of 57 (Latham-Green, 2020b; a). The value of regular exercise, to both the individual and society in preventing the costs of ill-health, is higher for individuals 45 and over (World Health Organisation (WHO), 2019). It has been estimated that only 40% of men complete moderate physical exercise (30 minutes a day, five or more days a week) (Pollard, 2010). Walking has been found to reduce the risk of heart problems by 31% and the risk of death by 32%. (Harvard Men's Health Watch, 2009; Pollard, 2010). In 2016 Public Health England estimated that a lack of physical activity was costing the UK £7.4 billion per year (England, 2016). Participation in DGS potentially has a significantly positive impact on a person's physical health and wellbeing.

Using the WHO HEAT tool[55], which can provide an estimate of the societal value of reduced mortality from physical activity of regular walking, for a person aged 45 and over, acting as a beater on a grouse

[55] World Health Organisation (WHO) (2019)

shoot twice a week, we calculate a societal value of up to £1,966[56] per year. The societal value for a person aged 44 and under could be up to £211[57] per year. While these values are indicative, the calculations highlight a major and positive social impact that should be recognised by policy makers and others.

Participation in driven game shooting, including DGS, has been found to have a statistically significant impact on participants' mental health and well-being[58] when compared to the national average (Latham-Green, 2020b; Denny and Latham-Green, 2020). The overall costs of poor mental health in the UK have been estimated at £105 billion per annum (Department of Health Independent Mental Health Taskforce, 2016). Maintaining well-being can be valued at £10,560 per person, per year (Cox, Bowen and Kempton, 2012; Maccagnan et al., 2019). This is a key finding that highlights a positive and measurable social impact that should be noted by policy makers and others.

We have not been able to find studies that comprehensively measure and attempt to value the social impacts of the commonly cited alternative uses of moorland. In the absence of such studies, **there is no evidence that banning DGS and moving to an alternative use of the landscape would deliver the range of social benefits that current practices provide**. We suggest that the alternative uses are likely to result in a reduction of social benefits, with negative implications for the sustainability of communities.

2.5 ALTERNATIVE USES

Advocates of alternative uses for grouse moors fail to calculate the full implications of these options in terms of their economic and social impacts. As a result, they fail to demonstrate that these alternatives are more environmentally, economically and socially sustainable than integrated moorland management, including DGS(Denny and Latham-Green, 2020; Latham-Green, 2020b; McMorran, 2009; Glass, Bryce and McMorran, 2015; Thomson, McMorran and Glass, 2018)***The evidence of the ecological impacts of alternative uses does not indicate that they deliver improved biodiversity or ecosystem services, and their wholesale adoption would almost certainly result in a reduction of natural capital. Many people have a fundamental misunderstanding of what DGS is and the management regimes it involves. DGS is not an 'either – or' activity. It is part of a complex, holistic system.***

Commonly cited alternative uses of moorlands include livestock grazing, commercial forestry, renewable energy, rewilding, tourism, and conservation. Alternative uses are normally advocated as part of a 'mixture' with other alternative uses. DGS does not take place in isolation. It is part of a complex web of integrated moorland management activities. Many landowners either graze their own animals, or their land is used by tenant farmers and graziers. Landowners frequently have relatively small areas of forestry.

[56] Converted from 2,270 Eur to GBP at a rate of 0.8666 on 09.04.2021 (Bank of England, 2021)
[57] Converted from EUR to GBP at a rate of 0.8666 09.04.2021 (Bank of England, 2021)
[58] Measured using the nationally recognised short Warwick-Edinburgh mental well-being score (SWEMWBS)

An increasing number of landowners are installing energy plants, with hydro-electric plants been seen as the least damaging to the environment. As described in the section on economic impacts, DGS drives high-end tourism, and facilitates tourism from non-shooting people throughout the year. All landowners engage in moorland management practices that are classed as 'conservation' and others that can be classified as 'rewilding'. **DGS is not an 'either – or' activity, it is part of a holistic mix. Those people that advocate the wholesale adoption of alternative uses of moorland are ignoring the current situation, and nearly all of the evidence for sustainability.**

Livestock farming in the uplands can rarely be profitable, even with subsidy, unless it is as part of farm income diversification. Conversion of uplands to grassland has been found to be environmentally damaging. Sheep farming currently exists as part of a complex agricultural management system on many upland moors managed for driven grouse shooting(Clark, Scanlon and Hart, 2019; Denny and Latham-Green, 2020; Thomson, McMorran and Glass, 2018). Livestock farming on its own does not deliver the wild-ranging economic and social impacts that integrated moorland management, including DGS, delivers.

Commercial forestry can provide a high level of income to landowners through timber production and subsidy and can provide some limited employment opportunities. Coniferous plantations might help achieve the UK's net zero carbon target on open habitats and croplands. However, coniferous afforestation should not take place on peat moorland as this can result in a net increase in carbon emissions. Additionally, conversion of moorland to coniferous plantation can be harmful for a range of flora and fauna. Losing moorland habitat negatively impacts ground nesting birds such as curlew and hen harrier. Dense coniferous plantations can negatively impact both the presence and breeding performance of some bird species such as ravens and some raptors. Areas of broadleaf woodland, with low planting densities that include open spaces may not impact these species in the same way but are still associated with net carbon dioxide emissions. Coniferous plantations may help alleviate flooding in some cases but can exacerbate it in others. Conifers have an acidification effect on soils and freshwater due to their effectiveness at scavenging acid pollutants(Allen and Chapman, 2001; Alonso, I., Weston, K., Gregg, R. and Morecroft, 2012; Bell, 2014; Burrascano et al., 2016; Burton et al., 2018; Cannell, 1999; Cannell, Cruickshank and Mobbs, 1996; Crane, 2020; Forestry Commission, 2020; Game and Wildlife Conservation Trust (GWCT), 2019, 2020d; Hardaker, 2018; Montenegro et al., 2009; Potts, 1998; Redpath et al., 1998; Rees and Ribbens, 1995; Thompson et al., 1995; Thomson, McMorran and Glass, 2018; UK Government, 2021; Wallace and Good, 1995; Wallace, Good and Williams, 1992; Zhang et al., 2017). Commercial forestry in isolation does not deliver the wide-ranging economic and social impacts that integrated moorland management, including DGS, delivers.

The IUCN has recognised that while renewable energy can reduce carbon emissions it can also negatively impact biodiversity. It recommends that any negative impacts need to be mitigated (IUCN, 2021; Bennun et al., 2021). Renewable energy in the form of onshore wind provides an income to landowners and investors through government subsidies and offers some employment, predominantly in the construction and commissioning stages (only 17% of employment is during the operational phase of a wind farm's life). Local communities can benefit from grants for community projects if wind farms are built in their area. Wind-generated energy can help achieve the UKs net zero carbon target. However, the impact of building

and operating wind turbines on peat soil leads to carbon dioxide emissions. Onshore wind facilities and operation are not universally accepted. Local support is required for onshore wind developments in England. Bats and bird species, particularly raptors which are often species at high risk, can be negatively impacted through collisions with turbines and reductions in the amount of functional habitat through interruption of migratory pathways(BiGGAR Economics, 2012; British Trust for Ornithology (BTO), 2017; Burns, 2019; Grantham Research Institute on Climate Change and the Environment, 2020; Grubb, 2015; Harper et al., 2019; Marques et al., 2020; Smith, Nayak and Smith, 2012, 2014; Thaxter et al., 2017; Toke, 2005). Concerns have also been expressed around decommissioned wind turbine blades, with news stories highlighting the existence of large burial sites for turbines (BBC, 2020c). Wind turbine blades are challenging to recycle with limited uses for any processed material recovered, an increasingly pertinent issue as in Europe alone, as at 2016, 50,000 tons per year of wind turbine blade material was predicted to reach the end of its life by 2022 (Beauson and Brøndsted, 2016). Hydro-electricity-generating plants can provide a valuable income source for some landowners where conditions permit. These plants are less intrusive than wind turbines and result in less damage to biodiversity. It is most unlikely that renewable energy, on its own, will deliver the wide-ranging economic and social impacts that integrated moorland management, including DGS, delivers.

The lack of a specific definition for rewilding means that it is difficult to assess its advantages and disadvantages for moorlands. There is no agreement on which environmental areas should and should not be reinstated through rewilding and how this should be done. Rewilding lacks a coherent temporal base (rewilding to what point in time: 100 years ago, 1,000 years ago, the end of the last ice age?). The use of the term rewilding has now expanded to cover a wide range of ecological restoration and human-nature relationships, usually relating to ecosystem restoration. Ecosystem restoration such as re-wetting of peatlands currently forms part of the work on many moors managed for DGS. The impacts of rewilding on particular species depends on the level and type of intervention. For example, research into the impact of entirely discontinuing grouse moor management at Berwyn SPA in Wales, showed that carrion crows, ravens, buzzards, peregrines, meadow pipits, whinchat and stonechat benefitted from this strategy; whereas hen harriers, golden plover, curlew, lapwing, ring ouzel, tree pipit, red grouse and black grouse numbers were reduced. Rewilding could theoretically open up new tourist opportunities but there are few scientific studies in this area. The support of local communities is required to ensure successful rewilding projects. Research suggests that a large proportion of upland residents are supportive of management of upland moorland for grouse shooting and many believe participation in DGS is part of their rural identity and/or tangible cultural heritage(Denny and Latham-Green, 2020; Latham-Green, 2020b). Therefore, it could be difficult to gain community acceptance of rewilding schemes in such areas, which could lead to their failure(Adams, 2006; Baines et al., 2014; Boivin et al., 2016; Brown et al., 2018; Carver, Evans and Fritz, 2002; Cerqueira et al., 2015a; Cramer, Hobbs and Standish, 2008; Deary and Warren, 2017; Department of Environment Food and Rural Affairs (DEFRA) and Natural England, 2020; European Commission, 2021; European Union, 2015; Game and Wildlife Conservation Trust (GWCT), 2019; Hall, 2019; Harper, 2018; Haslam et al., 2009; Lorimer et al., 2015; Mooney and Dennis, 2016; Navarro and Pereira, 2015; Olwig, 2016; Pellis, 2019; Rewilding Britain, 2021a, 2020, 2021b; Warren and Baines, 2012). There is no evidence which suggests that rewilding on its own delivers the wide-ranging economic and social impacts that integrated moorland management, including DGS, delivers.

Tourism currently exists in upland moorland areas managed for DGS in the form of both high-value shooting tourism, as well as other tourists visiting the moors for birdwatching, walking and general recreation. Track maintenance and land management by landowners contribute to wider tourist activities. A heavy reliance on tourism may lead to a less diverse employment base in upland areas, potentially reducing community resilience to extreme event impacts like the Covid-19 pandemic(Denny and Latham-Green, 2020; Game and Wildlife Conservation Trust (GWCT), 2019; Hall, 2015, 2019; North Yorkshire Moors National Park, 2021; Welcome to Yorkshire, 2019).

Conservation can provide opportunities for recreation and volunteering. Conservation activities are currently completed by landowners. These are part-funded by subsidies, thus also funded by landowners themselves, and utilise the skills and expertise of their workforce. It is not clear whether landowners would have the incentive to continue to invest in moorland conservation activities if DGS were not permitted. The conflict between those opposed to grouse moor management (and sometimes shooting for sport of any kind) could potentially damage the opportunities for experienced land management professionals like gamekeepers to work with NGOs such as the RSPB on future conservation projects, especially in light of the abuse that gamekeepers have been subjected to in recent years (British Association for Shooting and Conservation (BASC), 2021b; Cross, 2021; Thomson et al., 2020). Partial afforestation using mixed, broad leaf woodland could, in theory, be managed for conservation but deep peat areas should not be afforested, but rather the peat should be restored. In addition, it is unclear whether native woodland planting results in carbon sequestration and storage that is equal to or greater than the carbon released when the trees are planted (Burton et al., 2018; Payne and Jessop, 2018; Thomson et al., 2020; UK Government, 2021). Planting native tree species onto heather moorland in Scotland did not lead to an increase in net ecosystem carbon stock either 12 or 39 years after planting. Rather, plots with trees had great soil respiration and lower carbon levels than control plots that were heather-dominant (Friggens et al., 2020).

2.6 OPPOSITION TO DGS: MOTIVATIONS AND METHODS

The motivations of those opposed to DGS are not always clear. Motives may at first appear to concern wildlife and environmental protection. But there are often wider issues that influence opposition, including opinions on social equity as evidenced by land use, land ownership and the governance of natural resources.

The arguments that are frequently deployed against DGS are that it is not economically viable and there are better alternative uses for the moorlands (tourism, forestry, other forms of shooting etc.). Other reasons for opposing DGS include the killing of animals generally or specifically (raptor persecution, legal predator control; culling of mountain hares), pollution (burning, medication, lead shot), claims that DGS results in peat damage and increases flood risk, and ethical issues.

The opponents of DGS portray it as an activity that exists in isolation and do not take into account the evidence for the social and economic impacts resulting from integrated moorland management, including DGS, and tend not to have a comprehensive understanding of the evidence on biodiversity and ecosystem services.

Alternative uses of moorland such as forestry and renewable energy require government subsidy to ensure they are sustainable. Conservation as a single alternative use would require subsidies. DGS delivers significant tourism income, and areas with DGS are more economically sustainable as they are not over-dependent on tourism.

Walked up grouse shooting on its own is not economically viable as the only form of grouse shooting permitted (Sotherton, Tapper and Smith, 2009). DGS is more likely to get closer to a break-even point over a 5–10 year period. The arguments in favour of solely walked up grouse shooting fail to take account of the very significant and positive social impacts resulting from DGS. It is uncertain whether landowners would invest the capital and resources they do into moorland management if DGS were not permitted. The resulting change in moorland management regimes would reduce the positive economic and social impacts resulting from DGS, and it is very likely that biodiversity and natural capital impacts would be negative (Denny and Latham-Green, 2020; Latham-Green, 2020b).

Some species of raptor, such as buzzards, are thriving overall in the UK whilst others, such as the hen harrier, remain on the conservation red list (Stone et al., 1997; Baker et al., 2006; Musgrove et al., 2013; Woodward et al., 2020). There is national variation of raptor abundance between and within areas of the UK, but the core contention remains that illegal killing has and to some extent still suppresses raptor abundance on grouse moors (Murgatroyd et al., 2019). The conflict between those against DGS and the shooting community has been exacerbated by organisations on both sides of the debate interpreting the available data in a way that either supports their interests and agendas or damages the image of opposing groups (Hodgson et al., 2018). The shooting community has increasingly come to oppose raptor persecution. In England as part of a partnership approach the shooting community has been working with Natural England and others to ensure that hen harriers can increase to the maximum sustainable

population level across the UK, in all suitable habitats, not just in their current breeding locations, through participation in the Joint Hen Harrier Action plan (DEFRA, 2016) in England. Initial trials of the brood management programme[59] have increased hen harrier breeding success in the UK (Department of Environment Food and Rural Affairs (DEFRA) and Natural England, 2020).

Some organisations, such as the RSPCA, are opposed to all predator control. However, many organisations that manage areas of the countryside regularly and frequently use legal methods to control predators. The RSPB, NatureScot[60], Natural England, National Trust and the County Wildlife Trusts all use predator control to maintain their nature reserves as part of a range of conservation tools(Harper, 2018). Predator control on grouse moors can be a useful conservation tool for ground nesting birds such as hen harriers, lapwings, redshank and curlews, that are highly susceptible to predation from species such as foxes.

Opponents of DGS have concerns about the use of lead shot. The shooting community has taken voluntary action to end the use of lead ammunition. On 24th February 2020 shooting industry representatives issued a joint statement of their wish to see a phasing out of lead and single use plastics in ammunition used to shoot live quarry with shotguns within five years (British Association for Shooting and Conservation (BASC), 2019) and their intention to work with members to achieve this ambition. At the National Game Dealers Association (NGDA) annual general meeting of March 2021 members voted to commit to sourcing all feather and fur[61] game, including venison and wild boar, from lead-free supply chains from 1 July 2022. This move is in response to pressure from the largest retailers of game demanding a lead-free supply chain. While the NGDA only represents 30% of the game dealers in the UK, others are likely to follow suit. By 2025 when the voluntary transition away from lead shot takes effect, lead shot on grouse moors will cease to be an issue. There is a strong market for grouse with birds commanding premium prices. Many grouse moor owners put grouse into the food chain to defray some of their management costs. The decision of the NGDA means that the 2021 season is the last time many driven grouse will be shot with lead. The only exception will be those birds that are solely for the consumption of the Guns.

Opponents have used incomplete or misleading evidence around muirburn, flooding and mountain hare control to argue their position, including in parliamentary debates (UK Parliament, 2020; Game and Wildlife Conservation Trust (GWCT), 2021c), risking policy decisions being made using incomplete evidence.

[59] The RSPB withdrew from the brood management programme. Indeed, it took legal action at considerable expense, which was dismissed, to stop the brood management project. Mrs Justice Lang DBE, who was presiding said: "*There is simply no evidence to support the claimants submission that Natural England is seeking to circumvent the overall statutory purpose of conservation of an endangered species*" and, "*The RSPB has not been able to identify any material information that was not available to the assessors and appears to have misread the conclusions reached in the report*".

[60] https://www.nature.scot/professional-advice/land-and-sea-management/managing-wildlife/orkney-native-wildlife-project

[61] Fur game includes rabbits and hares.

Those opposed to DGS include an element that use methods include violence, intimidation and abuse against gamekeepers and others. Other opponents mount high profile social media campaigns and legal challenges. There are instances of opponents making use of selected evidence.

Ethical reasons are cited by some opponents of DGS. Looking at the issue of killing a grouse dispassionately, it seems not logical to single out DGS for such opposition in a country that seems happy for more than a billion animals to die each year so they can be consumed as food or used in products.

Instances of intimidation and disruption to grouse shoots caused by opponents are often publicised by opposition groups themselves (Raptor Persecution UK, 2018; Darlington and Stockton Times, 2018). Estates suffer from vandalism (Brown, 2019) and individual gamekeepers and their families are also targets of abuse both face-to-face and online (FarmingUK, 2021; Thomson et al., 2020), with many organisations using covert and overt surveillance of gamekeepers going about their daily duties (Brown, 2019). This abuse has been condemned by nature conservation groups and local MPs (Chalmers, 2021; Cross, 2021), although a motion to the Scottish parliament in relation to supporting gamekeepers in light of this abuse was ultimately defeated (Mundell, 2020). There are real concerns around the impact on gamekeepers' mental health and that of their families resulting from this abuse (Gamekeepers' Welfare Trust, 2020), which they can often not escape when they go home from work as they live in houses on the estate.

There are several high profile individuals, active on social media platforms, who campaign against driven grouse shooting (Knapton, 2017; UK Government and Parliament, 2019), utilising arenas such as Twitter. People involved in DGS are often not confident in using social media and communication media (Latham-Green, 2020b) or have poor access to reliable phone and internet. The spreading of inaccurate information, such as false accusations about the shooting of lapwings (Farming UK, 2017) by high profile supporters of shooting, can cause difficulties as, even after retractions are made, many 'retweets' will have already taken place. There have been calls to stop high-profile opponents of DGS, who regularly appear on the BBC, from using their position to help advocate their views. A new social media guidance policy has been produced by the BBC (Bonner, 2018, 2020; BBC, 2020a) but seems often be ignored by individuals

The use of legal challenges by Wild Justice, relating predominantly to shooting and general licences, has caused conflict between those for and against shooting, caused disruption to agriculture, damage to wildlife, and resulted in few changes to the way the licences work in practice. Those in the shooting community have raised concerns about the use of legal challenges vexatiously to disrupt the operation of their businesses. A petition organised by Wild Justice and calling for DGS to be banned was debated and defeated in Westminster Hall in June 2021.

Opponents of DGS have used selective, or partial, evidence to support their case. As a result, a balanced view of the evidence is not provided which might, in the worse-case, result in legislation based on

deliberately manipulated science(Game and Wildlife Conservation Trust (GWCT), 2021c),(Game and Wildlife Conservation Trust (GWCT), 2017).

Interest group bias on both sides of the debate has also influenced the available research base for DGS, with much research sponsored by those for or against shooting. Interest groups bias has also influenced policy making, with ministers in Wales and Scotland not following the recommendations of independent evidence review panels (National Resources Wales, 2018a; b; Bodkin, 2018; Grouse Moor Management Review Group, 2019; Scottish Government, 2020). Many people involved in shooting believe that its positive impacts are not understood. There is increased conflict between those for and against DGS (and other forms of shooting).

In Scotland, the Grouse Moor Management Review (2019), put forward a range of proposals to better regulate grouse moor management, to ensure positive impacts were maximised and negative impacts minimised. The report recommended moving to a licensing system after five years if criteria related to raptor numbers were not met. However, on 26th November 2020 the Scottish government announced that work on licensing DGS would start immediately. Grouse moor management in Scotland, as in England and Wales, was already extensively regulated prior to the licensing announcement. The situation is complicated by ongoing land reform issues which relate to historic land ownership in Scotland.

Grouse moor management in Scotland is already heavily regulated, as it is in England. General licences are required for control of certain species of birds and predators (NatureScot, 2021b). The use of snares is regulated by the Wildlife and Countryside Act 1981, as amended by the Nature Conservation (Scotland) Act 2004, the Snares (Scotland) Order 2010 Act and the Wildlife and Natural Environment (Scotland) Act 2011. Only individuals can be licensed to use snares and users must achieve approved accreditation, receive a personal ID number from the police, and attach an identification tag to every snare when set, with specific records needing to be kept(Game and Wildlife Conservation Trust (GWCT), 2021e). Annually renewable licences are required for the use of Larsen Traps, Larsenmate Traps, Larsenpod Traps and multi-catch crow traps use. Licences are required to cull mountain hares (NatureScot, 2021d). Specific licences may be applied for from NatureScot to take ravens, deer out of season and gulls. Medicated grit use is controlled by the Veterinary Medicines Regulations 2013 with Guidance Note 13 on 'The Use of Cascade' and the Wildlife & Countryside Act 1981 as amended. The managed burning of heather is regulated by the Muirburn Code (NatureScot, 2021c). There are restrictions on building tracks, roads, butts and grazing pressure is controlled on some designated sites.

The Land Reform Act (2016) was brought in by the Scottish Government. The Act includes a Community Right to Buy for Sustainable Development. The Act permits Scottish ministers to approve the purchase of privately owned land by a community body with a registered interest. The Act does not require the current landowner to agree to the land sale, but instead allows ministers to compel landowners to sell if they decide that the sale will further sustainable development in the area (Land Reform (Scotland) Act 2016), with both financial and administrative government support available for organisations who wish to utilise the 'Community Right to Buy' for sustainable development (The Scottish Government, 2021a; b).

3 METHODOLOGY

This report is based on a review of the relevant literature, both articles published in peer reviewed journals and reports produced either by research-based organisations or by task groups appointed by policy makers. We have read material published on websites by governments, non-governmental organisations, and interest groups. We have also reviewed magazines produced by relevant interest groups, as well as items appearing in the media. The earliest reference we cite is dated 1577, but the vast majority of our references date from the last decade, with many items being published in 2021.

Where relevant we cite our own research. Latham-Green's PhD investigating the social impacts arising from participation in driven game shooting analysed qualitative and quantitative data gathered from over 2,400 respondents (Latham-Green, 2020b). Her research is the largest, and most comprehensive, study of its type and sheds new light on a previously unmeasured aspect of sustainability. Denny and Latham-Green (2020) interviewed 61 people and gathered quantitative data via a questionnaire completed by 583 respondents. Based on this data we proposed a new framework for understanding the economic impacts of game shooting. We have developed the framework in this study as we believe it provides a helpful way of thinking about economic sustainability.

The literature review as a research method has the advantage of enabling authors to be up-to-date with the relevant science, as well as enabling them to assess and compare different items of evidence. However, we acknowledge that traditional literature reviews often lack thoroughness and rigour, especially when they are conducted ad hoc, rather than following a specific methodology (Snyder, 2019). We attempted to guard against this weakness by rating all the peer reviewed literature we read against firstly, the IUCN definition of sustainability, and secondly by reviewing the methodologies described by the authors.

We did not assume that, because an article appeared in a peer reviewed journal, it met a 'gold standard'. We recognize through personal experience that peer review has become an essential component of the academic writing process, helping to ensure that papers published in scientific journals answer meaningful research questions and draw accurate conclusions based on professionally executed experimentation. However, despite its wide-spread use by most journals, the peer review process has also been widely criticised for the slowness of the process to publish new findings, and the perceived bias shown by some editors and or reviewers (Kelly, Sadeghieh and Adeli, 2014). The increase in the number of online only or E-journals with little or no peer review may pose risk to the advance of knowledge. We have avoided articles in this type of publication wherever possible.

We do not suggest, or think, that this report is the last word on the sustainability of driven grouse shooting. We cite at least two articles published in 2021 that contradict earlier studies. We are certain that future publications will advance knowledge further. As we note in the introduction, this report is the first edition of a 'living document' that will be updated, at least annually.

4 OVERVIEW OF DRIVEN GROUSE SHOOTING

4.1 THE RED GROUSE: AN INTRODUCTION

> *The red grouse inhabits an extremely limited and ever-dwindling portion of the earth's surface, and has refused to multiply or become acclimatized elsewhere"*
>
> (Stanford, 1960)

4.1.1 INTRODUCTION

This chapter introduces the red grouse, the bird at the heart of the research project. It will describe the different species of grouse found in the British Isles and give a brief account of the appearance and behaviour of the red grouse. The habitat and distribution of this game bird will be described and the main diseases impacting red grouse in the UK briefly examined. The chapter will conclude by observing that the red grouse is one of the UK's seven endemic bird species and summarizing its legal status.

4.1.2 DIFFERENT SPECIES OF GROUSE

There are four different grouse species found in the UK: the black grouse (*Lyrurus tetrix*), the ptarmigan (*Lagopus mutus*), the capercaillie (*Tetrao urogallus*) and the red grouse (*Lagopus l. scoticus L.I. hibernicus*[62]*).* All these birds have specific dietary requirements and specific habitats. Red grouse in Ireland are sometimes thought to belong to a separate subspecies *L. l. hibernica* (Bruun, Delin and Svensson, 2002).

The red grouse population is estimated to be 230,000[63] – 265,000[64] pairs although populations can increase or crash in some years. It is one of this country's few endemic sub-species, meaning that they are only found in the British Isles. They inhabit heather moorland including areas of both blanket bog and upland heath. The black grouse population is estimated to be 5,100 males UK wide. They are found on the moorland fringe and use hill-edge woodlands of both conifer and deciduous species. There are estimated to be just over 1,000 capercaillie in a handful of pine-dominated Scottish woodlands[65], mainly within Badenoch and Strathspey in the Scottish Highlands. Ptarmigan live above 800m and like capercaillie are also only found in Scotland; the population size is estimated to be between 2,000 – 15,000 pairs[66]. Grouse populations tend to fluctuate in size over the years and in relation to management, so these figures are best seen as informed estimates.

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[62] The scientific name of the red grouse, *Lagopus,* is derived from Ancient Greek *lagos* (λαγος), meaning "hare", and *pous* (πους), "foot", in reference to the feathered feet and toes typical of this cold-adapted genus, and *scoticus* is "of Scotland".

[63] https://app.bto.org/birdtrends/species.jsp?year=2018&s=redgr

[64] RSPB estimate https://www.rspb.org.uk/birds-and-wildlife/wildlife-guides/bird-a-z/red-grouse/

[65] The most recent national survey was carried out in 2015/16.

[66] Source for population estimates British Trust for Ornithology https://www.bto.org/

During the nineteenth and twentieth century there were a few shoots in Scotland where capercaillie[67] were driven by beaters over guns[68]. However, since the 1960s the decline in suitable habitat and other factors has resulted in a crash in capercaillie numbers and they were legally removed from the quarry list in 2002 [69]. Black grouse are legal quarry between 20 August and 10 December, but for many years there has been for conservation reasons a voluntary moratorium by landowners on shooting them, and are only exceptionally quarry on driven grouse shoots. Ptarmigan are occasionally shot on walked up days in the mountainous areas where they live. However, the red grouse population is managed by humans to be large and productive enough to enable, in some years, a number of them to be the quarry on driven grouse shoots between 12 August and 10 December[70]. It is the red grouse that is the subject of this report.

4.1.3 THE RED GROUSE[71]

In appearance the red grouse is a dark reddish-brown in colour, with a black beak and a bright red, or scarlet, comb above each eye. Females are a lighter reddish-brown than males and have less conspicuous combs. Young birds are duller and lack the red combs. The tail of the adult bird is mostly black and the legs to the claws are feathered in pale grey as in other species of Lagopid grouse. This is because these birds live in areas with high snowfall, and the feathers help to keep the feet warm and to act like snow shoes, spreading the bird's weight so that it uses less energy walking on top of the snow, rather than sinking into it. When fully grown, red grouse are typically 37 – 42 cm long, have a wingspan of c. 55 – 55 cm, and weigh between 650 – 750 g. They are mostly vegetarian and typically eat heather, seeds, berries and some insects, more when very young.

FIGURE 4.1 THE RED GROUSE

IMAGE BY DPEXCEL FROM PIXABAY

The call of the red grouse is distinctive and easily identified by a '*chut!chut!chut!chut!chut!chuttt'* sound, sometimes described as '*Goback, goback, goback*'. The wings make a whirring sound when the bird is disturbed from its resting place. Grouse fly in the characteristic manner of game birds: rapid wingbeats alternating with long glides on rigid, bowed, slightly depressed wings.

[67] Capercallie were re-introduced to Breadalbane in Scotland in 1837 when T.F. Buxton, an English MP, sent his gamekeeper, Larry Banville, to Sweden to collect and bring the birds back to the UK. They were presented to the Marquis of Breadalbane to thank him for the grouse shooting that Buxton had enjoyed in Tayside. Source: The Banville Diaries.

[68] For example, Donside in Aberdeenshire.

[69] Which sadly has not reversed the decline in numbers.

[70] In Northern Ireland the grouse season is 12 August to 30 November.

[71] Source for this section include: Stanford (1960); Banville (1986); Souto (2018) and Bruun, Delin and Svensson (2002)

Red grouse begin to form pairs during the autumn and males become increasingly territorial as winter progresses. The nest is a shallow scrape up to 20 cm across which is lined with vegetation. About six to nine eggs are laid, mainly during April and May. The eggs are oval, glossy and pale yellow with dark brown blotches and are incubated for 19 to 25 days. the young grouse chicks can fly 12 to 13 days after hatching and are fully grown after 30 to 35 days.

Red grouse are the only truly endemic wild game bird in the UK. Like pheasants and partridges, they are straightforward to breed in captivity but their survival on release is typically extremely poor. As a result, grouse shoots never release grouse for shooting, but manage the red grouse's moorland environment to ensure a sustainably harvestable surplus.

4.1.4 HABITAT AND DISTRIBUTION

Red grouse live on heather moorland across the UK uplands; mainly concentrated in the hills of central and eastern Scotland, the Pennines and North York Moors. Grouse moors often occur on peat soils; either deep peat, which can be blanket bog, or shallow peat and mineral soils, which are on heathland areas. Grouse mostly eat the young shoots of heather plants, so heather management, usually by controlled burning, grazing and cutting, is undertaken to encourage new growth. A mix of young and older heather provides both good food quality and cover for nesting. As a result of this management, and historically management for sheep, no other country has extensive heather uplands equivalent to those in the UK. Most other heather areas are lowland or coastal, leaving the UK responsible for 75% of the world's heather moorland. For this reason, the 1992 Rio Convention on Biodiversity recognized the global importance of UK heather moorland. Heather-dominated moorland supports groups or 'communities' of plants growing together that are either only found in the UK, or are found more abundantly here than elsewhere in the world. These communities are different to those found under other land uses such as livestock farming or commercial forestry, so grouse moor management increases overall 'gamma' biodiversity in the uplands (GWCT, 2019). They include species of berry, grass, sedge and mosses such as *Sphagnum*, which together define habitats that are listed under the EU's Conservation of Natural Habitats and of Wild Flora and Fauna Directive.

Outside Scotland and Northern England, in Wales there are red grouse populations but their range has retracted. They are now largely absent from the far south, their main strongholds being Snowdonia, the Brecon Beacons and the Cambrian Mountains. There are reports of Welsh birds crossing the Bristol Channel to Exmoor, but they are not known to breed there and the most recent sighting of grouse on Exmoor dates to 2005. There is an isolated introduced population on Dartmoor, and overspill Welsh birds visit the Shropshire Hills such as Long Mynd, where they breed. Grouse were introduced to Exmoor, to Cannock Chase, and once a few pairs were introduced into West Suffolk[72] but breeding populations were not self-sustaining. In Ireland red grouse are found locally in many parts of the hill and bog country: it is commonest in Mayo, where the population is increasing, and on the Antrim plateau, with other healthy populations in the Slieve Bloom Mountains and the Knockmealdown Mountains; a few pairs still breed in south County Dublin. The small population in the Isle of Man is mostly concentrated in the southern hills but conservation work is ongoing throughout the uplands to ensure the species' continued viability.

[72] A red grouse was seen on Berners Heath near Elveden, Suffolk, in 1916. It was the last of its kind in East Anglia.

4.1.5 DISEASES

Ever since Edward Wilson, the naturalist who perished with Scott in the Antarctic, began his researches on grouse disease in 1906, there have been biologists at work on grouse and the enemies of consistent brood productivity such as sheep-ticks, heather beetle and thread-worms. There has been more work for them to do as grouse diseases have increased in number and spread in geography. Grouse populations display periodic cycling, where the population builds up to very high densities only to crash a few years later, and then recover. The three main diseases affecting red grouse are louping ill virus, strongylosis, and respiratory cryptosporidiosis.

Approximately one third of grouse moors carry the louping ill virus. Louping ill virus is a flavivirus (RNA virus), also known as sheep encephalomyelitis virus. Flaviviruses are transmitted by arthropods, and louping ill virus is transmitted by ticks. In red grouse, this virus can cause mortality as high as 78%. The main tick vector is the sheep tick *Ixodes ricinus*. Although the vast majority of louping ill transmission is caused when the parasite bites its host, red grouse chicks can rarely be infected with the virus when they eat ticks that carry the virus. This virus may be a significant factor in red grouse populations. The presence of louping ill reduces chick survival, with up to 80% of infected chicks dying. As a consequence, chick survival rates can average 50% lower on moors with louping ill.

The 'classic grouse disease' strongylosis is not caused by ticks or a virus but by a nematode worm *Trichostrongylus tenuis*[73]. This gut parasite is widespread in red grouse and high levels of infection can cause significant reductions in both breeding success and direct mortality. Research in the north of England has shown that this parasite is largely responsible for the cyclical fluctuations in grouse numbers on moors in this region. The parasite is most prevalent when grouse stocks have been high, but it may also reduce breeding success on low-density moors.

First diagnosed in the UK in 2010, respiratory cryptosporidiosis, caused by *Cryptosporidium baileyi*, is present in approximately half the grouse moors in northern England, where it reduces natural survival and productivity of red grouse. It is effectively absent from Scotland.

4.1.6 ENDEMIC STATUS

The British Isles have few endemic species of animals and plants due to past frequent glaciations[74] and the existence of a land bridge to Europe until about 9000 years before present. Most endemic species to the British Isles are considered to be subspecies of a larger species, with mutations or adaptations slightly changing the species in the islands or in certain localities. Consequently, there are few endemic species of birds in the British Isles, although there are slightly more subspecies. However, it has been widely held that one of the birds that is endemic to Britain is the red grouse, which has been able to develop in isolation from other subspecies of the willow ptarmigan which are widespread in northern parts of Eurasia and North America.

[73] This endoparasite is often eaten with the tops of young heather shoots and can lead to mortality and poor condition, including a decrease in the bird's ability to control the scent it emits.

[74] Repeated glaciations have what is sometimes described as a "wiped clean effect" resulting in many species having been forced out of the modern area of the UK to more southern parts of Europe, or perhaps becoming extinct.

It appears that red grouse are more than simply colour variants of willow grouse[75]. There is an increasing body of evidence that there are genetic differences between the nominate race of willow grouse (*Lagopus lagopus lagopus)* and Scottish red grouse *(L. l. scoticus*) (Quintela et al., 2010) and Scottish red grouse and Irish red grouse (*Lagopus lagopus scoticus/hibernicus*) (McMahon et al., 2012). Whether these are distinct enough to say they are separate species is unclear and no one has committed; there is nothing certain in science[76]. The genetic differences between Irish red grouse and Scottish red grouse also mean that the Irish grouse may well be *L. l. hibernicus* rather than *L. l. scoticus*. If that is the case, there could be similar genetic variance between Scottish red grouse and Peak District or Welsh red grouse.

The British red grouse is probably best described as an endemic (no natural population anywhere else, with very limited dispersal linkage, apparently over a period of at least 25,000 years) sub-species (because they can still produce fertile offspring) of the willow grouse. In any event, it is interesting to note that *L. l. scoticus* and *L. l. hibernicus* are already noted in Annex II/1 of the Birds Directive as distinct from *L. l. lagopus* i.e. the EU recognises three sub-species of the species.

The red grouse thus is one of just seven species of birds that is unique to Britain; the others being the Pied wagtail, the Shetland wren, the Fair Isle wren, the St Kilda wren, the Scottish crossbill, and the White-throated dipper. Importantly, the red grouse has much the largest population of the bird species endemic to Britain.

4.1.7 LEGAL STATUS

In common with other wild birds, the red grouse is the subject of legislation designed to ensure its conservation. When it was a member state of the European Union, the UK was bound by the provisions of Council Directive 2009/147/EC on the conservation of wild birds (popularly called the Birds Directive[77]) to take the requisite measures for the protection of the red grouse[78]. However, as it is a species to which Annex II of the Directive applies, Article 7 permits hunting (shooting) under national law, provided population levels are not threatened as a result. Interestingly, in 2002 Ireland was found by the European Court of Justice to be in breach of its obligations under the earlier Directive to protect the red grouse because it had allowed a crucial breeding ground to become degraded through overgrazing by sheep[79]. Legal protection for the grouse is not new in the UK. As Stanford reports, "the red grouse has survived through uncounted centuries and has been protected by law in Scotland since the days of Mary Queen of Scots. As long ago as 1577 Holinshed described the "cokes and hennes which absteyning from corne do feed upon naught else but the leaves of cytilus which the Scottes do commonly call haddar." [80]

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[75] There is substantial colour polymorphism in willow grouse. The willow grouse that live in coastal areas of Norway look very like red grouse as they have much less white winter plumage than their mountain-dwelling counterparts.

[76] Dr Adam Smith, GWCT Director Scotland, March 2021

[77] The main elements of the Birds Directive, including Annex II, Article 7 still apply to the UK after 1 January 2021, https://www.gov.uk/government/publications/changes-to-the-habitats-regulations-2017/changes-to-the-habitats-regulations-2017

[78] It is interesting to note that *L. l. scoticus* and *L. l. hibernicus* are noted in Annex II/1 of the Birds Directive as distinct from *L. l. lagopus* i.e. the EU recognises three sub-species of the species.

[79] JUDGMENT OF 13. 6. 2002 — CASE C-117/00.
https://curia.europa.eu/juris/showPdf.jsf;jsessionid=40CD45DDDDE54D93591B54E832C9E523?text=&docid=47406&pageIndex=0&doclang=EN&mode=lst&dir=&occ=first&part=1&cid=7313207

[80] Source: Holinshed (1577) cited in Stanford (1960)

4.2 WHAT IS DRIVEN GROUSE SHOOTING?[81]

> *"Grouse shooting is reckoned by many to be the finest of all forms of game shooting. Not only is the red grouse an exceptionally fast and agile bird, which offers some of the most difficult of all shooting, but it also has its home in the most glorious upland countryside. The combination of sporting shooting and magnificent scenery, once experienced, is never forgotten, and draws grouse shooters back to the moors year after year."*
>
> (Downing, 2018)

4.2.1 TYPES OF GROUSE SHOOTING IN THE UK

There are three ways in which grouse are shot in the UK, 'walked-up', 'over dogs', and driven[82] (McMorran, Thomson and Glass, 2020). In walked-up shooting groups of shooters (the 'Guns') walk in a line across a moor. Dogs may be used to flush the grouse from the heather for the Guns to shoot at, or specialist pointing dogs used to locate and indicate where birds are that one of more guns then flush and shoot. The shooting of grouse that have been located by working specialist pointing dogs is the most common form of grouse hunting anywhere else in the world. The number of Guns on a walked-up day is typically four to eight and the number of birds shot normally ranges from 16 to 30 (McMorran, Thomson and Glass, 2020). In driven grouse shooting teams of beaters work to drive the birds towards the Guns, who are stationary in a line and concealed in specially constructed 'butts' (interestingly, the Badminton Library[83] shows clearly that the earliest recorded driven grouse were shot on the Stanhope moors in 1805 by boys lying behind rocks, or crouched in sand scrapes, before butts were thought of). Butts may either be temporary screens made of wood or permanent structures, often built of turf and stone. The number of birds shot on a driven day can range from fewer than 100 (50 brace) to over 400 (200 brace)[84]. The RSPB suggests that walked-up grouse shooting is widely regarded as environmentally sustainable[85]. However, it has concerns about the sustainability of more intensive driven grouse shooting (Royal Society for the Protection of Birds (RSPB), 2020a).

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[81] Information in this chapter has also been sourced from 'The Shooting Man's Bedside Book Watkins-Pitchford (1948), republished 1994

[82] McMorran et al (2020) suggest there is a third way of shooting grouse, over pointer dogs. As this method involves Guns walking, it is included within the walked-up category in this report.

[83] Walsingham Lord and Payne-Gallwey, R. (1902) Badminton Library – Shooting: Moor and Marsh, Longmans, Green and Co. London

[84] The record bag of 2,929 birds shot on 12 August 1915, by eight Guns, at Littledale and Abbeystead in Lancashire is extremely unlikely ever to be repeated. Source: The Shooting Man's Bedside Book

[85] The question of what is meant by 'sustainable' is an interesting one. McMorran et al (2020) report the rests of case studies of four walked-up grouse shooting estates in Scotland. Despite having walked-up shooting, all four estates were actively managed for grouse, which included heather burning, predation control and the use of medicated grit, the same management techniques that are used on moors where driven grouse shooting takes place. In these estates grouse management was referred to as being relatively low input, due to a combination of low staffing levels and owner motivations, and also due to less emphasis being placed on ensuring sufficient grouse numbers existed for driven grouse shooting. These cases do not obviously show that walked-up grouse shooting is more sustainable against the IUCN definition of sustainability.

4.2.2 THE COST OF GROUSE SHOOTING

The cost of grouse shooting to people that own moorland are examined in detail in section 5.2, *The Economics of Driven Grouse Shooting*. However, the cost of a day's grouse shooting for an individual Gun is significant. The cost of a walked-up day, with the possibility of a bag of 20 birds, is roughly the same as a day shooting pheasants or partridge where the bag could be 100 – 200 birds. The cost of driven grouse shooting can be five times that of a pheasant day for a similar number of birds shot. A moor in Yorkshire advertised driven grouse shooting in 2021 at rates shown in Table 4.1[86]:

Month	Number of birds	Cost per Gun/number of Guns
August and September	250	£2,906.25, 8 Guns
October	200	£2,250 per gun, 8 guns
November	160	£1,740 per gun, 8 guns

TABLE 4.1 INDICATIVE COST OF DRIVEN GROUSE SHOOTING FOR ONE GUN IN 2021

Red grouse are regarded internationally as the paragon of gamebirds, the marketplace confirms this view.

4.2.3 A TYPICAL DAY DRIVEN GROUSE SHOOTING

A typical day's driven grouse shooting consists of meeting at 09.00 where the team will meet the hosts and any shoot day helpers (loaders/minders), who will take care of the Guns throughout the day's shooting. There are normally between 8 and 12 Guns shooting. Following arrival and introductions, a safety speech will be given, and a draw will take place to establish each Gun's shooting position or butt number for the day. Guns will then leave the meeting location for the first drive[87] where they will head to their butt where their loader will be with all the necessary equipment for each drive, including guns and cartridges. Most days will consist of two drives followed by a break for snacks and drinks. Further drives will then be shot before heading back to meeting location for a meal. However, the nature of driven grouse shooting is unpredictable. Grouse drives take place across wide, open moorland, and the beaters often walk many miles in order to move the coveys[88] forwards and ensure that they end up flying over the Guns. Their job can be an arduous one, especially when the weather is very hot or if there is heavy rain. Despite the best efforts of the beaters, birds may try to fly away from the line of guns, hence the critical role that flankers have to play, or they may even fly away from the Guns back over the heads of the beaters. Beaters might have to walk for three or more miles per drive, thus Guns can spend a lot of time waiting for birds to appear. J.K. Stanford wrote, "I had been out for six hours, during which I had had about six 'unforgiving minutes'. The rest had been expectancy or regret" (Stanford, 1952). Moreover, if an eagle or other large raptor is flying over the moor the grouse may ignore the efforts of the beaters and remain hidden in the heather. Finally, having grouse fly over the Guns is no guarantee that they will be

[86] https://www.dawnay.co.uk/sporting/prices-availability/

[87] A 'drive' is the term used when beaters have flushed birds so that they fly over the line of butts (if the drive is successful) so they can be shot at. The Gamekeeper normally determines when a drive has finished and Guns should cease firing, using a horn or whistle to tell Guns to stop.

[88] The collective noun for a group of grouse is a covey.

shot. Grouse are agile and can fly quickly. With a following wind the birds can easily be moving at more than 70 mph when they go over the butts.

Although there may be only 8 to 12 Guns shooting at the birds during a driven grouse day, the number of people involved in the day can be more than 50. A day's driven grouse shooting requires a great deal of planning and organization, before, during and after the day. The next section will describe the roles of people involved in the driven grouse industry.

4.3 WHO IS INVOLVED IN THE DRIVEN GROUSE INDUSTRY

> *"The Twelfth is not all about the keepers, owners and their guests; it is a time when the local community, from all walks of life, becomes a part of the big event, and continues to work for all the subsequent days of the season. The Twelfth will usually see the most people out, sometimes close to a hundred if one includes beaters, loaders, flankers, pickers-up, house and cooking staff as well as others in support."*
>
> (Millington-Drake, 2015)

Setting up and running a day's driven grouse shooting is a complex operation, involving a 'cast list' of several hundred people that carry out a surprisingly wide variety of different roles. Indeed, although the term 'industry' is sometimes controversial, both among those that shoot[89] and their opponents, it is an appropriate word to use to describe the highly developed, integrated network of roles and trades that have evolved to enable the occasional harvest of a wild bird.

The Guns, those people that want to shoot grouse, have a relatively simple part to play in the industry: they help fund it by paying to shoot. Other players in the cast list have roles that that are understood by people that have no knowledge of grouse shooting e.g. hotel and inn keepers, vehicle hire businesses, caterers and restaurants. However, other roles that are critical to the success of the industry are not commonly understood.

Table 4.2 lists the roles played by people involved in the driven grouse industry and provides a brief description of how they fit into the integrated network.

TABLE 4.2 THE ROLES OF PEOPLE INVOLVED IN THE DRIVEN GROUSE INDUSTRY

Role	Description
Landowners	Landowners are, obviously, those that own the land where DGS takes place. Ownership may result from inheritance but is more frequently as a result of purchase. Some owners manage their land themselves, but owners with large holdings often employ Estate Managers. Owners may organize DGS themselves, either directly or through Estate Managers, employing Gamekeepers and other staff, or rent out the rights to shooting to Sporting Tenants

[89] The term 'industry' is opposed by many people and organisations involved in driven grouse shooting as they think it has connotations of exploitation and environmental degradation.

Sporting Tenants	Sporting Tenants rent moorland on which DGS can take place. Leases are typically for several years. Sporting Tenants will employ Gamekeepers and other staff involved in the organization of DGS.
Estate Managers and Factors	Estate Managers, or Factors in Scotland, are engaged by some landowners to manage their estates. Their role can cover land surveying, tenant and community relations, and staff management. On a moorland estate the role typically includes managing conservation and wildlife, access and visitor/tourism management, recreation, woodland management, and shoot management.
Sporting Agents	Some estates market and sell their own shooting. However, many estates work with Sporting Agents who match people wishing to shoot driven grouse with availability. Agents will work with several estates. Some Guns simply want a day's shooting, while others will require a more bespoke service including the provision of transport, cartridges, loaders etc.
Gamekeepers	Gamekeepers on a grouse moor have the role of managing the habitat and wildlife, which can include vermin control, to provide a harvestable surplus of grouse for shooting. Grouse gamekeepers often also manage or help manage a property's pheasant/partridge shooting and deer stalking. Gamekeepers can be full- or part-time. The head-keeper is typically a full-time role with Under-Keepers (more junior staff) reporting to them. On some estates the head keeper is also the estate's sporting manager, selling and organising the shoot days.
Beaters and Flankers	Beaters walk, in teams controlled by Gamekeepers, across the moors in order to drive the grouse towards the line of butts behind which the Guns are waiting. They are normally supported by Flankers who have the role of using flags to try and ensure the grouse fly over the butts, rather than out from the side of the beating line. Flankers are normally more experienced in management of shoots than beaters. The numbers of beaters and flankers involved in a day's driven grouse shooting varies, but typically involves at least 20 – 30 people.
Pickers-up	Pickers-up are people with trained dogs (normally spaniels or retrievers) who wait behind the line of butts and collect the fallen birds when a drive is completed. Birds that have been shot can fall up to half-a-mile from the butts on very windy days and dogs are needed to find them as they are normally hidden in the heather (against which the birds are, of course, well camouflaged) or between rocks. A driven grouse shoot can involve five or more pickers up, with 20 or more dogs between them.
Drivers	To move the beaters, flankers, pickers-up and keepers between drives, transport is often required[90]. In many cases these vehicles have dedicated drivers.

[90] Of course, people used to have to walk between drives, but vehicles become a feature of driven grouse shooting from the 1940s onwards.

Caterers	Driven grouse shoots nearly always provide food and drink for all involved on the day, and meals of various size and quality are served, depending on the shoot. Typically, either local caterers are engaged or cooks are employed by estates for the season.
Farmers	Many large estates have long-established tenant farmers. Many farms have both lowland (typically in valleys) and moorland. Gamekeepers have to liaise with farmers as both are involved in managing the moorland environment.
Graziers and Commoners	Graziers and Commoners have rights, often long-established, to graze sheep on areas of moorland. Again, Landowners, Estate Managers, and Gamekeepers have to liaise with graziers and commoners as they are involved in managing the moorland environment.
Contractors	Contractors can be divided into those providing 'domestic' services to an estate, such as carpenters, builders, plumbers etc. and those providing landscape management services such as peatland restoration, bracken clearance, track maintenance, heather management, water-course management (including grip[91] blocking) etc. Landscape contractors typically work on grouse moors from January to July.
Guns	The people that shoot the grouse. Guns are either invited by people hosting the shoot or pay for the experience. Many Guns travel hundreds of miles to shoot driven grouse, with a several of them coming from outside the UK. Given the distances they travel to shoot, Guns normally spend at least one night in hotels etc. local to the shoot. Some Guns spend several days in the local area and bring their partners with them.
Loaders	On some moors Guns only use one shotgun to shoot with. However, on many moors Guns use two shotguns and have people in the butt with them so they can quickly load and fire while a covey of grouse fly over or near the line of butts. Loaders may live local to the moor, but some Guns bring experienced Loaders with them. These visiting Loaders require accommodation etc. and their costs are usually covered by the Guns.
Hotels/Inns etc.	Grouse are mainly found in the more remote areas of the British Isles with low populations. Therefore, most people that wish to shoot grouse, and can afford to, will have to travel for their sport and will require accommodation in hotels or inns. For hoteliers and innkeepers Guns and their guests represent high-value tourism between August and December. Many hotels and inns near grouse moors gain hundreds of bed-nights etc. during the grouse season.
Gun shops and Outfitters	Guns buy their shotguns, cartridges and specialist clothing from licenced gun dealers, most of which also sell a range of clothing specifically designed for game shooting.
Vehicle hire	Guns that live in the UK typically drive their own vehicles to shoots. However, Guns from overseas often hire vehicles to use while they are in the UK. Typically, the

[91] A 'grip' is a ditch dug to drain wet areas of moorland.

	vehicles hired are expensive SUVs, such as Range Rovers. Some international Guns also hire drivers.[92]
Game Dealers	The dead grouse is a valuable commodity. In nearly all cases, birds are collected from the moor (on the day they were shot) by Game Dealers. These Dealers will collect birds from many moors in their local area, process them and then transport them to UK or international markets either using their own transport or couriers. Unless a grouse has been badly damaged when it was shot, or was not found by the Pickers-up, it will go into the human food chain.
Restaurants	Grouse shot in the UK are an attractive menu item for high-value restaurants in the UK and abroad.

It should be noted that Table 4.2 does not include insurance companies and other providers of business services. Insurance companies are involved in the driven grouse industry, but as indirect suppliers rather than players with a specialist role in the integrated network.

The interplay between some of the parties involved in the grouse industry can be complicated and often depends more on personal relationships rather than commercial transactions. Sheep have grazed on moorlands for hundreds of years, and cattle are becoming more common on some moors. Certain hardy sheep breeds have been adapted to live on the meagre fare many moors offer (although they are often crossed with other breeds of sheep and fattened on lower-lying pastures where they typically spend the winter). As the Moorland Association notes[93], "it is important that grouse moor managers work closely with farmers, commoners and graziers to strike the right balance on this sensitive land. Grouse and sheep each need the best nutrition they can get from upland heath and blanket bog – without damage or domination" (The Moorland Association (MA), 2021). The ownership of land and the rights upon it are often complicated in the moorlands, especially on common land. "Compromises have to be made to meet the demands for clean water, flood risk and wildfire mitigation and carbon capture. They have to be reconciled with maintaining a beautiful landscape for all to enjoy, as well as being hard working living landscapes for people and wildlife. Close co-operation is crucial when carefully controlled heather burning and/or mowing takes place. This encourages diversity across the moors, helps spread out grazing sheep and boosts important fresh, nutritional growth of grasses and shrubs."(The Moorland Association (MA), 2021) DGS often depends on people displaying high-levels of collaboration.

The ways in which the integrated network of parties in the driven grouse industry work together, and the economic, environmental and social impacts that result, are explored in the following sections of this report.

[92] The authors of this report have met a Gun from Greece who keeps a Range Rover, shotguns and shooting equipment in the UK, in the care of an employee (UK national). When he comes to the UK to go shooting, he is met at the airport by his employee who takes him to the relevant moor, and acts as his loader, driver etc. This employee has no other duties.

4.4 THE SIZE OF THE INDUSTRY

This section examines the published evidence for the size of the driven grouse industry. It will review the evidence for the number of moors on which driven grouse shooting is practiced, and how large these moors are; the numbers of people that are employed by the industry, and its financial value. The chapter will give an idea of the scale of the industry, but also highlight some of the issues that should be accepted by anybody discussing the sustainability of DGS.

4.4.1 NUMBER OF GROUSE MOORS

Many aspects of DGS, like the red grouse itself, are elusive. It is not even clear how many moors are deemed to be grouse moors, those where shooting of grouse takes place. Moreover, some moors only have walked-up shooting, whereas others will host both driven and walked-up shooting. To complicate matters further, driven shooting cannot take place every year on many moors due to fluctuating numbers of grouse.

The Grouse Moor Management Group (Scotland) observed in its report of December 2019 that,

"a major challenge in undertaking this review was the lack of definition of a 'grouse moor' and the absence of official information on the number of estates on which grouse shooting occurs. We estimate that the current number of grouse shooting estates in Scotland is around 120 but note that this includes great diversity in both the size and level of investment in individual grouse shooting businesses." (Grouse Moor Management Review Group, 2019, p.3)

The Moorland Association estimates that grouse shooting takes place on 190[94] estates in England and Wales. Therefore, there would seem to be about 310 grouse moors in the UK on which either walked-up or driven grouse shooting is practiced, or in some cases both forms of shooting (The Moorland Association, 2021b). The Countryside Alliance believes there are 149 grouse moors in England. On the other hand, Animal Aid (a group opposed to shooting) states, "there are about 500 grouse moors in the United Kingdom covering 1.5m hectares. These moors range from Wales and Derbyshire in the South to the highlands of Scotland in the North. An average size moor is 2,000 hectares, while the smallest is 200 hectares and the largest, 10,000"(Animal Aid, 2016). A moor of 200 hectares is unlikely to contain sufficient grouse to make driven grouse shooting possible. Therefore, if the number of 500 grouse moors is taken at face value it must include any moorland where walked-up shooting *might* take place. However, the group Who Owns England claims to have mapped nearly all the 'around 100' grouse moor estates in England (Who Own's England, 2018), a figure which seems low compared with the Moorland Association's estimate of 190 estates in England and Wales, and the Countryside Alliance's figure of 149 grouse moors in England alone.

4.4.2 AREA COVERED BY GROUSE MOORS

Unsurprisingly, given the different claims that exist for the number of grouse moors, the area covered by land on which driven grouse shooting is practiced also not certain. Who Owns England claims that the around 100 grouse estates in England cover an area of c. 550,000 acres. This figure seems rather small

[94] Not all these estates are members of the Moorland Association, but 175 of them are.

when compared with data from other sources. The Moorland Association, which represents owners of moors in England and Wales states that its members are responsible for over a million acres of moorland, over 860,000 of which are upland heather. Since 1999, the Game Conservancy Trust (latterly the Game and Wildlife Conservation Trust, GWCT), in collaboration with the National Gamekeepers' Organisation (NGO), the Moorland Gamekeepers' Association (MGA) and the Scottish Gamekeepers' Association (SGA), has collated a survey of their gamekeeper, stalker and ghillie members. The survey now covers 19,780 square kilometres (4.9 million acres). This area includes 270 estates covering over 11,750 square kilometres[95] of the British uplands which the GWCT divided into groups based on the main quarry species: red grouse only; red grouse and red deer; and red deer only (GWCT, 2021a).

The location of these estates within the British uplands determines, through habitat and species availability, the main quarry species. Estates managed solely for red grouse were mainly in southern Scotland, northern England and Wales. Estates managing both red grouse and red deer were mainly in north-eastern Scotland, with those managed solely for red deer in north-western Scotland. Location was shown to lead to differences in the estates' size and their habitat. Red grouse estates in England were smaller than in Scotland by an average of 300 hectares. In Scotland, grouse moors were roughly half the size (3,300 hectares) of the other two types of estate (7,000 hectares).

The GWCT looked at whether grouse moors coincided with Sites of Special Scientific Interest (SSSI).
It noted that "on average, SSSIs make up 16% of the upland area of Britain, and the shooting estates in our survey covered 15%. Shooting estates accounted for 29% of this upland SSSI area compared with an expected 16% if it were randomly distributed."

4.4.3 NUMBER OF PEOPLE EMPLOYED ON GROUSE MOORS AND VALUE OF DRIVEN GROUSE SHOOTING

Those bodies that conduct surveys and then estimate both the numbers of people employed in driven grouse shooting and the economic value of the industry are, unsurprisingly, organisations that are pro-shooting. As might be expected the conclusions published by the different bodies vary[96]. The situation is complicated by a number of factors; for example, many full-time employees of grouse estates do not spend all their time on activities associated with DGS, and DGS employs large numbers of part-time workers. Answering what might be a simple question for a manufacturing company such as 'how many FTE staff are employed by your business', is more complicated for many estate owners.

The website of the BASC claims that grouse shooting in England, Scotland and Wales supports the equivalent of over 2,500 full-time jobs and is worth in excess of £100m to the economy annually (BASC, 2021). These figures presumably include data for walked-up grouse shooting. However, the Moorland Association claims that "in England grouse moor management creates 42,500 work days a year and is responsible for over 1,500 full-time posts. Of these, 700 are directly involved in grouse moor management, with a further 820 jobs in related services and industries. Keeper staff are employed all year round, irrespective of the season, and additional workers brought in on a casual basis, up to 50 people a day on the bigger moors. Research has shown that associated spin-offs from grouse shooting in the North

[95] 11,750 square kilometres is 1,175,000 hectares.
[96] It is not known what questions the various organisations asked, but it is assumed that they were not identical so different results are not unexpected.

of England are worth in excess of £15 million a year, benefitting a raft of rural businesses. These include game dealers, the hospitality industry, equipment suppliers and transport operators, many of them based in some of the most remote areas. Each year, owners and sporting tenants of our 175 member grouse moors in England and Wales spend a combined total of £52.5 million on land management, 90 percent of which is privately invested." The Association's website also claims that that businesses associated with grouse shooting in England and Wales benefit by an additional £15.2 million a year (The Moorland Association, 2021a).

The situation in Scotland is equally uncertain. In 2010 The Fraser of Allander Institute published its report, 'An Economic Study of Grouse Moors'. The report includes data from 2005-2009 and is drawn from a survey questionnaire sent to a sample of 304 upland estates in late 2009 and early 2010. The report concluded that grouse shooting on those estates that responded to the survey supported a total of 324 jobs, £4.4 million worth of wages and contributed £7.0 million to Scottish GDP. It was projected that, based on these figures, grouse shooting on 140 "core" grouse estates in Scotland is likely to support a total of 493 jobs, £6.7 million worth of wages and contributes £10.7 million to GDP. It was further estimated that if grouse shooting on responding estates reflected grouse activity on these 304 estates, then grouse shooting would support in Scotland a total of 1,072 jobs, £14.5 million worth of wages and contribute £23.3 million to GDP. Of course, not only is this data over a decade old, but it represents survey findings, a projection, and an estimation. Moreover, as the report observed, in 2009 grouse shooting took place on just 81.5% of surveyed estates, and the number of grouse shot had declined by nearly 50% compared to 2001. As noted above, grouse numbers fluctuate (Fraser of Allander Institute, 2010).

4.4.4 CONCLUSION

Hard facts about DGS are elusive. Organisations that are pro- and anti-shooting are unable to say for certain how many moors host driven grouse shooting, how many acres are covered by these moors, how many people are employed by the activity, and what the financial value of the activity is. The key point to take away is that driven grouse shooting is not a constant, consistent activity.

5 SUSTAINABLE DRIVEN GROUSE SHOOTING: THE EVIDENCE

5.1 THE COMPLEX WEB OF GROUSE MOOR MANAGEMENT

A 2020 study considering the impact of management of land for grouse on communities found that rather that being a stand-alone activity, grouse moor management was part of a complex web of economic, social and intangible impacts, as illustrated by Figure 5.1 below (Denny and Latham-Green, 2020). These impacts are in integrated with the many ecological and environmental impacts, including the biodiversity impacts of integrated moorland management, explored in sections 5.3 and 5.4 of this report. Economic impacts are considered in section 5.2 and social and intangible impacts are considered in section 5.5 of this report.

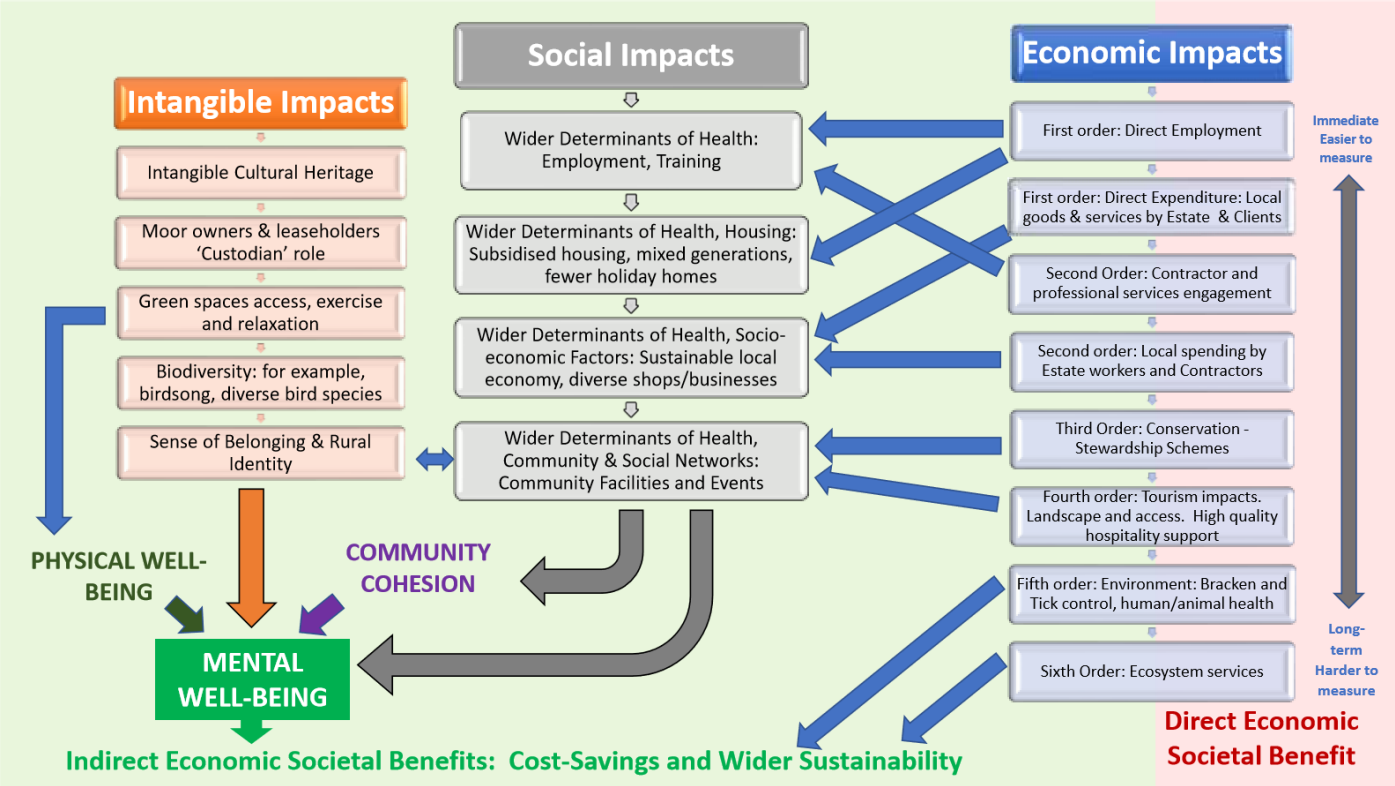

FIGURE 5.1 THE COMPLEX WEB OF INTEGRATED MOORLAND MANAGEMENT SOCIAL, INTANGIBLE AND ECONOMIC IMPACTS

Source: (Denny and Latham-Green, 2020)

5.2 THE ECONOMICS OF DRIVEN GROUSE SHOOTING

5.2.1 INTRODUCTION

There has been much research into the impacts of grouse shooting on the ecology and environment of moorland areas. However, Thomson et al (2018) noted that the existing evidence base for the socio-economic impacts of grouse shooting is relatively limited and dated. Therefore, industry collated and reported data is often cited when discussing the economic impacts of grouse moor management in general and DGS in particular. Cobham Resource Consultants (1992) produced a schematic way of portraying the economic impacts of a number of country sports, see Figure 5.2. The scheme is a useful reference point for this study and can be compared with a more recent schematic produced by McMorran et al (2020) that specifically identified expenditure incurred in a Scottish grouse estate, see Figure 5.3. This latter figure is interesting as it uses a case study approach to identify the recuring costs of DGS. It hints at a key point that policy makers, practitioners and interest groups need to take into account: DGS does not take place in isolation from other land management activities.

However, the Cobham and McMorran schemes do not attempt to identify the social impacts and the value that some of these might have; these aspects were outside the terms of reference of these studies. In addition, the schematics do not consider all the economic factors that can result from driven grouse shooting identified by Denny and Latham-Green (2020). Therefore, this report has wider-ranging criteria for investigation. It is only by examining all the economic impacts of DGS that it is possible to identify whether it is sustainable. In this section of the report, we examine economic sustainability, whether DGS is able to continue over a period of time. The evidence regarding the environmental, ecological and social sustainability of DGS are examined in the following sections.

5.2.2 THE SUSTAINABILITY OF REMOTE COMMUNITIES

Driven grouse shooting takes place in rural, often remote, areas of moorland. Therefore, any consideration of the economic impacts of DGS must consider the economic situation of moorland communities. Asking whether DGS contributes to the sustainability of remote, rural communities is a valid question. Rural out-migration of youth and in-migration of retirees and resultant demographic changes represent a potential threat to the sustainability of rural economies in many rural areas across Scotland (Thomson, 2012) and moorland areas in England. There is often a shortage in affordable housing to buy, and in some moorland communities landowners provide significant numbers of housing units. Pressures on the land resource, and the very wide set of stakeholder interests in land, can also lead to conflict, illustrated for example by regular contentious debates around windfarm proposals at local, regional and national levels (Warren et al., 2005). However, as noted above, comprehensive assessments of the economic and social circumstances of rural moorland communities are few in number.

A report by the British Association for Shooting and Conservation (2009) into the impact of grouse shooting on the ecosystem reviewed existing research and suggested that there were positive economic and social impacts on communities. However, these impacts were unspecified and unquantified, and no attempt was made to compare individual communities. It concluded that landowners and managers of grouse moors invested time and money into their moorland and that this investment 'has many benefits, including socioeconomic support for upland communities, decreasing the likelihood of rural depopulation and helping the UK reach and maintain its conservation objective' (BASC 2009, p.2). However, BASC has the mission of

promoting and protecting sporting shooting and advocating its conservation role throughout the United Kingdom. Therefore, its reports are open to allegations of bias by those opposed to game shooting.

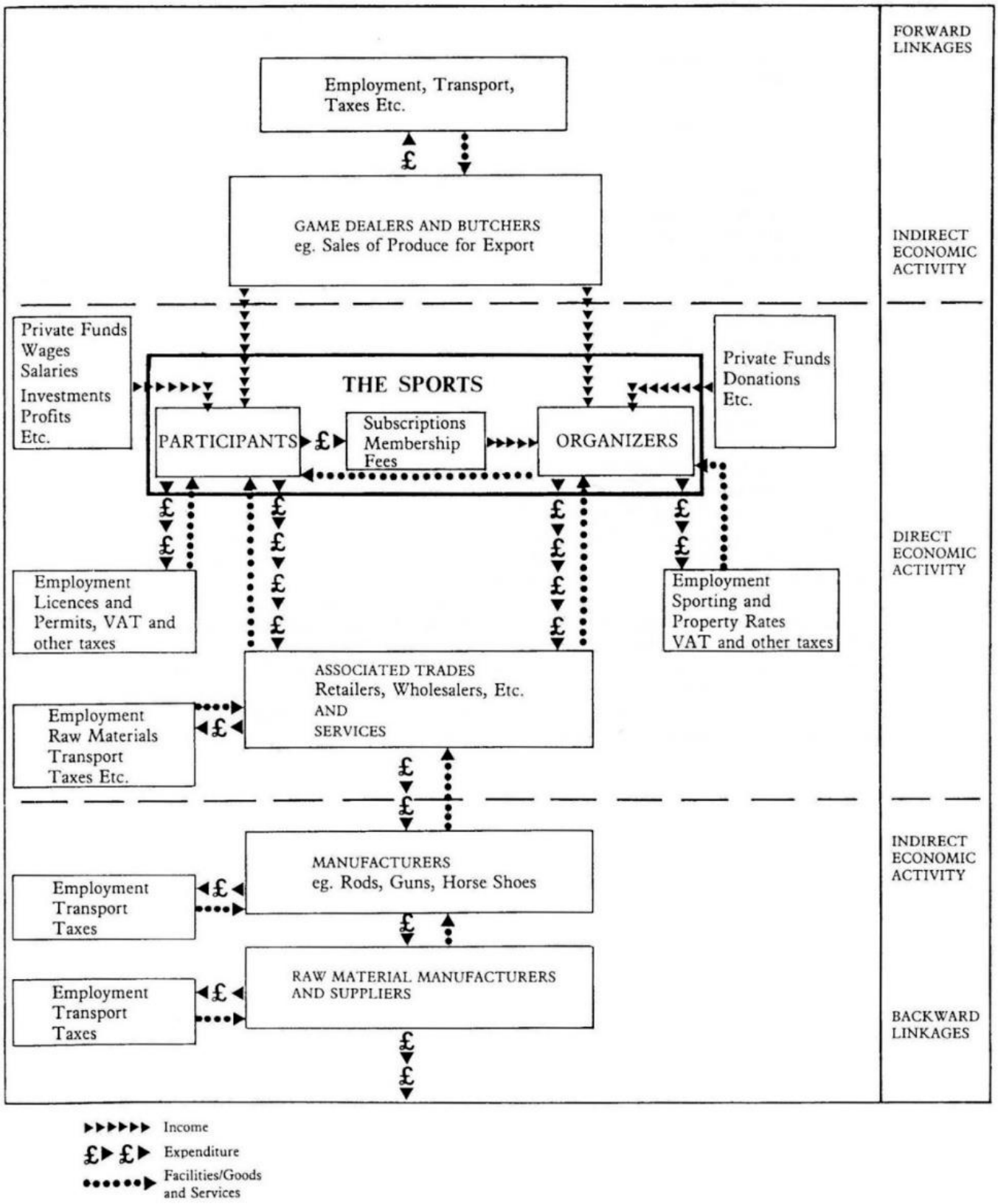

FIGURE 5.2 SIMPLIFIED STRUCTURE OF RELATIONSHIPS BETWEEN THE INTERESTS INVOLVED AND THE PROVISION AND PURSUIT OF COUNTRY SPORTS, ILLUSTRATING THE TYPES OF ECONOMIC ACTIVITY GENERATED (COBHAM RESOURCE CONSULTANTS, 1992).

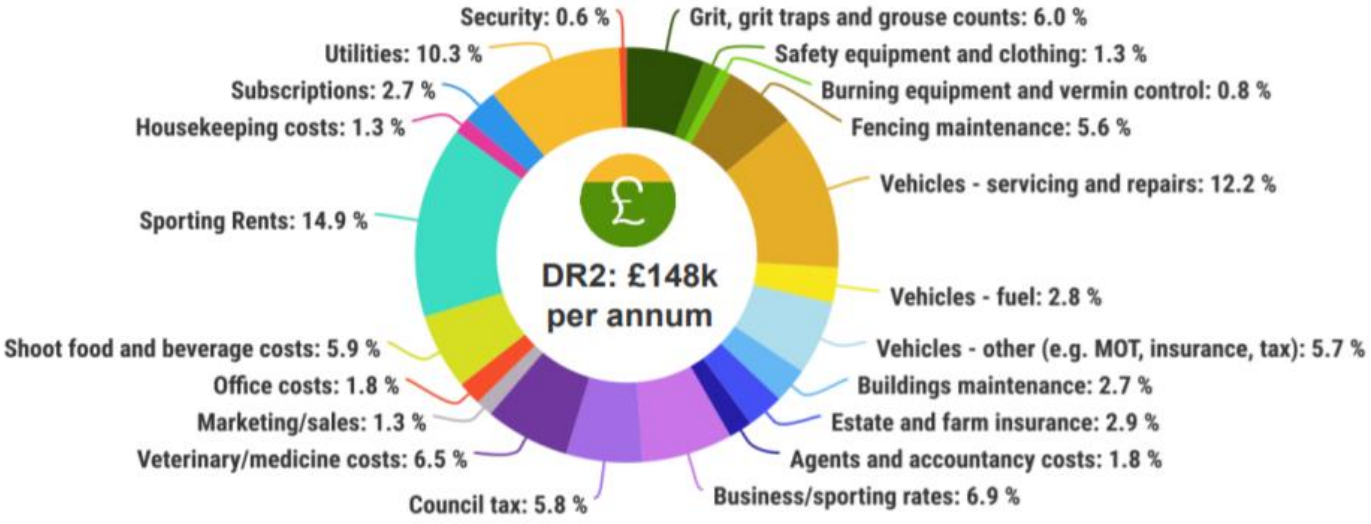

FIGURE 5.3 DETAILED BREAKDOWN OF RECURRENT EXPENDITURE DIRECTLY RELATED TO GROUSE SHOOTING ON A SCOTTISH ESTATE (MCMORRAN, THOMSON AND GLASS, 2020)

McCann (2018) points out that in searching for economically viable alternatives to DGS in the UK uplands, results were limited. Suggestions include forestry[97] and ecotourism. When looking into the revenue generated from alternatives such as snow sports, water sports, nature tourism and horse riding, it was found that country sports (i.e. shooting and fishing) contributed more to the economy than all of these other uses (Bryden et al., 2010; Public and Corporate Economic Consultants (PACEC), 2015). However, this study did not aim to identify the impacts of country sports at the community level but made national comparisons.

There have been several recent reports investigating the overall importance of grouse shooting in Scotland. The Grouse Moor Management Review Group in Scotland, chaired by Professor A. Werritty and reporting in 2019, identified that the most recent and detailed summary of past research to date was the Scottish Government's report *Socioeconomic and biodiversity impacts of driven grouse moors in Scotland* (Thomson, McMorran and Glass, 2018). Werritty recorded that, with some qualifications, the report states that, on the basis of the existing database, in 2009 the grouse moor sector supported around 2,640 FTE jobs (both direct and indirect) with £14.5 million spent on wages, grouse moor management and support services. This yields a total Gross Value Added £23 million contribution to the Scottish economy annually, concentrated in rural areas where there are considered to be few other economic opportunities. More recent data collected by the Scottish Moorland Group suggests that more intensively managed estates have an average annual wage

[97] The report of the Grouse Moor Management Group pointed out that at present (2019), as a *result of grants or subsidies*, the afforestation of moorland, where feasible, is more profitable for the owner than retaining the moorland for Red Grouse https://www.gov.scot/publications/grouse-moor-management-group-report-scottish-government/pages/3/

bill of £210,000 and support suppliers (often rurally located) with around £515,000 of annual expenditure (Grouse Moor Management Review Group, 2019).

In contrast with the overview, large-scale, reports of Werritty, BASC and the Moorland Association[98], McMorran has conducted two detailed primary research studies of the benefits and impacts of grouse shooting on community residents.

McMorran (2009) studied in detail a community located in an area of Scotland where grouse shooting is a key local industry, to examine the impacts of the activity on community residents. While the study did not compare the case study community with other communities not involved with grouse shooting, it demonstrated that there were often substantial socioeconomic benefits resulting from the activity at the local community level. McMorran concluded that grouse shooting made a very significant contribution to the local economy, in terms of employment and benefit for local businesses.

McMorran surveyed 252 households, containing c. 560 people. He had 113 responses to his survey, equating to 20% of the total population and 37% of households. As grouse shooting was a major activity in his case study area, 51% of respondents lived on estates involved in shooting, while 49% did not. Of the respondents, 10% were employed in the game industry. However, 18% said their livelihood depended on the grouse shooting. The analysis of survey responses enabled him to identify both individual and community impacts of grouse shooting, which can be summarized as follows:

- 40% of respondents said they received positive impacts as individuals such as employment, income for business, rural in-migration, and attractive landscape.
- 18% of respondents said they received negative impacts as individuals such as impact on some wildlife, restricted access, noise and smoke at certain times of the year.
- 81% of respondents said the community received positive impacts such as employment, income for businesses and the local economy, rural in-migration, and environmental improvements.
- 17% of respondents said the community received negative impacts such as impact on some wildlife, risks to public safely, disturbance (when shooting or muirburn was in progress) and an unquantified negative impact of having absentee landowners.

Interestingly, none of the negative impacts claimed for individuals or the community were economic or social (with the possible exception of aspects of having absentee landowners). However, the positive benefits cited by respondents were heavily weighted on the economic and social impacts of grouse shooting. All the businesses surveyed by McMorran felt that they benefited to some degree from grouse shooting, with shooting parties being an important seasonal source of revenue. However, more important than the shooting parties were the gamekeepers employed on grouse moors (and their families) as they were customers of local businesses throughout the year. People living and working in the community spent more money locally than those working outside the community. Grouse shooting was also regarded by respondents as a vehicle to counter the out-migration of young community members and their replacement by older people retiring to the area.

McMorran identified that although other activities such as tenant farming, tourism businesses, forestry, fishing and deer stalking were present on some of the estates in his case study area, on almost all of these

[98] The Grouse Moor Management Review Report, BASC and the Moorland Association reports are all summaries of existing research. They did not involve primary research.

estates grouse shooting and grouse moor management constituted the single most important estate activity and management objective.

McMorran et al (2015) studied two areas of northern Scotland where grouse shooting was carried out, the north-eastern Monadhliath Mountains and the Angus Glens. As in his 2009 study, the survey results revealed that community respondents perceived individual and community positive and negative impacts resulting from grouse shooting. The employment generated by grouse shooting, and income for local businesses, were highly valued. Other direct and indirect impacts of the grouse shooting industry on local businesses were evident in both his study areas, including use of local accommodation. Additional examples included spend by estates, estate staff and/or estate customers in garages, vehicle dealerships, sporting goods suppliers, butchers and on local tradesmen. The year-round presence of gamekeepers and their families was regarded as economically important to the communities, and had social impacts including the contribution of children to school rolls. The continued presence of workers directly employed in grouse shooting was particularly important in years when grouse numbers were low, and shooting was consequently limited. In addition, many respondents said that that grouse shooting brought about the long-term provision, improvement and maintenance of infrastructure. This included housing, roads, buildings, fences and walls, as well as the development and maintenance of hill track networks which can be used by locals and visitors (Glass, Bryce and McMorran, 2015).

The findings of this 2015 study demonstrate a wide range of direct and indirect socio-economic impacts. Both of the study areas were, like many moorland communities, remote from cities and large towns. The impacts of grouse shooting are likely to be disproportionately significant in such areas. However, in neither the 2009 nor the 2015 study did McMorran and his co-researchers attempt to compare shooting and non-shooting communities, nor was any judgement made on the sustainability of DGS[99].

McMorran *et al.* (2013) studied the economic activities that landowners in the Cairngorms National Park (Scotland) carried out on their land. Table 5.1 summarizes the economic activities reported, together with details of income and expenditure provided by respondents.

[99] Such a judgement was outside of the terms of reference of McMorran's study.

Economic Activity	No. of landholdings involved	Income £	Expenditure £	Remarks
In-hand agriculture	28	6 million +	3.9 million	44% of income from public support payments and grants
Tenanted agriculture	30	1.3 million	1.35 million	1.1 million of this income was from farm rents
Forestry and woodland management	44	2.3 million	2.6 million	39% of income from planting and management grants
Sporting land uses	41	4.4 million +	6 million	No subsidies or grants received
Conservation management	30	1.1 million	1.9 million	£713,250 income sourced from public grants
Residential property	38	1.6 million	2.1 million	Barriers to further development included lack of grants to refurbish properties
Commercial property	11	533,000	137,000	High income to expenditure ratio. 66 business tenants on the 11 landholdings
Tourism or leisure, including retail	32	9 million	5.7 million	Retail income from seven landholdings produced 3.1 million income

TABLE 5.1: ECONOMIC ACTIVITIES, INCOME AND EXPENDITURE, IN CAIRNGORMS NATIONAL PARK

McMorran et al. (2013) showed that landowners (individuals rather than communities) can generate profits from commercial property rents, and from some tourism and leisure activities, especially if income from retail units is included. However, other economic activities in the Cairngorms were either carried out at a loss to the landowner or, in the case of in-hand agriculture, only generated a surplus due to public support payments and grants. In-hand agriculture, forestry and woodland management, and conservation management were economic activities that required significant payments of tax-payers money. In contrast using land for sporting purposes did not attract grants but, despite being a loss-making activity, was practiced on 41 landholdings. As Thirgood et al. (2000) pointed out grouse shooting is one of the few uplands land uses which is not directly subsidised by the government.

5.2.3 ECONOMIC IMPACTS

"Grouse moor owners put a lot of money into their estates, and most don't run at a profit. There is a well-known phrase, 'how do you get £1 million by running a grouse moor? Start with £2 million'!! That sums it up."

(Andrew Green, Managing Director, Green's of Haddington, 25 May 2020[100])

"The majority of grouse moor enterprises are not profitable but still contribute significantly to the local economy even in a season when there is no shooting".

(Grouse Moor Management Review Group, 2019)

A number of claims are made about the economic impact of grouse moors. The GWCT[101] cites the report 'The Value of Grouse Moor Management' which indicated that grouse moor owners in England spend £52.5 million every year on grouse moor management. The report also indicated that businesses associated with grouse shooting benefit by £15.2 million every year. These include game dealers, accommodation providers, equipment suppliers, catering establishments and transport operators. The GWCT points out that many of these businesses are in economically Less Favoured Areas in remote rural locations which depend on grouse shooting as the main economic driver outside the tourist season. It is claimed that grouse moors in England support 1,520 full time equivalent jobs. 700 of these are directly involved in grouse moor management, and a further 820 jobs are in related services and industries. As noted above, the Moorland Association's website, citing the same report, suggests that the owners and sporting tenants of its 175 member grouse moors in England and Wales spend a combined total of £52.5 million on land management a year, of which 90% is privately invested[102]. All of these organisations are, of course, regarded as supporters of well-managed and legal shooting, and consequently their claims are dismissed by some groups and individuals.

In August 2020 the Uplands Partnership published a report entitled 'What impacts does integrated moorland management, including grouse shooting, have on moorland communities' (Denny and Latham-Green, 2020). That report, authored by the research team that produced this report, gathered primary data by carrying out 61 semi-structured interviews with people involved, directly or indirectly, with DGS; and, importantly, people that lived in areas where DGS took place, but who were not involved in the activity. This dataset differs from that of McMorran et al (2020) and other studies by including people that had nothing to do with grouse shooting[103].

As part of the analysis of the data gathered from interviewees (n = 61) for the 2020 report, the authors isolated examples of economic impact that were described by the interviewees. It is fair to say they were surprised by the range and depth of the economic impacts described. The economic impacts identified are, inevitably, linked and part of a holistic whole. However, they were able to identify six different economic

[100] Name of interviewee given with his permission.

[101] See p.42 in 'Moorland Conservationists: The Untold Story' GWCT (2020)

[102] https://www.moorlandassociation.org/grouse-shooting-economics/

[103] McMorran et al (2020) conclude that, "grouse shooting can generate significant economic impacts for communities, with impacts localised and disproportionately important in regions where grouse shooting is most prevalent."

impacts, only two of which are cited by the GWCT and the Moorland Association. Therefore, it is suggested that this economic impact model is more complete than that developed by previous studies.

To illustrate the range of economic impacts described, they were divided into several levels, or orders, based on how immediately they were delivered, and how easy they were to measure. The schematic shown at Figure 5.4 was developed to display the impacts. The lower order (fourth, fifth and sixth level) are not simple to measure, but they need to be included to reflect the symbiotic and integrated nature of the economic effects of managing a moor for grouse. The schematic highlights a key point: economic impacts and sustainability are not capable of being reduced to a single, simple figure. Simply comparing the money spent by an estate on providing driven grouse shooting with the income it gets from Guns paying to shoot grouse does not measure economic impact, and certainly does not measure sustainability. It is also important to highlight that some of the economic orders identified overlap with environmental and ecological benefits. This overlap is explored further in section 5.4.

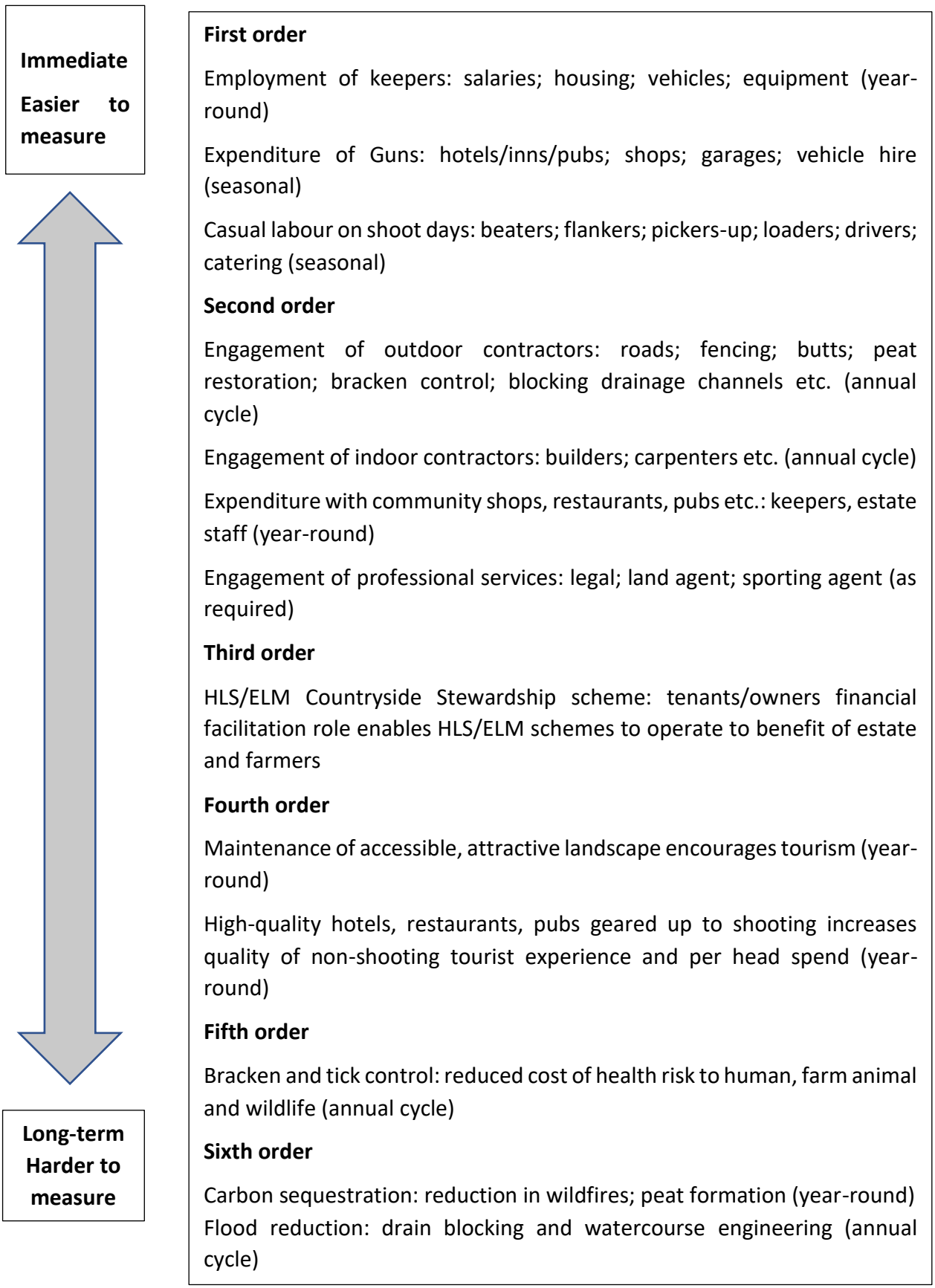

FIGURE 5.4 SCHEMATIC SHOWING ECONOMIC IMPACTS OF INTEGRATED MOORLAND MANAGEMENT, INCLUDING GROUSE SHOOTING.

> *"I cannot think of any activity that could take place on the moors that generates anything like the income that grouse shooting does. Walkers, bird-watchers, cyclists are welcome to use the moor, but they all do so for free. When they go into the local villages, they buy some meals and normal tourist stuff, but don't spend heavily like the shooting parties."*
>
> Land Agent

The first order economic impacts are those directly resulting from the activities involved in the shooting of grouse; the employment of keepers (the great majority of which are employed full time) and the engagement of casual labour in the form of beaters, loaders, pickers up, drivers, caterers etc. Included in this first order impact is the money spent by people shooting (the Guns), both the money they pay to the estate, and the money spent with local hotels and businesses during the season. This report does not set out to estimate the total value of this first order economic impact in the UK[104]; we do not intend to replicate the work of earlier studies. However, we will examine a few case studies that illustrate the scale and importance of first order economic impacts to remote moorland communities.

As noted elsewhere in this report, and by Thompson et al (2018) and McMorran et al (2020), estates do not solely depend on grouse shooting for their income. They have a number of income-generating activities, integrated with each other and often co-dependent, which combine to produce the classic moorland flora and fauna. Most of these activities attract subsidies, with the exception of grouse shooting, and the income from grouse shooting is vital to many estates. A farming estate owner in North Yorkshire provides an interesting case study.

> *"If we look at the economics of my moorland, each ewe will have on average 1.5 lambs, worth £40.00 each in the market. So, each ewe can produce £60.00 income. You can have one sheep on four acres of moor without doing damage to the land. You can have a pair of grouse on four acres, and they average six or seven young. Their value is £80 – 100 a bird each. For a thousand acres of moorland, you can earn c. £15,000 from sheep, or c. £120,000 from grouse. On a well farmed moor grouse provide a much better return. In addition, whereas for every 1,000 ewes you need one full-time worker; you need a full-time worker for every 500 brace of grouse. Because grouse produce a good return, you employ more staff, and they have families and live locally. Cattle are less profitable than sheep due to overheads such as silage, sheds, machinery etc. However, cattle improve the land for ground-nesting birds including curlew, lapwing, woodcock. Cattle work brilliantly as part of an integrated system."*
>
> Farmer and estate owner, North Yorkshire

The amount of money estates earn from grouse depends on the numbers of grouse available to shoot (and in some years there may not be any), and how much they charge the Guns. Most of the money charged for shooting goes to pay the wages of the gamekeepers and the costs of their housing, vehicles and equipment. As we describe elsewhere in this report, most estates do not set out to make a profit from shooting grouse and the owners or tenants are investing their own capital into the activity, a point confirmed by the report

[104] Given that DGS does not take place every year due to fluctuations in the grouse population, there is no such thing as a 'typical year's' expenditure.

of the Grouse Moor Management Group. This Group surveyed the economic impact of grouse shooting based on detailed information from 16 Scottish estates (3 walked-up and 13 driven). The key findings were:

- Only one grouse enterprise made a small profit; all the rest were loss-making and reliant on substantial private investment;
- The average investment (revenue and capital) was £183 per ha across the estates. This compares with a typical sheep farming business of £50 per ha, but which includes approximately £25 per ha of public subsidy;
- On the 16 grouse moor estates that provided information, the average labour unit was 1 FTE gamekeeper per 704 ha, compared one FTE shepherd per 4,046 ha;
- Capital expenditure, often high in the first 5-10 years, can make significant contributions to the local economy;
- On driven grouse moors, the employment of casual labour to help with the shooting activities can be significant to the local economy, with shoots often employing up to 100 casual staff over the whole season with approximately 30 employed on each day of shooting throughout an average season[105].

McMorran et al (2020) reported the results of detailed case studies of four Scottish moors where driven grouse shooting takes place, when grouse numbers permit. The average capital investment specifically related to grouse shooting was £59,096, and the four estates spent £418,000 on running costs for their collective grouse enterprises, excluding staff costs. Across the four estates the average cost of running sporting enterprises was £45 per hectare. However, the average earned revenue only covered 58% of running costs and in all cases sporting activities were loss making, with an average net business cost of £19 per hectare that other estate enterprises or owners needed to fund. Importantly, over a five-year period, 95% of capital expenditure by the four estates was local or regional; and annual grouse-specific recurrent spending was on average 71% local or regional.

People that want to shoot grouse (the Guns) spend money not only with estates, but also with local businesses. In many cases their expenditure is vital to the local community. A moor owner in Northumberland described how on a shooting day he has nine Guns, who come from throughout the UK as well as the USA, Germany and Italy. The guns typically stay in six or seven local hotels.

> *"The (Name of Hotel) in (Name of village) is a key local hotel for shooting. it is owned by a charity which lets it to a firm that runs a number of hotels aimed at shooting parties."*

This hotel is also used by Guns shooting with another estate owner who said,

> *"Guns stay in local hotels, such as the (Name of Hotel). Without shooting the local hotels would struggle. They are normally completely booked by shooting parties from 11 August to October. (Name of village) is small and quiet. It is a much more social place during the season. Shooting is a key part of social life for many locals. There is no local hostility to shooting, it is absolutely integral to the area."*

[105] The numbers of people taking part in a day's driven grouse shooting does, of course, vary. On some shoots the number of people employed could be as many as 50 or even 60 on a single day.

Other hotels and inns earn substantial income from shooting. A farmer in North Yorkshire said,

> *"there are nine guns shooting on a day on my moor. One or two teams come from abroad each year. The guns stay in the local pub, the (Name of Pub) at (Name of village), which is a big shooting pub."*

When interviewed, the landlord of this pub explained how important shooting parties were to his business.

> *"I set out to run the inn so it would be used by the shooting community. When I took the pub over there were six bedrooms, there are now 15. The cost is £90.00 per night, plus food. There is an extensive evening menu designed for parties of 10 – 12. As well as me and my wife, I employ six chefs and up to 30 other staff at the height of the shooting season. I try to employ locals wherever possible. In a typical year 30% of my business from August to September is shooting parties, and it is at least 20% of the business from October to January. Keepers use the pub all year round. I am the biggest employer in (Name of village) and the biggest hotel or inn for 10 miles in any direction. (Name of village) has about 500 people; apart from the (Name of pub), there is a shop cum Post Office, but it is only open part time. I work with a number of shoots. The (Name of pub) is a destination inn for shooters, and is geared to up help people have a great time shooting. The staff understand the needs of teams of guns, it gets them away in the morning, half the rooms allow dogs and I liaise with team organisers. If there was no shooting, life would be tough. There are walkers and tourists, but they don't spend as much as shooting people. Without shooting or tourism, there is no point in (Name of village), 2018 was a tough year because of the low grouse numbers, I took on many fewer staff."*

Grouse shooting is expensive. Many people that want to shoot grouse also want to indulge themselves by booking luxury accommodation. Two owners of luxury-country house hotels in North Yorkshire gain significant income from shooting parties. One owner explained,

> *"I have six or seven let days on the moor a year, and typically for each of these days nine guns will stay in the hotel for two to three nights. Shooting accounts for c. 140 bed nights a year*[106] *in the castle, and another 50 – 60 room nights in other hotels and inns. I also provide catering on the moor for the guns and beaters. The overseas grouse teams are especially big spenders. It is very high-end tourism". The other country house-hotel owner remarked, "I am in the sales and marketing profession. I charge a team of guns (normally eight people) a price for the house of £3,500 + VAT per day. Many teams also bring wives, partners etc. In a good year I will sell 35 – 40 days, in a moderate year perhaps only 32. In 2018, a bad year for grouse, I only sold 25 days.*"

To operate these two enterprises, over 150 full time staff are employed in a normal year. Both of these country house hotels are in locations that have no major industry or employers and are thus very important to the economy of their moorland area.

Grouse shooting attracts many Guns from overseas whose expenditure is equivalent to export earnings. The second of the country house-hotel owners cited in the previous paragraph points out,

[106] At a cost of c. £250 per head per night, plus food

"overseas guests account for about 60% of my business in August, and at least 50% of it in September. They bring big money into the UK as they also spend lots of money locally. In the North York Moors and the North Pennines, foreign clients account for about 80% of the Guns in August and about 70% in September. The amount of tourist dollars spent is massive. Teesside Airport is probably only open because of private jets coming in for the shooting season".

A moor owner in Northumberland also mentioned Teesside Airport,

"Guns fly into Teesside Airport in private jets, they hire vehicles and drivers, they stay at local inns and hotels for two or three nights. Many of them bring wives or partners who go spend money locally in Durham or places like Bowes Museum. A vast amount of money is spent."

The owner of a very large estate in Scotland agreed that overseas clients are important,

"a lot of teams of guns come to Inverness Airport each season. They spend money with taxi firms, car hire firms, caterers, laundries and contractors. The Guns are international." He made the point that, "the red grouse is one of the few animals that is indigenous to the UK and the UK alone. We need to look after them. The UK is unique for the volume and quality of its gamebird shooting. We do it in a much more professional and smarter way than the USA, Spain, France or Germany. They don't have the tradition of gamebird shooting we do. It is a great story and it is undersold. We are the Rolls Royce of game shooting. The Americans are over-awed by the formality and professionalism of our moors. Of course, there are some poor shoots, but good ones are excellent and it is not found anywhere else. We have something here that is not replicable."

A sporting agent described the impact made by one US citizen that rented the shooting on a North York Moor for 20 years.

"Each year the client and his invited Guns stayed in (Name of village), in the (Name of hotel). The hotel provides top class service. Earlier in the season the Guns would be mainly US citizens, and UK teams would be on the moor in September and October. The client took over the (Name of hotel), he had a suite there for his personal use for much of the year. There would typically be nine guns staying for six days at a time, then another team would come in the next week. Guns would be collected from airports in locally-hired Range Rovers driven by people from the village. (Name of the shop) a sporting clothing and tailors in (Name of village) did very well from the invited guns. Many of the Guns got very enthusiastic about the grouse shooting experience. They would not dream of appearing on the moor without appropriate clothing. Many of them ordered bespoke tweed shooting suits from (Name of shop). They spent vast amounts of money in (Name of shop)."

The estimated spend on hotel accommodation alone each year, in just one hotel, was over £75,000.

Some overseas nationals do not lease moors, but own them. A land agent gave the example of a moor that was bought over 35 years ago by an international buyer. He said,

"He (the owner) employs over 20 full-time staff, mainly keepers. He also employs lots of staff in the shooting lodge. It is only the family that shoot, there are no let days. On a shoot day there will be over 50 local staff beating, loading, picking up, driving etc. There are normally

10 to 12 shoot days a year. He pays for 600 – 700 man-days employment a year, as well as the 20 full-time keepers and the house staff."

The moor is in a remote area of Northumberland.

A day's driven grouse shooting involves more people than the Guns. As noted in section 4.3, on a typical driven day there will be people employed as beaters, flankers, pickers-up, loaders, drivers, and caterers. The numbers of these casually employed staff may vary by estate and by the time of year. Many moors maintain the same number of beaters through the season; others decide they need more beaters in August than they do later in the season. The amount of money spent over a season on casually employed staff varies; we were given examples ranging from £60,000 to over £100,000. The ages of those involved in a day's shooting ranges from teenagers to (very) old-age pensioners. Most casually employed staff are local (within an hours' drive, which in moorland areas is less than 30 miles) although people come from some urban areas such as Middlesbrough, Tyneside and Ashington in Northumberland (which was mentioned by several interviewees as a town with a long tradition of supplying beaters to estates up to 60 miles away). A sporting agent gave an account of the numbers of casually employed staff on one moor in the North York Moors National Park,

"During the grouse season the number of people out on a shooting day, excluding the Guns, was 60 to 70. There were about 20 days shooting a year if grouse numbers permitted. There would be about 50 beaters, each getting £50 a day and 10 pickers up each getting £100 a day. Lunches were done by a local farmer's wife who charged £500 a day. The Guns had their personal loaders who would stay in a local pub for six to eight weeks during the season. The client paid for everything, apart from beer. The bill for loaders was another £8 – 9,000 a year."

A hotel owner described the impact that the grouse shooting season has on the Yorkshire Dales,

"Tourism in the Dales is seasonal. Out of season there is a very slow pace of life. All the estates have keepers and they are up and about all year on the moors, it is an isolated life. Prior to the season the entire community gets excited; young lads look forward to going beating; pubs, hotels and shops are all gearing up for business; the whole place looks forward to getting involved with and benefiting from shooting.",

The money earned from casual employment on the moors can be very important to local residents. A chartered surveyor[107] described how he met a man working his dogs on the moor and recognized him as the person who had run the outdoor clothing shop in Appleby[108] for years. The man said how his shop closed due to online competition. He now works his dogs and gets the same income (c. £20k p.a.) as he had when he was running the shop as he now has no overheads. The ex-shopkeeper claimed that without his income from working his dogs on shoots, he would either have to take a job in a supermarket or move for work. The chartered surveyor then observed,

"If you think about it, golf gives nothing to the community. You go to the course, play a round, drink in the bar and go home. It doesn't involve lots of locals, it doesn't spend big money in the local shops[109]. Shooting is different, it gives a lot to communities."

[107] Interviewed on 21 May 2020

[108] A town in Cumbria

[109] However, most people that play golf live in the locality of the club, so they will spend money in shops etc. What driven grouse shooting can do is provide significant external income to a (often remote) community.

It is very obvious that the first order economic impacts are large and, we suggest, under-estimated by previous studies. Moreover, the cash and employment generated by these impacts can have a very great importance to remote communities where there is limited alternative employment.

SECOND ORDER

> *"If there was no grouse shooting lots of local businesses would go bust; contractors, carpenters, caterers and garages for a start. There would be a very big impact on the rural economy".*
>
> Managing Director, bracken control business

The grouse shooting season normally lasts no more than two and a half months. However, managing a moor so that shooting can take place is a year-round activity. Estates are significant economic entities that do not only run grouse moors (McMorran et al 2020). They also generate income from other activities including agriculture, forestry, alternative energy, property and land rental. An owner of one estate in North Yorkshire installed a small hydro-electric power (HEP) plant on one of his water courses which generates electricity sold for c. £40,000 p.a.[110] Interestingly, this sum is almost exactly the same as the income he gets from 1,200 sheep. However, the forestry on the estate generates no profit. He pointed out that,

> "*Like all farmers, I can get subsidies for most of my activities, farming, HEP, and so on, but there are no subsidies or grants for shooting, which is the only income-generating activity in moorlands that is not subsidised. Shooting is 'one of the legs on the chair' that keep this estate going and allows me to employ local contractors."* [111]

Similar to the farmer quoted in the preceding paragraph, most estates employ local contractors all year-round, for both outdoors and indoors work. An estate owner in North Yorkshire said,

> *"The estate is a big user of local contractors, for both inside and outdoors tasks, so indirectly it is a big employer", and a Scottish land-owner added, "The (name of) estate is a big local purchaser from contractors and suppliers of all sorts".*

The money spent on contractors can be considerable. The owner of a moor in Scotland, which has been in his family since 1919, said,

> *"I do my accounts each year. My estimate is that I put about £800,000 p.a. into the local economy because of the estate. This sum includes money spent on moorland roads, the keepers, their houses, vehicles, the sheep (which have to be wintered on low land in Fife, miles away from the moor), contractors and so on. The money paid to beaters etc. would only be about £80,000 of the total investment, about 10%. Money is spent throughout the year, not just in the shooting season."*

The CEO of an estate in Durham offered a similar example when he commented,

> *"The family, and the tenant, put a lot of money into the management of the moor. The tenant has just spent hundreds of thousands of pounds to renovate properties for the keepers. The*

[110] McMorran et al (2020) report that three of the four estates they studied where driven grouse shooting took place had installed renewable energy schemes (five hydro and one wind farm). The income from these schemes was used to offset losses incurred from other estate activities.

[111] All quotations are taken from Denny and Latham-Green (2020)

owners and sporting tenants (on this estate) are very high net worth people[112]*. The moors are their passion, they invest and local people benefit."*

Grouse moors also attract significant annual investment from rich foreigners[113]. An agent that had managed an estate on the North York Moors for 20 years, on behalf of an American tenant pointed out,

"The client was very wealthy and he wanted the moor to be right. I reckon he spent £40,000 p.a. on road building, and £50,000 p.a. on casual labour for the other tasks, excluding beaters. In addition, vehicles were hired from local companies all year round."

The work done by agricultural and moorland contractors is extensive. In spring and early summer, roads are upgraded. The North York Moors estate the agent (cited in the quote immediately above) managed is on a sandstone bedrock and needed to be continually resurfaced at a rate of about 25% of total road length p.a. The contracting work on roads was usually carried out by local farmers, and involved four or five people, five-days-a- week, for about six weeks. Interestingly, much of the work done was carried out by local farmers after the lambing season, providing important extra income to them. In early summer the butts have to be maintained or built. Modern wooden butts are made in sections off-site by a carpenter, and then assembled in place on the moor by a construction team consisting of a carpenter, driver, fork-lift driver and two others. They would work under the guidance of four keepers. To complete the annual outdoor cycle, from October to April, three or four farmers would be employed (when conditions were right for controlled burning) to work with the keepers to burn the heather to ensure it could regenerate both for sheep and grouse. As health and safety has become more important, more people are required to manage the burning, and more machinery is used.

The operations manager of an agricultural contractor described her company's work.

"The company's customers are North Pennines AONB, Natural England[114]*, and estates. The estates are by far the biggest customers. Shooting estates are essential clients, they are a huge part of the company's revenue. The work the company does includes access track maintenance, stone butt repairs and building, wooden butt repairs and building, fencing, bracken control, heather maintenance, moorland restoration, drainage, spring-head clearance. The main income generator is bare peat restoration*[115]*."*

Nearly all estates use health and safety advisers to ensure the work carried out through the year complies with relevant legislation. The managing director of a health and safety advisory business which works with shooting estates from the North of Scotland to East Anglia, as well as hundreds of non-shooting businesses, stated

"On a grouse moor we will look at all land management practices, including road maintenance and condition, butt construction and use, burning, fencing, bracken control, management of wildlife, worming and gritting of birds, personal safety for staff with ticks, sheep dipping, forestry and so on."

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[112] Not all moor owners are equally wealthy.

[113] Money spent by foreign tenants is equivalent to export earnings in that foreign money enters the UK economy.

[114] There is a National Nature Reserve at Moor House, see http://www.exploreteesdale.uk/national-nature-reserve

[115] See the Sixth Order of economic impact below.

There is a strong market for grouse. Whereas some pheasant and partridge shoots struggle to find a market for the birds, grouse command a premium price[116]. To meet the demand for grouse, game dealers operate substantial businesses, normally in remote areas. A dealer from North Yorkshire explained,

> *"I employ eight staff from August to March; some are local but three Poles have been coming over for years. They live in static caravans on the site and can earn £15,000 over six months, much more than they can earn in Poland. I collect birds from over 60 moors, on the day they are shot. I have four vans and each one will do over 30,000 miles over the six months of the shooting season. My waste disposal bill alone is £1,000 a week during the season and I buy in over 10,000 plastic boxes each year for packaging the birds. In a good grouse season, I spend over £100,000 on couriers to get birds to UK customers. In addition, grouse are exported to France where there is a strong demand. (Name of company) is one of only two businesses in this Dale. If I closed, people would be able to find work, but they would have to travel a lot further. The money generated by grouse shooting is important. Most owners do a lot to maintain their property, the moor and the houses etc. for the keepers. The money pumped into estate infrastructure is huge, and lots of people in the community are employed."*

An important element of the second order economic impact results from the staff that estates employ. The 15 estate owners based in North Yorkshire, Northumberland and Scotland that were interviewed for this study employ between them c. 80 keepers and c. 175 other full-time staff[117]. All of these people live, many with their families, in remote (in some cases very remote) areas. A land agent pointed out,

> *"The keepers are in the community all year round. They spend money there, their children go to school locally. In an estate I know well, the keepers run charity events, cut the grass in the public areas of the village, and organize social gatherings before and after the shooting season. The shoot Christmas dinner is the biggest social event the village has with over 80 people attending. The estate employees keep this village going."*

A retired vicar also highlighted the importance of the year-round presence of estate staff to the community in Northumberland that he had just (in May 2020) retired from.

> *"The parish has a charity shoot every year that raises between £40,000 – 65,000. A lot of the money goes to local causes like the maintenance of the village hall and the church. (Name of village) is quite feudal, it is an estate village so the doors and window frames are the same colour. Rents are very low so it still has affordable homes. Therefore, young people can stay in the village. The (estate owning) family take their responsibilities very seriously. The village school is kept going because estate staff and young people can afford to live there and their children go to the school."*

The vicar commented on how the economic and social impacts of the estate were inter-twined,

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[116] The claim made in an email Wild Justice sent on 18 June 2021 (urging its supporters to contact their MPs in advance of a debate by the Petitions Committee on whether DGS should be banned) that, "about half a million Red Grouse are shot in a typical year – few of them are eaten – it's just shooting for fun" is bizarre given the market for grouse.

[117] These estates employ more than the average number of staff. They are cited as examples as they illustrate the size of some estates. Estates can be very significant economic entities in remote, upland areas.

"Everybody in the village knows everybody else. When coronavirus started, I set up a 'buddy system' through the church. In the village everybody was included, whether they went to church or not. It is paternalistic, but it works. It is a fantastic community. People are resilient and resourceful. Because it is remote, people just cope with problems; if you lose your job, you get another, people help each other. If you can't get food, somebody will deliver it. There are lots of upland farms, but these are small and are really only run by the families that live in them. The major economic activity in the area is estate farming, including shooting, forestry and so on."

Estates are also purchasers of professional services. As well as employing land and sporting agents, many of them use lawyers. Although professional service providers are seldom local, they are an element of the economic impact of grouse moorlands. A lawyer (who does not shoot) specializing in land disputes said,

"My clients range from large estates, to family farms, trust funds, institutional landowners such as the National Trust, and tenant farmers. Common areas of dispute are where parties have competing interests on the land. I have not come across disputes between communities and shoots, it tends to be specific groups that take action against shoots."

Pointing out the economic impact of grouse shooting to remote communities he observed,

"If there was no grouse shooting, the impact would depend on the location. In many places, if there was no shooting, the land would not or could not be used for anything else as it is so poor. The North Pennines is pretty desolate, if there was no shooting, nothing would happen."

The data gathered by the Denny and Latham-Green (2020) study, and this 2021 study supports the contention of the GWCT and the Moorland Association that the economic impact of driven grouse shooting results not only direct (first order) effects, but in indirect (second order) impacts. A rule of thumb might be the more remote the area, the greater the economic importance of the estate owners and sporting tenants (McMorran et al 2020). The first and second order economic impacts are important to individuals, businesses and communities. Driven grouse shooting, and the management regimes required to sustain it, do not exist in isolation (Thompson et al 2018). A range of activities take place on moors where grouse live which overlap, compliment and (occasionally) conflict with each other. Contractors and providers of professional services benefit as a result. Any discussion or decision about the sustainability of driven grouse shooting must ensure it takes into account the economic benefits that result to people, businesses and communities as a result of integrated moorland management.

THIRD ORDER

"It is the sporting tenant that puts the money into the initial phases of the Higher Level Stewardship scheme that makes it viable and enables farms to keep going."

Retired Academic (Visiting Professor)

Third order economic impacts result from the part that some sporting tenants and estate owners have played in enabling Higher Level Stewardship (HLS) and Countryside Stewardship schemes to operate[118]. Interestingly, this aspect of the operation of the Stewardship schemes is little explored in academic literature. The great majority of literature about Stewardships schemes focuses on the ecological and environmental impacts, not the mechanisms which enable the schemes to operate in different areas.

The aim of HLS has been for farmers and land managers to undertake environmental management schemes which offer "significant benefits" to high-priority areas. Its primary objectives are wildlife conservation, maintenance and enhancement of landscape quality and character, natural resource protection, protection of the historic environment, and promotion of public access and understanding of the countryside[119]. In other words, HLS provides funding to farmers and other land managers in England in return for delivering environmental management on their land. The situation in Scotland is slightly different. The Grouse Moor Management Group noted that pre-Brexit EU support for farming, state financial aid for agriculture and forestry was both extensive and well established. However, the Group pointed out that moorland estates have recently had only limited support for their farming activities via agricultural subsidies and Agri-Environment schemes[120].

The HLS scheme has been very detailed, spelling out both possible payments and also the land-management regime required for eligibility. For example, the Option Directory for HLS and Capital Items (2012) published by Natural England[121] indicated payment for maintenance of rough grazing for birds at £80 per hectare, and restoration of rough grassland habitat for birds at (again) £80 per hectare. These payments were for management practices used to provide rough grassland habitat for upland birds (particularly breeding waders) and other target species. They were targeted at land parcels above the Moorland Line, and that either supported populations of upland birds currently or had the potential to do so. The detailed nature of the scheme can be seen by the fact that it specified that management would normally include "grazing with cattle and/or sheep at an agreed stocking density (between 0.4 and 1.0 Livestock Units/ha depending on site conditions and objective) between 31 March and 20 June. At other times, stocking densities must be managed to achieve the desired sward height. Restoration will be individually tailored to the site, but may include blocking existing surface drains, ditches and grips[122] to create or extend areas of wet, marshy grassland vegetation."

In their 2020 study, Denny and Latham-Green conducted semi-structured interviews with 61 respondents, 21 of whom were farmers, landowners, or land managers. Examples taken from interviews with respondents

[118] It will be interesting to see how the Environmental Land Management (ELM) scheme operates and how tenants and owners become involved with it. We briefly discuss this point in section 5.4

[119] Farmers Weekly website https://www.fwi.co.uk/arable/all-you-need-to-know-about-higher-level-stewardship#:~:text=The%20aim%20of%20Higher%20Level,of%20landscape%20quality%20and%20character accessed 23 April 2021

[120] https://www.gov.scot/publications/grouse-moor-management-group-report-scottish-government/pages/3/

[121] http://publications.naturalengland.org.uk/publication/2827091?category=45001

[122] It is interesting to note that in 2012 Natural England was paying moorland landowners and farmers in the HLS to block drains, ditches and grips. Many of these moors will have grouse shooting taking place upon them. Chris Packham's claim in 2017 that driven grouse moorland management "is ecologically disastrous", partly because of draining, took no account of the operation of HLS. More worryingly, the Labour Party issued a demand for a review of driven grouse shooting on 11 August 2019 in which it claimed that, "earlier this year, as happens annually, much of that (moor) land was drained and dried out to prepare it for grouse shooting." This claim is factually incorrect.

based in the North Yorkshire Moors serve to illustrate the importance of HLS to the economic viability of the area.

There are about 27 shooting estates, each with at least one full-time gamekeeper, in the North York Moors National Park area. Analysis of interview data suggests that perhaps half a dozen of these estates cover their costs, while the rest run at a loss and are subsidised either by their owner or the sporting tenant. One example of the level of subsidy involved was provided by an interviewee[123] who acted as agent for an estate in the North York Moors that was leased by a US citizen from 1997 – 2017. The agent estimates that, over the 20-year tenancy, the moor had cost the US citizen an average of £600,000 a year.

An interviewee that works in a Further Education College (and who does not shoot) described how he had been heavily involved in a HLS scheme operated by an estate and local farmers,

> *"The Scheme was interesting as very little money went into the estate. The funding went to around a dozen or so individual shepherds and graziers who had their flocks on the moor…the landowners were very much adding value to the landscape as a whole, not just their estates…they had the attitude that they wanted to put something in place that was better than when they started."*

Another interviewee[124] pointed out that the ability to enter the Higher Level and Countryside Stewardship schemes in many upland areas depends on grouse shooting, as it would not be possible to deliver a scheme where any capital works are involved without an active, and wealthy, sporting manager. He gave a detailed account of how the post-Brexit Stewardship scheme would work. The interviewee had been working on the application for the Stewardship scheme for Bransdale on behalf of the estate owner, the sporting tenant and graziers. The new scheme starts in 2021 and is estimated to be worth £6 – 8 million over 10 years. The scheme includes capital and revenue grants in return for specified outcomes. The capital grant is paid in full (100%) *after the work has been done*,[125] so without significant investment up-front of c £450,000, he claimed the Stewardship scheme could not operate. Moreover, until the capital work has been done, no revenue payments are made. The capital work is for renovation of buildings and roads etc. and is used to employ mainly local contractors. In the case of Bransdale it is only the sporting tenant that has the cash available to finance the capital work, so the whole Stewardship scheme depends on the shooting interest. While the capital projects mainly benefit the estate, the revenue payments are essential to the farmers and graziers. It is reasonable to say there would be no farming in its current form on the North York Moors without the Stewardship revenue payments. McMorran et al (2020) suggest a similar situation exists on some Scottish moors. None of the four estates studied in detail had farming that was profitable, indeed "farming activities on all four estates either broke even or were loss making."

Moreover, while farmers can get a high percentage of their annual income from moorland Stewardship schemes (one farm in Bransdale gets 22% of its total income from Stewardship, another gets 33%), there is a time-lag between claiming a revenue grant (normally claims are made in the spring) and the receipt of the payment (payments are normally made in the winter). This 'income gap' between the spring claim and the winter payment means most farmers need to have part-time or second jobs, and many of the farmers and

[123] Interviewed on 22 May 2020

[124] Interviewed 22 May 2020

[125] https://www.gov.uk/government/collections/countryside-stewardship-information-for-agreement-holders

their families earn additional income as contractors, beaters, caterers etc. on shooting days[126]. The Bransdale estate operates as a partnership: the estate owns the land, the sporting tenant has the shooting, the graziers put sheep and cattle on the land[127]. All three parties work together and all benefit from the Stewardship scheme, as do contractors and, as a result of shooting, the casual labour. The Bransdale case is far from unique; a similar situation exists on many other estates in the North York Moors. The shooting interest plays a key role in financial facilitation.

FOURTH ORDER

> *"Over a five-year period, you might not get any shooting in two years, but the expenditure is constant. You spend a lot of money for something that might not happen and, as a result, you get a landscape that people value, the heather moorland. Tourists come to see the heather moorland and bring money into the communities. Grouse shooting makes communities sustainable."*
>
> Assistant Land Manager

As noted above, the grouse shooting season normally lasts no more than two and a half months. However, maintaining a moor so that shooting can take place is a year-round activity. These management activities result in an accessible landscape that many people find attractive, resulting in year-round tourism and leisure activities. A retired local government official observed,

> *"People do use the moors for other leisure activities such as mountain biking, walking, bird watching etc. However, they don't pay anything to the estates when they do these activities and if the estates did not manage the moors, there would be no paths and very few birds."*

A qualified ecologist that has managed nature reserves in the past and now works for a shooting and conservation organisation, pointed out that,

> "*The North York Moors National Park has to be managed to remain moorland, or it will revert to woodland". The great majority (80 – 85%) of the North York Moors National Park is managed because the estates have grouse shooting as part of their integrated economic activities."*

Furthermore, he claimed,

> *"Tourism in the N York Moors is largely dependent on the heather landscape so, without management for shooting there would be less tourism. For example, in the Tour of Yorkshire the cyclists ride through the iconic moorland, it has a real quality to it. People go to the North York Moors in July and August to look at the heather on the hills. The keepers and the way they manage the heather are key to the appearance of the heather."*

[126] A shooting day on Bransdale involves about 45 people employed as casual labour i.e. not the Guns, Keepers or FT employed estate staff

[127] We discuss the issues involved with multiple stakeholders working together in section 5.3.12

As a director of a charity points out,

> *"(apart from shooting), the only other economic games in town are agriculture and tourism, and agriculture depends on subsidies. Tourists like heather moors, and they exist largely because of management for grouse. I am not sure the alternative landscape would be as attractive."*

The Grouse Moor Management Group (2019) highlighted that the Scottish moorlands were equally dependent on long-established management practices. The report said, "heather moorland – admired by tourists in high summer when the hills appear to be covered in a purple haze – is not the natural vegetation on much of Scotland's hill country. Within the climatic 'forest zone', much of Scotland's heather moorland is the product of centuries of burning and other management, initially through deforestation and fire (some of it natural), and then for the grazing of livestock (sheep, cattle and goats) and, since the mid-19th century, also for the shooting of grouse. Relaxation of this active management, allowing the vegetation to revert to natural forest would likely yield a different landscape over much of Scotland from that of today's open moorland. In some locations, natural regeneration of the native woodland up to the former tree line is already well under way with consequent gains and losses for species diversity dependent on different habitats. The moorland landscape associated with grouse shooting is thus largely a 'cultural' landscape in which muirburn alongside other management activities are essential for its perpetuation."

As well as the overall appearance of an attractive landscape, integrated moorland management also provides tourists with increased access opportunities. A gamekeeper in the North York Moors pointed out that,

"The shoot maintains lanes and tracks (at a cost of £30 – £50,000 p.a.), which provide access for the public all year round at no cost. All the keepers enjoy engaging with walkers on the moors. People can learn about the moors when they come here walking".

It is not only in the North York Moors that tourists make use of the landscape created by moorland management. A game keeper in the North Pennines observed that,

> *"People come to see the fells and walk on them all the time".*

An estate owner in the Peak District agreed saying,

> *"Heather moorland is very valuable to the Peak District, people come to look at it".*

While the chief executive of an estate in Durham believes that,

> *"Moors are beautiful and emotive places, people relate to them."*

The managing director of a bracken control business observed,

"I didn't know about grouse moors before I started bracken spraying. I was a farmer in lowland Scotland and did not understand what estates did. I've learned that estates have a 90% positive impact on their areas and communities. In Scotland you can walk where you want and owners have spent huge money creating an environment that everybody can enjoy, for free."

People that are not involved in shooting also described how they liked visiting the moors. A lecturer in a FE College in Yorkshire said he visits the moorlands a couple of times a month as he likes birdwatching, a hobby shared with a retired policeman from North Yorkshire who pointed out *"there are lots of species on the moors",* while a Headteacher of a primary school in Northumberland said,

> *"I enjoy the moorland landscape and the vastness of it. It's good to get away to some peace and tranquillity and admire nature. It's also good to take children there and teach them about the environment and the importance of caring for it for future generations as well as appreciate how lucky they are to have this on their doorstep".*

A Parish Councillor (and retired truck driver) from the North York Moors area said,

> *"I visit the moorland daily. I like to see the little grouse chicks being raised, the variety of species including buzzards and kites. There is a balance and variety here, lots of small birds, skylarks, wheatears, various other larks, as well as buzzards and kites".*

As well as encouraging and enabling year-round tourism, it is suggested that grouse shooting can increase the expenditure of the non-shooting tourist. The Managing Director of a shooting business used the example of the village of Reeth, in the Yorkshire Dales, to illustrate this point,

> *"Reeth has been greatly influenced by shooting. It has a high-end restaurant, two pubs and a hotel. The restaurants, pubs and hotels in the area are high-quality because they want to appeal to shooting people. As a result, other tourists can go to great pubs and restaurants etc. all year round. They are smart and high quality because of the money going into the area from shooting. The high-quality facilities increase tourist spend. In addition, because of the way they are managed and the wildlife they contain, the moors are attractive to tourists and birdwatchers etc."*

The evidence, both from people that are involved in shooting and those that are not, indicates that the existence of heather moorlands, with good levels of biodiversity and year-round access, is attractive to tourists. Tourism and biodiversity are intimately related, the prosperity of the tourism industry is directly dependent upon healthy ecosystems. Most tourist activities are also directly based on the many services provided by ecosystems[128], The presence of some high-quality facilities (hotels, restaurants etc.) means that many levels of tourists can be catered for, from the day-trippers going walking or birdwatching and taking their own sandwiches, to those wanting a holiday in a privately run, luxury hotel. Moreover, an area with integrated moorland management, including grouse shooting, results in a year-round living landscape with economically resilient communities. Urquhart and Acott (2014) in their study of the social identity of Cornish fishing communities illustrate the importance of 'real' communities with a quote from a Visit Cornwall tourism manager, "being in a place where there are real live people that you can talk to in the pub or on the harbour-side does bring things to life. I think again it adds another dimension to people's holiday the fact that they're not living in some museum."

And people do like visiting areas of moorland. The Staffordshire Moorlands Tourism Study (2011)[129] reported that in 2009 there had been 3.35 million trips to the area, of which 39,500 were overnight trips (thus 93% were day trips). These tourists were estimated to have contributed £158 million directly to the local economy and supported 3,495 full time equivalent jobs. The North York Moors National Park website[130] states that, "tourism is vital to the North York Moors National Park. We currently have 8.38 million visitors annually, generating spend of £730m and supporting 11,290 full time equivalent jobs. Half of our visitors say that

[128] www.iucn.org

[129] https://www.staffsmoorlands.gov.uk/media/1687/STAFFS_MOORLANDS_TOURISM_STUDY_FINAL_REPORT__16_May_2011_/pdf/STAFFS_MOORLANDS_TOURISM_STUDY_FINAL_REPORT__16_May_2011_.pdf?m=1482422146543

[130] https://www.northyorkmoors.org.uk/looking-after/advice-and-grants/tourism accessed 18 April 2021

National Park status is an important influence in their decision to visit…The National Park Authority recognises the significant role that tourism plays in the economy of the area and we're keen to work with local businesses to encourage visitors to stay longer and spend more, sustainably, while raising the profile of the North York Moors." The 2018 survey[131] of visitors to the North York Moors identified that 99% rated the moors good or very good, and 75% were very likely to return. In the Scottish Highlands, 2019 was "a very good year for tourism"[132]. There were 2.9 million overnight visits, resulting in an overnight spend of £777 million. Figures also indicated a large increase in domestic day tourism spend in the region, to c. £571 million.

The exact value of this fourth order economic impact is not possible to calculate; figures comparing tourism between areas where grouse shooting takes place and those where it does not are not available. As noted above, in some areas of moorland the amount of land that is managed for activities including DGS is significant, between 80% and 85% in the North York Moors. It is evident that the moorland landscape that results from integrated moorland management, delivers very significant economic benefits as a result of tourism.

FIFTH ORDER

> *"You really don't want to get Lyme Disease. I caught it from a tick in 2017 and I was really unwell. I don't think I have fully recovered yet to be honest."* [133] Ecologist

The fifth order economic impact is derived from the land management practices employed on grouse moors that result in a reduction of the threat of diseases to both human and other animals. Game keeping practices reduce bracken coverage and tick numbers, both through direct bracken control and through use of sheep to act as tick 'mops' Controlling bracken and ticks is important for human and animal health, both of which have economic impacts[134].

Dense bracken covers about 900,000 hectares in the UK and is increasing by between 1 – 2% p.a. Bracken is present and increasing on a further 700,000 hectares. The four main health impacts caused by bracken are:

- Direct toxicity to animals and humans due to a number of poisoning and growth impacting chemical groups within the spores, frond, rhizome and true root systems.
- Impacts through the action of the living plant and litter on the soil and water systems in the habitat, including direct toxicity in drinking water.
- Creation of an environment which encourages the concentration of some of the animal hosts, such as deer, sheep and microtine rodents on which the four stages of the tick life cycle depend. The hosts are frequently the 'carriers' of pathogens which have the potential to cause Tick Borne Diseases (TBDs) in other animals (and people) which have no immune tolerance to them.
- Related to the point above, the encouragement of disease spreading parasites through the creation of favourable conditions to complete life cycles and sustain high populations. Dense bracken, and the litter it creates, provide ideal 'questing' conditions for ticks and the environment for the different tick

[131] https://www.northyorkmoors.org.uk/looking-after/advice-and-grants/tourism/North-York-Moors-Visitor-Survey-2017-and-2018-infographic.pdf

[132] https://www.visitscotland.org/binaries/content/assets/dot-org/pdf/research-papers-2/regional-factsheets/highland-factsheet-2019.pdf

[133] Interviewed in July 2020.

[134] We are not, of course, suggesting that only moors managed for grouse shooting control bracken and ticks.

life stages to rest and metamorphose (echdysis) between blood feeds. It also encourages hosts which are the source of the TBD pathogens.

A bracken control company director questioned by Denny and Latham-Green (2020) pointed out that bracken, *"holds c. 70% of the tick load on a moor".*

Moreover, in the UK changes in land use policy and the climatic gradient have encouraged bracken growth over the last 30 years and not only does the plant hold the majority of the ticks on a moor, but tick numbers are increasing rapidly. Moor owners and gamekeepers in England and, especially, North Wales and Scotland reported ticks as being a 'massive problem'. In Scotland ticks were described by one moor owner as endemic.

The risks to health from tick-borne diseases are serious, and under-estimated[135]. Professor Roy Brown writes,

*"the number of tick-borne diseases is increasing dramatically (seven diseases currently pose serious health risks to birds, mammals and people in the UK). The rates of infection in ticks and multiple pathogen loads are also increasing. New pathogen strains (e.g. the Flavivirus causing Tick Borne Encephalitis [TBE]) have become 'native' in the UK in the very recent past. " It was estimated at an internal NIHR (National Institute for Health Research) working meeting in February 2020 that there could be as many as 18,*000 *new cases of Lyme Disease confirmed in the UK in 2020, against about 4,000 in 2015. Lyme Disease is a 'headline' problem but there are several other chronic (as well as acute) tick transmitted infections affecting a much larger number of people, as well as companion animals, stock and wild mammals and birds*[136]*."*

On estates where grouse shooting occurs, landowners, gamekeepers and farmers/graziers combine activities to control both bracken and tick numbers. The reduction in tick burden on managed moors means that they are more healthy places for both wild and domesticated animals, and humans. This reduction is important as the impact of ticks on wildlife, not just grouse, can be very serious. As one keeper reported,

> *"I've seen curlew chicks completely covered in them".* [137]

[135] Tick-borne diseases include arborvirus (which includes Tick-Borne Encephalitis and the Flavivirus group. Ebola and Zika are members of this group); protistans; bacteria (including Lyme Disease); tick paralysis; and alpha gal syndrome.

[136] Professor R Brown, 29 May 2020. Professor Brown is Visiting Professor in Epidemiology and Invasive Species Control at the University of Lincoln and a specialist researcher/consultant working in the environmental control of hard bodied ticks and Tick-Borne Diseases in the Northern Hemisphere at the habitat/landscape scale through the research company ' R & D Applied Biology' in North Yorkshire.

[137] A. Jenkins, cited in Moorland Conservationists: The Untold Story, GWCT, 2020

While it is not possible to put an economic value on the impact of tick control on wildlife, the worldwide economic impact of poor livestock health is more obvious. Cattle and sheep can be badly affected by tick-borne diseases. Kivaria, (2006) reported that the annual cost of cattle lost to tick-borne diseases in Tanzania was estimated to be $364 million (2006 figures). More recently, and reporting research carried out in the UK, Rocchi, Reid and Sargison (2015) observed that louping ill virus in sheep, if untreated, can result in coma and death in a proportion of animals (between 5-60% in affected flocks). A moorland owner reported in 2020 that:

> *"our shepherd began to notice symptoms in some of the lambs and at that point we had sheep and grouse tested for the louping ill virus. The tests proved 84% positive and the vet said it was the worst case he had seen. After better treatment, there was a great improvement in the flock's general condition."*[138]

The impact of louping ill virus on red grouse can be equally dramatic. The virus is responsible for high levels of mortality with 79% of infected grouse chicks dying from the virus[139].

Currently research is progressing on a new form of louping ill vaccine for sheep. As well as a welfare benefit for the sheep the reduction in viral prevalence will benefit red grouse. This research, costing over £300,000 has been equally co-funded by public grant and by private donation from grouse moor owners.

Research into the economic costs of tick-borne disease in humans, unsurprisingly, produces a variety of different figures. Zhang *et al.* 2006 calculated that the expected median of all costs (direct medical cost, indirect medical cost, nonmedical cost, and productivity loss[140]), in five counties in Maryland, USA, aggregated across different diagnosis groups of patients, was ≈$281 per patient (2006 figures). Johnson (2018) using data from across the USA suggested the cost of Lyme disease in the country might exceed $75 billion a year[141]. Mac, Da Silva and Sander (2019) report on six studies that assessed economic burden of Lyme disease from a societal perspective and estimated significant annual national economic impact ranging from $143,000 in Sweden to $786 million in the USA (the cost of Lyme disease in Scotland was estimated to be $735,550 a year). They conclude that Lyme disease imposes an economic burden that could be considered significant in the US and other developed countries to justify further research efforts in disease control and management. They also point out that the societal costs for Lyme disease can be equally impactful as healthcare costs but are not fully understood. Moreover, Lyme disease is just one tick-borne disease and that, as noted above, seven diseases currently pose serious health risks to birds, mammals and people in the UK[142].

In the UK it is possible to calculate the cost of using the health services due to a tick-borne disease. A visit to a General Practitioner resulting in a prescription is estimated to cost £68, whereas hospital day-case costs £742, and admission to hospital £1,864 per episode (all costs 2019)[143]. However, these costs do not allow

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[138] J Kemp-Welsch cited in ibid.

[139] https://www.gwct.org.uk/research/species/birds/red-grouse/controlling-louping-ill/#:~:text=From%20the%20blood%20samples%20we,start%20of%20the%20shooting%20season.

[140] Mattingly and Shere-Wolfe (2020) also point out that in addition to direct health care costs, productivity losses should also be taken into account.

[141] https://www.lymedisease.org/lymepolicywonk-costs-75billion/

[142] And it is not known how many people in the UK catch tick-borne diseases in a year. The British Medical Journal online observes that Lyme disease cases may be three-times greater than estimated, see https://www.bmj.com/company/newsroom/uk-tick-borne-lyme-disease-cases-may-be-3-times-higher-than-previous-estimates/

[143] Source: Unit Cost Database https://www.greatermanchester-ca.gov.uk/what-we-do/research/research-cost-benefit-analysis/

for the severity of an illness resulting from a tick-borne disease or take any account of productivity loss due to the illness. Moreover, it is obviously not possible to estimate how many people do not acquire a tick-borne disease as a result of land management practices common on grouse moors. However, it is possible to assert with some certainty that bracken and tick control on grouse moors result in a positive economic impact, which is likely to increase as more tick-borne diseases establish themselves in the UK and tick numbers rise, as a result of reduced risk of disease to both animals and humans.

SIXTH ORDER

"Carbon capture is a big thing for us." (Moor owner, North Yorkshire)

In our schematic illustrating the economic impacts of grouse moors (Figure X), the impacts, either positive or negative, that are delivered over the longest term and, consequently, are hardest to measure are the land management practices that are aimed at sequestration of carbon, encouraging peat formation, reducing wildfires, and reducing risk of flooding. We examine the environmental and ecological impacts of grouse moor management in sections 5.3 and 5.4. However, the potential impacts of the sixth order economic factors that have been identified from the analysis of interview data in our 2020 study do need to be considered as part of a symbiotic and integrated economic and social model. This consideration involves us in examining the place of integrated moorland management in providing ecosystem services (examined in more detail in section 5.4).

'Ecosystem services' is the term increasingly used to describe the many and varied tangible and intangible benefits to humans provided by a natural environment with healthy ecosystems.

Such ecosystems include agroecosystems, forest-ecosystems, grassland-ecosystems and aquatic eco-systems. When they are 'healthy', ecosystems offer such benefits as natural pollination of crops, clean air, the mitigation of flooding and soil erosion, prevention of disease, and human mental and physical well-being through the receipt of recreational and spiritual benefits. Collectively, these benefits are becoming known as 'ecosystem services', and are often integral to the provisioning of clean drinking water, the decomposition of wastes, and resilience and productivity of food ecosystems. The importance of healthy ecosystems has been known by farmers for centuries[144] and by scientists[145] for decades. For example, the service of formation of soils and soil fertility that sustains crop and livestock production depends on the ecosystem processes of decomposition and nutrient cycling by soil micro-organisms. Vargas, Willemen and Hein (2019) point out that ecosystems contribute to economic development through the supply of ecosystem services such as food and fresh water. Therefore, information on ecosystems and their services is required to support policy making, but this information has not traditionally been captured in economic statistics.

As the UK National Ecosystem Assessment website observes[146], some scientists have advocated a stricter definition of ecosystem services as being only those components of nature that are directly enjoyed, consumed, or used in order to maintain or enhance human well-being. Such an approach can be useful when it comes to ecosystem service accounting and economic valuation. However, while the value of food

[144] See, for example, the agricultural practices of Charles 'Turnip' Townshend, 2nd Viscount Townshend and his work promoting the Norfolk four-course system.

[145] See, for example, the extensive work of Stephen T. Trudgill on the importance of healthy soils.

[146] http://uknea.unep-wcmc.org/EcosystemAssessmentConcepts/EcosystemServices/tabid/103/Default.aspx

production can be quantified, the value of other services, for example peat formation or mental well-being, have not been readily understood by policy makers, or the public. There is a danger when calculating the value of ecosystem services that only the services whose value can be easily calculated will be included. Moreover, as ecosystem services are defined in terms of their benefits to individuals and groups, they are context dependent: not everybody will value the services produced, or value them in the same way.

The Millennium Ecosystem Assessment (MEA) (2005)[147] grouped ecosystem services into four broad categories: *provisioning*, such as the production of food and water; *regulating*, such as the control of climate and disease; *supporting*, such as nutrient cycles and oxygen production; and *cultural*, such as spiritual and recreational benefits. Integrated moorland management, as defined in this report, delivers all four categories of ecosystem services using the MEA definition.

However, quantifying the economic benefits of eco-system service is a difficult and inexact science. Schröter *et al.* (2021) point out that while conservation efforts are increasingly supported by ecosystem service assessments, these assessments depend on complex multi-disciplinary methods, and yet rely on a number of assumptions which reduce complexity. However, as many assumptions are ambiguous or inadequate, misconceptions and misinterpretations may arise when interpreting results of assessments. They point out that an interdisciplinary understanding of assumptions in ecosystem service science is needed to provide consistent conservation recommendations, and suggest that future assessments should be carried out to increase transparency about assumptions, and to test and validate them and their potential consequences on assessment reliability. This work, if carried out will support the taking up of assessment results in conservation science, policy and practice, but it is in its infancy.

The McMorran et al (2020) study recognised that there were indirect economic benefits and/or costs arising from integrated grouse moor management. However, attempting to account for these aspects was beyond the scope of their research. Denny and Latham-Green (2020) did attempt to identify areas of potential indirect impact arising from moorland management associated with driven grouse shooting. Their primary data gathering included semi-structured interviews with 17 moor or estate owners, 13 (76%) of whom stressed the importance they attached to carbon sequestration and peat formation and restoration[148]. The owner of an estate in North Yorkshire highlighted this point,

> *"Carbon capture is a big thing for us. Peat is a major sequester of carbon and, when conditions are right, peat is being formed all the time from sphagnum moss. We have to look after the moors to maintain the peat. This means we have to keep the heather short and new. If it gets old and woody you get wildfires and they will damage or destroy peat that has taken hundreds of years to deposit. Sphagnum moss is key for peat*[149] *and it will not grow if the heather is too long and the moss doesn't get enough light."*

A Scottish estate owner echoed this theme,

> *"Our moor has deep peat, over 10 metres deep in places. It is a designated site for blanket bog. If you don't manage the heather, it gets too long and the sphagnum moss can't form,*

[147] https://www.millenniumassessment.org/en/Index-2.html

[148] The interview schedule did not have a question that mentioned carbon sequestration or peat restoration. However, the majority of estate or moor owners spoke about these issues, often with real passion. We are not, of course, suggesting that only owners of moors where grouse shooting takes place are concerned with carbon sequestration, peat formation and restoration.

[149] In section 5.4 we examine evidence that does not fully support this claim.

so there is less peat formation. Managing the heather with controlled burning reduces the risk of wildfire, if it is done on a seven-year rotation."

A moor owner and farmer stressed the importance of Stewardship schemes to carbon sequestration, saying,

"All the (local) farmers have joined into the Higher-Level Stewardship environmental scheme (which is being replaced by the ELM scheme). The scheme provides payments for producing environmental outcomes. These outcomes are hard for us individual farmers but if a group of farmers work together, they can succeed. The outcomes include things such as biodiversity, carbon capture, maintenance of habitats such as blanket bog. I am very keen on integrated moorland management."

The importance and economic benefit of carbon sequestration and storage has been recognised by UK policy makers for over a decade. The Climate Change (Scotland) Act 2009[150] recognised the value of peatlands and peatland restoration to ensure that carbon was sequestered rather than emitted. The modelling conducted by Reed *et al.* (2013) showed restoration of peatlands damaged by former intensive management would result in an increase in carbon sequestration and storage, with a number of co-benefits, which could counter the loss of habitats and species elsewhere in the landscape. A 2013 Defra report concluded that it is possible to value peatland carbon in the context of a Payments for Ecosystems Services (PES) scheme by using a standard value approach. It also suggested that to obtain greatest carbon emission reduction benefits PES schemes should generally target severely degraded and drained peatland sites. The report highlighted the need to revegetate bare peatlands to increase carbon storage. However, there is no generally accepted methodology to calculate the amount of carbon stored in peat on grouse moors[151] or to calculate the economic value of carbon sequestration measures on moorland at the current time.

The impact of moorland restoration work was also claimed to impact on biodiversity (illustrating the holistic nature of the moorlands). The Operations Manager of the agricultural and moorlands contractor (cited earlier) remarked that a significant proportion of her firm's income comes from peat restoration. She contrasted restoration projects for different clients,

"In 2019 the company did two projects at the same time, one on a National Nature Reserve and one on an estate. On the estate there were lots of waders and other wildlife. On the Nature Reserve the staff saw very few birds. The Nature Reserve does not manage the heather like the estates do, so it gets long and you get trees sprouting. The lack of light reduces sphagnum moss formation and you don't get new peat forming. If you don't manage a moor, you get a wood. If you have shorter vegetation, the ground nesting birds can see predators and they feel safe. They love it."

[150] https://www.hutton.ac.uk/sites/default/files/files/publications/Peatlands%20final_web_reduced%20size.pdf

[151] Using data from the Moorland Association, recent GWCT estimates put the amount of carbon stored in peat on grouse moors at between 66 and 205 million tonnes, which is 11-35% of the total carbon stored all English peatlands. The GWCT went on to estimate carbon emissions from grouse moors and found that English grouse moors emit around 1-5% of the net carbon emissions from England's peatlands per year. English grouse moor carbon emissions are therefore proportionally well below the proportion of carbon that they store, compared to other peatland uses. https://www.gwct.org.uk/policy/briefings/carbon-storage-on-grouse-moors/?utm_source=All+Contacts&utm_campaign=82e63069dc-Non-Mem-NL-230421&utm_medium=email&utm_term=0_dd843c5cb6-82e63069dc-27564919&mc_cid=82e63069dc&mc_eid=1da0a5cac3

Nearly all moor and estate owners commented on the importance of managing the drainage on their land. They were struck by the irony that they can now access government funding to undo what their predecessors were paid by the government to do! An estate owner in North Yorkshire summed the situation up well,

> *"The estate is in the latest Countryside Stewardship scheme which, apart from other things, provides payments for blocking up the moor drains that were put into the moor between the 1940s and the 1970s as part of earlier government environmental schemes".*

Another North Yorkshire moor owner said his aim was to manage the land,

> *"...so the activities are carbon neutral, and to sort out the water issues so there is no pollution or flooding etc. I am now being rewarded for undoing what the government paid moorland owners to do post-WW2. I am blocking moor drains etc. to control flooding downstream."*

This owner pointed out that water from his land drains into the River Ouse, which flows through York. He has put meanders into streams on his land (which had been straightened by government-funded drainage schemes in the 1960s) to lengthen the water course, reduce peak flows, and improve aquatic life, as a contribution to try to reduce flooding downstream. The potential value of such work done by one moor owner is highlighted by Watson *et al.* (2016) who estimated that the annual value of flood mitigation services carried out on one small river and area of wetlands in the USA provided *annual* benefits of between $126,000 and $450,000 to the town of Middlebury, VT in terms of flood damage reduction. Applying Watson et al's methodology to all moorland flood mitigation schemes delivered by UK grouse moor owners would presumably result in an estimate of the potential value of such schemes. However, such a study would be complex and very expensive.

Therefore, while parallels from some previous research can be drawn, the economic impacts of carbon sequestration and flood reduction work carried out on grouse moors, while significant and positive, are currently impossible to accurately measure. The costs of the flooding that hit the UK (including York, which experienced 'nightmare' floods in December 2015[152]) were estimated by the Environment Agency (Environment Agency, 2018) but it is clearly not feasible to try to calculate on a UK level the economic effect of blocking moor drains, or increasing the length of streams. Similarly, work done to encourage peat formation and reduce wildfires cannot be accurately valued economically on a large-whole landscape scale. However, the value of this work is undoubtedly significant. A qualified ecologist who has never been involved in grouse moor management or shooting pointed out that,

> *"Until coronavirus hit us, all political parties were being affected by the impact of climate change. They have now realised that climate change is expensive. The moors hold the biggest carbon store in the UK and have done for hundreds of years. If you have too much old heather, it becomes a major fire risk and when it burns in a wildfire you get a deep fire which can burn underlying peat. This is disastrous for the moor and for carbon release. But controlled burning of short heather does not burn the underlying peat. Effective moorland management, for grouse and other animals protects the biggest carbon store in the UK. It protects against climate change."*

The Sixth Order economic impacts resulting from integrated grouse moor management clearly exist; indeed, they are recognized by policy makers in the UK. Sequestering and storing carbon, reducing wildfires, and mitigating flooding have positive economic values. It will be interesting to see if in the next few years work

[152] See https://www.bbc.co.uk/news/uk-england-35186241

on ecosystems services will have advanced sufficiently for the impacts of current and potential future moorland management regimes to be compared in financial terms.

5.2.4 THE ECONOMIC SUSTAINABILITY OF DRIVEN GROUSE SHOOTING: CONCLUSIONS

Driven grouse shooting does not happen in isolation. The Schematic at Figure 5.4 showing the different orders of economic impact resulting from integrated moorland management, including grouse shooting, represents a holistic approach to identifying impact. It demonstrates the complex integration of actions that are involved in integrated moorland management, and the depth and breadth of the impacts of these actions. The Immediate impacts (orders one and two in the schematic) are fairly simple to measure (which is presumably why previous studies have focused on them). Long-term, and very-long term, impacts result in effects over years, in some cases over decades. Consequently, measuring them accurately is not possible. However, the fact that it is not possible to measure an effect (for example, as noted above, it is not possible to say how many people and animals have not acquired a tick-borne disease as a result of moorland management practices[153]) does not mean that it is not present, and that it is not important. The impacts of integrated moorland management on the agriculture sector through financial facilitation; on tourism through the creation of a unique, accessible and attractive landscape; on human and animal health through tick and bracken control; and on carbon sequestration and flood control through moorland management and restoration practices, are immense. Moreover, their long-term financial impact is clearly massive, not only for local communities, but for the wider UK population.

The question whether DGS is economically sustainable is an interesting one. Evidence from previous studies indicates that, viewed as an isolated activity, much DGS is not profitable.

However, it is important to highlight two key findings from previous studies; firstly, the majority of moorland owners and tenants do not set out to make a profit from driven grouse shooting and, secondly, DGS is not practiced in isolation. Denny and Latham-Green (2020) conducted a survey[154] of people that lived or worked in areas where grouse shooting took place. Responses were received from 73 estate owners, moor owners and leaseholders (sporting tenants) across the UK. All 73 respondents in this category 'agreed' or 'strongly agreed' that it was important to them that they left a better environment on the moor for future generations than when they arrived. In addition, all these respondents 'agreed' or 'strongly agreed' that 'there is an essential, symbiotic relationship between farming and shooting land management'. The strong sense of being the current custodians of the land was identified from both moor owners ("*I am the custodian of the moor.*" Estate owner), and those who had worked with them on the HLS environmental management scheme *("the tenant is embedded in the community. The events he organises (and discretely funds) bring together the 40 – 50 people in the Dale. It is not charity, or bribery, but because the tenant feels he belongs and that his duty is to do things that others cannot*". Visiting Professor). Respondents clearly believe their role is to focus on the long-term sustainability of their land, and the activities associated with its management for future generations, and the sustainability of their local communities, rather than simply maximising profits. As the report of the Grouse Moor Management Group pointed out, "the economic contribution from grouse moors undoubtedly makes a valuable contribution to some remote local communities. The long-term private investment attracted by grouse moors, and willingness to bear financial

[153] Unless, of course, a controlled experiment was done by getting matched samples of people and animals to spend time on moors where tick numbers were, and were not, controlled. There would be some interesting ethical obstacles to overcome before such a study could be conducted!

[154] In addition to semi-structured interviews

losses, is unlikely to be repeated for other activities. Unlike other upland land uses, neither grouse shooting nor deer stalking are subsidised from the public purse."

Any comprehensive estimation of the economic sustainability of integrated moorland management, including driven grouse shooting, should take into account the impacts of the Six-Order Schematic shown in Figure 5.4. We can hypothesise that if landowners and tenants were fully rewarded for the direct and indirect economic benefits that integrated moorland management, including driven grouse shooting, generates[155] there would be no question about the economic viability of this form of land management. However, in the absence of a holistic reward system for all economic impacts, sustainable moor ownership and leasing will continue to depend on an integrated model of economic management and, in some cases, on landowners and tenants being prepared to invest their money without expectation of a return. It is concluded that DGS is economically sustainable on the majority of moors where it is currently practiced, provided that grouse numbers and the regulatory environment permit shooting to take place in most years[156].

Furthermore, we recommend that any decision about an alternative use of moorland currently used for DGS should use our Six Order model in order to identify the economic impacts and sustainability of other options. Simply claiming that moorland should be afforested, rewilded, or used for more intensive livestock generation does not take account of the evidence. Integrated moorland management, involving grouse shooting, provides a number of positive economic impacts. We are not saying that DGS and the income generating activities integral to integrated moorland management represent the optimum economic use of the landscape. However, we are saying that those that propose alternative uses of the UK's moorlands should demonstrate that the economic impacts of their preferred options deliver outcomes that are at least as valuable, and that are sustainable.

[155] Calculating the overall economic impacts is, of course, not possible at the present time.

[156] The increasing prevalence of heather beetle and ticks, perhaps linked to climatic factors, is a potential threat to having a sufficient surplus of grouse to shoot at.

5.3 INTEGRATED MOORLAND MANAGEMENT: SUSTAINABLE BIODIVERSITY?

5.3.1 NOTHING IN ISOLATION

Making a living from moorlands is not easy. DGS is not an isolated phenomenon, rather it takes place as part of a complex, integrated, year-round web of activities, many of which involve multiple stakeholders. Moorland is less agriculturally productive than other land and most grouse moors are classed as 'Less Favoured Area' (LFA) because of their lower production and distance to market. Therefore, a range of income generating activities is required if people are to make a sustainable living in, often remote and harsh, upland areas.

Few, if any, moorland estates or moor owners solely depend on grouse shooting for their income. They are engaged in year-round operations and have a number of income-generating activities in addition to shooting, typically livestock grazing, commercial forestry, renewable energy generation, and tourism. Each of these income-generating activities are explored further below. The key point about these economic ventures – what the authors describe as integrated moorland management – is that they are interconnected with each other, and with grouse shooting, and often co-dependent. People employed by estates and moor owners seldom work on only one area of activity. Different economic ventures, and the management regimes that result from them, combine to impact the classic moorland landscape with its associated flora and fauna. Disentangling the impacts resulting from integrated moorland management is difficult and our review of the literature suggests has not been accomplished so far.

Many of these economic activities attract subsidies, with the notable exception of grouse shooting. This chapter will review the evidence for the sustainability of the landscape on which driven grouse shooting is practiced and the impacts of integrated moorland management on the biodiversity of these areas of the UK.

5.3.2 LIVESTOCK GRAZING

Livestock have been grazed on the moorlands for centuries. Cattle mainly graze in lower, grass-rich, areas, but sheep can range at higher altitudes and thrive on heather and other moorland vegetation. Managing moorland for grouse has, in the past, often sat uneasily with sheep grazing. Durie (1998) observed that in the mid-nineteenth century while graziers welcomed predator control, particularly control of foxes, they were accused by game keepers of burning too much and letting their sheep overgraze young heather thus preventing it from regenerating[157]. During the twentieth century, government funded schemes promoting afforestation and intensification of sheep grazing in the British uplands led to widespread declines in globally rare heather moorland. Between 1948 and 2009, when grazed heavily by sheep, heather-dominated vegetation on Langholm Moor in south-west Scotland declined from 53 to 14% cover. Large-scale sheep reductions from 2011 then allowed increase of heather-dominated vegetation cover to 18% by 2015 (Ludwig et al., 2020a). It should be noted that the operation of various stewardship schemes, again funded by governments, has worked to reduce the numbers of sheep in many upland areas, in order to prevent over-grazing and to allow heather landscapes to recover. However, sheep removal does not necessarily result in an increase in the diversity of species of vegetation (Marrs et al., 2020).

McMorran, Thomson and Glass, (2020) point out that sheep enterprises generated a profit before capital costs of £25 per hectare on average. However, this statement is qualified when they observe that excluding

[157] The same problem that was seen in Ireland in 2002, see section 4.1.7 above.

CAP support, all the sheep enterprises returned losses, with average losses of £15 per hectare *before* capital costs. The sheep enterprises were therefore heavily dependent on public support (66% of revenue on average) to ensure their financial viability. As we note in the section on the Economics of Driven Grouse Shooting, many farmers and their families work closely with gamekeepers and moor owners, and earn additional income from shooting. Additionally, integrated moorland management can result in farmers benefiting from the financial facilitation role played by many estates and sporting tenants in securing Stewardship schemes funding. Without this facilitation role, many moorland farmers would struggle even more than they do at present to remain viable. The work of the farmers and the estates has become, in many areas, symbiotic leading to the maintenance and enhancement of heather moorlands, with year-round access, which are promoted to tourists[158] and generate very significant income to the local area. A moor owner in Northumberland remarked, "it is unthinkable not have them (farming families) farming the upland areas…we work with them on the Higher Level Stewardship scheme which provides payments for environmental outcomes. The outcomes are hard for individual farmers but if a group of them work together, they can succeed." [159]

Since World War 2 it is government policy and funding regimes that has largely determined the number of livestock grazing on heather moorland. As priorities have changed from maximising food production to maximising biodiversity and mitigating climate change, upland farmers and landowners have responded as they seek to generate income. Governments have used economic incentives to affect and change behaviour of those seeking to earn an income from moorland. It is not surprising that livestock grazing has impacted on the flora, and thus the fauna, of moorlands. Moor owners engaged in integrated moorland management have to strike a balance between different economic activities, some of which complement each other, and some of which can compete. Livestock grazing and driven grouse shooting can and do co-exist in harmony, if a workable balance is achieved. As noted above, a farmer in North Yorkshire described how livestock grazing can operate to the benefit of moorland, "cattle are less profitable than sheep due to overheads such as silage, sheds, machinery and so on. However, cattle improve the land for ground-nesting birds including, on my farm, curlew, lapwing and woodcock. Cattle work brilliantly as part of an integrated system." [160] Such an integrated system is sustainable, but the balance can always be tipped one way or another by the operation of government policies and subsidies.

5.3.3 COMMERCIAL FORESTRY

As noted in the section on alternative uses of moorlands, trees cannot grow everywhere and there are shown to be negative impacts from afforestation, particularly large-scale coniferous planting (see also the section in this report on alternative uses of moorland). The UK NEA notes that since World War 2 commercial forestry has caused a great loss of biodiversity to mountains, moorlands and heathlands (MMH). In the 1950s, development of powered cableway extraction methods allowed access to previously unmanageable areas and access roads across areas of MMH were opened-up in many parts of the UK. Most of this destruction

[158] See, for example, https://www.northyorkmoors.org.uk/visiting/see-and-do/amazing-views

[159] Interview with S Denny 13 May 2020

[160] Interview with S Denny 12 May 2020

occurred prior to 1990 and was most abundant in Scottish and Welsh MMH. Since 1990, due to removal of tax incentives, there has been a steep decline in afforestation on organic soils[161].

However, integrated moorland management often includes forestry with woodlands planted in lower-lying areas of estates. The income that can be generated from timber and timber biproducts is part of the income mix of many estates and can be important for long-term economic sustainability. Evidence gathered by Denny and Latham-Green suggests that for most moor owners, commercial forestry is small scale (<10% of an estate or farm), confined to lower areas, and always part of an integrated system.

5.3.4 RENEWABLE ENERGY GENERATION

Integrated moorland management involves upland landowners in a range of income generating activities, including alternative or renewable energy production. It is worth noting that the world's first use of renewable energy was by a Northumbrian grouse moor estate owner in 1878. Lord Armstrong, owner of Cragside, installed a hydroelectricity plant, raising water by means of an Archimedes screw which enabled water from the lakes on the estate to generate electricity to illuminate the house. Over a century later, increasing numbers of estate owners are seeking to generate income through either water, wind or biomass power-generation schemes.

The International Union for the Conservation of Nature (IUCN) notes that renewable power capacity was projected to expand by 50% between 2019 and 2024. However, the IUCN points out, "clean energy sources like wind and solar can also impact biodiversity through disturbance and loss of habitat, the generation of noise pollution, collision and other indirect pressures. Therefore, despite the intrinsic and much-needed positive contribution of these renewable technologies to a clean energy future, renewable energy projects need to address the associated risks to biodiversity, throughout the entire project life-cycle -- from design and permitting to the operational and decommissioning phases."[162] The impact of renewable energy generation on biodiversity has to be balanced against the potential opportunities for mitigating climate change.

The GWCT observed that the UK's commitment to increasing renewable energy production is critical for reaching net zero carbon emissions. The funding available (subsidies funded by taxpayers) to install renewable energy schemes, and the income that can be made from operating them, can be an important part of a diversified income for upland landowners[163]. However, while hydro schemes are typically small scale (being the size of a small barn) and are claimed to have little negative impact on the environment[164], building wind farms on moorland is shown to affect its habitats, soil, and the wider landscape. The main impacts on moorland habitats from wind farms are from the use of land for tracks, crane hard standings, turbine bases, control buildings, borrow pits and changes in drainage. Pearce-Higgins *et al.*, (2009) found the density of some moorland bird species near wind farms was reduced by between 15% and 48%. Another study by Pearce-Higgins *et al.*, (2012) found that the impact of wind farms on moorland birds may be highest during the construction phase, with lower numbers of red grouse and curlew during construction. Moreover,

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[161] https://backup.ons.gov.uk/wp-content/uploads/sites/3/2017/07/UK-natural-capital-developing-UK-mountain-moorland-and-heathland-ecosystem-accounts-2.pdf

[162] https://www.iucn.org/ Accessed 21 May 2021

[163] One owner of a 5,000 acre moor in North Yorkshire claimed that his small hydroelectric power scheme brought in c. £40,000 p.a. to the estate, the same income as he got from his 1,200 sheep. Interview with S Denny 15 May 2020.

[164] See, for example, https://cairngorms.co.uk/hydro-schemes-given-go-ahead/ https://en.wikipedia.org/wiki/Ruswarp_Hydro

as this report makes clear in the section on alternative uses of moorland: renewable energy, in particular the manufacture, decommissioning and recycling of wind turbines has many environmentally negative impacts. Against these negative impacts we have to consider anecdotal evidence that many grouse moors have benefitted from the cashflow capital afforded by a windfarm, from the infrastructure of roads that facilitate burning and predator control, and possibly from reduced bird of prey presence. Moreover, it is entirely possible to drive grouse through a turbine field. Future editions of this report will examine these claims in more detail.

Where forested areas are felled to return an area to moorland (albeit with turbines) for renewable energy generation, over time this could be beneficial in enhancing overall biodiversity (Werritty et al., 2015). Pearce-Higgins *et al.*, (2012) suggested some species such as skylark and stonechat may benefit from the habitat change. Where income from the windfarm is reinvested in surrounding moorland the increased management and small-scale scrub planting could benefit some species. Providing renewable energy is a main priority for the country with clear environmental and economic benefits. However, in an integrated economic and ecological system there are no actions without consequences, and these must be weighed up against negative effects.

5.3.5 TOURISM

As noted in section 5.2 on the economics of driven game shooting, the evidence, both from people that are involved in shooting and those that are not, indicates that the existence of heather moorlands, with good levels of biodiversity and year-round access, is attractive to tourists. Increasing the accessibility of moorlands to visitors in a sensitive way also brings advantages in terms of public appreciation and understanding of some of the UK's most beautiful environments. Tourism can not only generate income but can also help raise awareness and support from both local inhabitants and visitors to the values of biodiversity[165]. The North York Moors National Park website is an interesting example of how organisations seek to raise awareness[166].

Moreover, income from tourism is important to upland communities and to farmers (Busby and Rendle, 2000). The GWCT reports that tourism is an area of increasing interest as an income source for some upland landowners and is extremely important to rural economies more widely[167]. The potential for generating revenue on a large scale to replace the current main land uses is not yet known, nor are the possible ecological impacts. More tourism can generate higher incomes for people and businesses in an area, but increased numbers of visitors will require more infrastructure, and are associated with increased disruption to both people and wildlife. Other concerns for the upland environment include higher risk of wildfires, which are already considerably more likely in spring and summer. Natural England reported that 67% of wildfires occurred in spring, and a further 25% in summer (while only 8% of wildfires occurred at the times of the year when muirburn was allowed, and these fires were caused by accident or arson), with bank holidays and weekends being particularly associated with fire outbreaks.

The grouse shooting season normally lasts no more than two and a half months, but integrated moorland management is a year-round activity. These activities result in an accessible landscape that many people find attractive and are able to access for year-round tourism and leisure activities.

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[165] https://www.iucn.org/ Accessed 21 May 2021

[166] https://www.northyorkmoors.org.uk/looking-after

[167] https://www.gwct.org.uk/policy/briefings/alternative-uses-for-upland-moors/

Tourism is one of the income opportunities that upland areas can benefit from and, of course, people that shoot grouse are tourists to the area in which they shoot. Grouse shooting is expensive, and the Guns and their entourage are high-end tourists.

As noted previously in this report, the evidence, both from people that are involved in shooting and those that are not, indicates that the existence of heather moorlands, with good levels of biodiversity and year-round access, is attractive to tourists. Moreover, the presence of some high-quality facilities (hotels, restaurants etc.) means that many levels of tourists can be catered for.

5.3.6 PLANTS AND ANIMALS

Moorland, including upland heathland, bogs and grasses, and soils usually have a peaty top characterized by semi-natural vegetation[168]. The climate and soil types found on moorland have resulted in a characteristic flora and fauna, particularly at higher altitudes where heavy grazing does not restrict 'typical' upland plant growth. This characteristic flora has been favoured over millenia by periodic burning and removal of trees to renew sub-scrub growth for either stock or grouse which has resulted in a generalized heather-dominated moorland (Goodwin, 1981; Rodwell ed, 1991). However, inappropriate burning or lack of it can alter the MMH habitat. Encroachment of trees and the 'simplification' of vegetation structure can be caused by the lack of controlled burning, while too frequent burning can lead to the alteration of a moor to grassland[169]. As in all aspects of integrated moorland management, there is a balance to be struck.

Rodwell (ibid) suggests that it is possible to detect some broad climate-related patterns among the communities of moorland plants. 'Atlantic heather moor' is typically found through the more equable lowlands and upland margins of north-west Britain. On higher, cooler, ground in the hills of the north and west *Calluna-Vaccinium myrtillus* heath is more dominant. In broad terms this *Calluna-Vaccinium* heath can be regarded as the typical British 'Boreal heather moor', although in the drier conditions of the east-central Highlands of Scotland, which has extremes of temperature, the *Calluna-Arctostaphylos* uva-ursi heath is more common.

Areas where grouse shooting takes place, commonly called 'grouse moors'[170] are not solely composed of typical heather moorland. The latest GWCT grouse moor survey[171] covers 19,780 square kilometres (1.978 million hectares) of the UK, reveals differences in habitat management between groups of estates based on either location or quarry species, and sets this habitat management into its biological context.

The GWCT analysed information from 270 estates covering over 11,750 square kilometres of the British uplands, dividing them into groups based on the main quarry species: red grouse only; red grouse and red deer; and red deer only. The location of the estates within the British uplands determines, through habitat and species availability, the main quarry species. Estates managed solely for red grouse were mainly in southern Scotland, England and Wales. Estates managing both red grouse and red deer were mainly in north-eastern Scotland, with those managed solely for red deer in north-western Scotland. Red grouse estates in

[168] https://backup.ons.gov.uk/wp-content/uploads/sites/3/2017/07/UK-natural-capital-developing-UK-mountain-moorland-and-heathland-ecosystem-accounts-2.pdf

[169] Ibid.

[170] We argue that the 'grouse moor' label is unhelpful as it implies only grouse shooting takes place on an area of land. As we have shown, grouse shooting rarely, if ever, takes place in isolation from other economic activities, although the management of some areas can be largely dictated by the need to support grouse numbers.

[171] https://www.gwct.org.uk/research/species/birds/red-grouse/grouse-moor-survey/

England were smaller than in Scotland by an average of 300 hectares. In Scotland, grouse moors were roughly half the size (3,300 hectares) of the other two types of estate (7,000 hectares). The proportion of the area of moorland on English red grouse estates was also significantly less than in Scotland (39% compared with 47%), with grassland (a combination of improved and semi-natural grassland) making up about 49% of the area compared with 33% in Scotland. Scottish red grouse estates and red deer estates had less moorland than the estates managed for both (48% versus 62%), with red grouse estates having more of their area made up of grassland (33%) than did red grouse and red deer estates (27%). Estates managed solely for red deer had a greater proportion of their area covered by woodland (19%) than did the other estates (red grouse - 14%; red grouse and red deer - 10%).

Between the 1940s and 1980s, moors that stopped grouse shooting lost 41% of their heather cover, while moors retaining shooting lost only 24% (Robertson et al 2001). Historically, a landowner's commitment to grouse management may have dissuaded them from converting moors to other land uses such as forestry or agriculture. As a simplification, in England, the loss of heather moorland was mostly due to agricultural improvement and overgrazing, whereas in Scotland, heather moorland was mostly lost because of agriculture, grazing and forestry.

Grouse moor management comprises of a range of management practices, including predator control, muirburn, grazing management and disease management (Newey et al., 2016; Thompson et al., 2016; Mustin et al., 2018; Littlewood et al., 2019) [172] .These management practices are carried out to maximise red grouse *Lagopus lagopus scotica* numbers for sport shooting. Grouse moor management has been demonstrated to have positive and negative effects on the distribution and abundance of different species and biodiversity (Thompson et al., 2016; Brooker et al., 2018; Mustin et al., 2018). Predator control, the legal killing of crows *Corvus corone*, foxes *Vulpes vulpes*, stoats *Mustela erminea* and weasels *Mustela nivalis* undertaken as part of grouse moor management to minimise predation of red grouse has been shown to benefit other ground nesting birds (Fletcher *et al.*, 2010; Newey *et al.*, 2016; Littlewood *et al.*, 2019 and see Mustin *et al.*, 2018 for recent review), and mountain hares (Patton et al., 2010; Brooker et al., 2018; Hesford et al., 2019). Predator control will suppress the local population of controlled species. However, the wider biodiversity impacts of predator control on the controlled species are poorly understood (Brooker et al., 2018)

5.3.7 MAMMALS

Excluding Cetacea there are 44 native terrestrial mammal species found in the UK (Harris and Yalden, 2008), and an additional 16 terrestrial introductions such as Red-Necked Wallaby, Chinese Water Deer, and American Mink. There are two species of seal. The largest single group of mammals are the bats, with 17 species. Schedule 5 of the Wildlife and Countryside Act (1981) protects all species of bat, and the Wild Cat (apart from in Scotland), Dormouse, Pine Marten, Otter, Red Squirrel and Water Vole (as well as sea mammals). The Mammal Society website[173] lists 11 species commonly found on moorland: mountain hare, weasel, water vole, rabbit, red deer, wild tat, pygmy shrew, mole, field vole and woodmouse. It is not clear why this list does not include the fox, stoat and badger[174], all of which are commonly present on moorland.

[172] https://sefari.scot/sites/default/files/documents/Part%204%20-%20Biodiversity%20Impacts.pdf

[173] https://www.mammal.org.uk/?s=mammals+found+on+moorland

[174] S. Denny has seen several fox earths and two badger setts on moorland in Northern England.

Other mammal species are occasionally found on moorland, and many species of bats are found in the north of England and in Scotland and will fly over moors at certain times of year.

Yalden (2008) states that internationally, uplands hold special mammal communities, especially those found in open landscapes above the tree line. He pointed out that while many mammal species are seriously endangered, uplands generally retain more complete mammal assemblages than lowlands, because variously of their remoteness, lower human population density or better protection status (e.g. as national parks and wilderness areas). Historically, they have often served as refuges for lowland species (for example, in Britain). However, studies into the impacts of integrated moorland management on biodiversity are limited in number and often based on small scale studies (many without control or comparator sites). In addition, the literature examining the impacts of integrated moorland management on biodiversity does not always encompass mammals, for example Grant *et al.*, (2012) looked at vegetation, invertebrates and birds, but not mammals.

The main impacts of integrated moorland management on mammals are through predator control and the maintenance of a heather moorland habitat. Predator control by humans is at least as old as livestock husbandry, and probably older. Reduction of predator numbers specifically to allow an increased harvest of some game species was mainly a nineteenth century development, while the adoption of predator control to benefit endangered species for their own sake belongs to recent decades. In Britain, predator control to benefit small game populations and allow harvesting has been practised for nearly 200 years, and has undoubtedly played a role in shaping the present-day fauna. Although earlier gamekeeping severely reduced the geographical range of several mammalian (and avian) predator species, nowadays predator control is subject to legal restrictions based on species' conservation status and humaneness (Reynolds and Tapper, 1996).

The chief targets of mammal predator control measures are fox, stoat,weasel and feral cats. Hudson, Newborn and Robertson (1997) examined the corpses of red grouse on study sites on grouse moors for a period of 10 years. They found that stoat kills (of grouse) were more prevalent in England, but fox (and large raptors) were more frequent predators in Scotland. Predators were also more abundant in Scotland with the frequency of sightings being positively correlated with the number of grouse killed. Grouse mortality was highest in spring. Obviously, foxes do not just eat grouse. Leckie *et al.* (1998), in their study of moorland in south-west Scotland, found that foxes ate rodents, game birds, lagomorphs, carrion and insectivores. Rodents were the most frequent prey in sites dominated by grass, while gamebirds and lagomorphs were more frequent in heather moorland. As rodent populations increased, so did the numbers eaten by foxes; as rodent numbers decreased, the numbers of game birds eaten increased. It appeared that foxes switched to gamebirds in years, or habitats, where rodents were uncommon. However, the situation may be more complex than Leckie et al suggested. Ludwig, Roos and Baines (2020) report the results of a 27-year study on a moor in south-west Scotland. Their findings suggested that there was increased predation of grouse chicks in years with high vole abundance. The numbers of foxes were only weakly positively associated with vole abundance when their numbers were not controlled, whilst weasel indices showed no relationship with voles. The effect appeared to be high vole numbers attracting buzzards to the moor, which predated on grouse broods when found. But when vole numbers declined on the moor the buzzard hunting would also decrease, presumably moving elsewhere, and predation on grouse would also drop.

The moorland mammal that has generated the most controversy in recent years is the Mountain Hare, as is discussed in more detail in section 6.3, The Situation in Scotland. Here we review recent literature on how integrated moorland management impacts this species. The Grouse Moor Management Review Group

(GMMRG) report[175] to the Scottish Government, November 2019 pointed out that Mountain Hares are considered to benefit from some aspects of grouse moor management, particularly the reduction of predators and the creation/maintenance of mosaics of different ages of heather. However, the GMMRG report also claimed that the evidence-base for Mountain Hares is poor, claiming that, "not only is there no standardized method of counting Hares on moorland, but there is no mandatory formal monitoring of populations. Neither are the numbers of Mountain Hare shot, either for sports shooting and game food, or for management purposes[176], known. As a result, "it is currently not possible to estimate what the population of Mountain Hares in Scotland actually is, nor how it has changed over time." These statements do not, in our view, accurately reflect the findings of peer-reviewed literature.

Our review of the literature indicates that mountain hares benefit from DGS though improved food quality, cover and reduced predation pressure. Crucially, the only place in the British Isles where mountain hares thrive at the uniquely high densities associated with the UK is on grouse moors. Elsewhere mountain hare abundance has declined as grazing has been improved, woodland cover has expanded and predation pressure increased as gamekeeping efforts have declined and protected predator numbers increase. The evidence base for mountain hare range is extensive, including 100 years of bag data, 30 years of presence-absence surveys and three years of abundance estimates. These estimates have been generated by moor managers with no financial support from SNH/NatureScot. Despite this evidence base mountain hare conservation status was deemed by NatureScot to be unsatisfactory-unknown.

The inconsistency in claiming that there is not enough data on mountain hares to assess their status is evidenced by the research[177] which has established that trends in mountain hare abundance indices vary with region and grouse management intensity. Hare populations are higher and relatively stable on moors where driven grouse shooting is practised relative to lower indices and greater declines on moors where grouse were either walked-up or not shot. Mountain Hare numbers fluctuate over time[178] in a quasi-cyclical manner, fluctuations being more pronounced where hares are more abundant, i.e. on driven grouse moors. It is not clear whether these fluctuations are due to resource competition, parasitism or shooting.

It appears that reductions in mountain hare numbers over time probably reflected sampling at decline phases of the cycle, particularly on driven moors, rather than being part of true long-term declines (Hesford 2019). If the UK wishes to have a healthy population of the mountain hares, the evidence is that a management regime that does not involve integrated moorland management is less likely to sustain the species.

[175] Sometimes, incorrectly, called the Werritty Report.

[176] The GMMRG report notes that Mountain Hare management has taken place for four purposes: reducing competition with grouse for food; reducing browsing impact on young trees etc.; reducing the tick burden on red grouse; and reducing parasite burdens on Hares and risk of disease, see p. 39 in file:///C:/Users/simon/Downloads/grouse-moor-management-review-group-report-scottish-government%20(1).pdf

[177] Hesford et al (2019)

[178] Mountain Hares have the potential for high population growth.

5.3.8 BIRDS

The combination of predator control and habitat management can result in some bird species thriving in areas of integrated moorland management. On the Finzean Estate in Aberdeenshire birdwatchers have recorded 135 species[179], including many birds of prey[180]. The GWCT's Upland Predation Experiment[181] found that lapwing, golden plover, curlew, red grouse and meadow pipit bred on average three times more successfully when predator control was performed, compared to the same moorland when predators were not controlled. As a result, breeding numbers increased in subsequent years, but in the absence of predator control, they declined. There also seems to be a positive link between integrated moorland management and the populations of some birds. Results from the Langholm Moor Demonstration Project, described in Ludwig, Roos and Baines (2019), showed that restoring grouse management was beneficial for three wader species; overall, curlew numbers rose by 10% per year on average, golden plover by 16% and snipe by 21%. Their results support the hypothesis that restoring predator control as part of grouse moor management can reverse declines of some wader species. The converse can be seen where integrated moorland management is lost. Analysis of upland bird species trends in southwest Scotland found declines in several upland bird species, including red and black grouse, golden plover, lapwing and curlew, and these are generally attributed to large-scale changes in land use, including afforestation, more intensive farming and reductions in grouse moor management (Whitehead, Hesford and Baines, 2018). Additionally, an analysis of the status of grouse management in the north of England, the Scottish mainland, Wales and southwest of England showed that range contraction for curlew, golden plover, lapwing and dunlin was smallest where grouse shooting was retained and greatest where it had disappeared completely (Aebischer, Ewald and Tapper, 2010). Predator control would seem to be increasingly important if some species of bird are to thrive. The meta-analysis carried out by Roodbergen, van der Werf and Hötker (2012) found that predation of the nests of oystercatcher, lapwing, black-tailed godwit, curlew and redshank, had increase by around 40% since the 1970s across the UK.

However, it is not as simple as saying that integrated moorland management is good for many species of birds; different management practices affect bird species in different ways, a point clearly made by (Douglas *et al*, 2020). This situation can be illustrated by looking at the extent to which muirburn is practiced on an estate. Newey *et al.* (2020)[182] found that curlew and golden plover prevalence generally increased with intensity of muirburn, though golden plover occurrence peaked in the 41-60% burn category whereas curlew increased with greater percentage muirburn. This was particularly the case for these, and the other bird species assessed by the hectad (10km x 10 km) where sample sizes for squares representing intense muirburn were very small. Merlin prevalence increased with increasing intensity of muirburn up to the 41-

[179] As of 24 January 2020 there are 622 species of bird on the British list maintained by the British Ornithological Union. This total includes migrants and such exotics as Ring Necked Parakeets which now breed in southern England, as well as occasional visitors such as Hoopoes.

[180] GWCT (2020) Moorland Conservationists: The Untold Story https://www.gwctshop.org.uk/products/moorland-conservationists-the-untold-story Not all of these bird species were found on upland heather moor, the estate has many different types of habitat.

[181] https://www.gwct.org.uk/research/species/birds/lapwing-and-other-waders/predator-control-and-moorland-birds/#:~:text=The%20Upland%20Predation%20Experiment%20based,and%20abundance%20of%20moorland%20birds.

[182] https://sefari.scot/sites/default/files/documents/Part%204%20-%20Biodiversity%20Impacts.pdf

60% muirburn, and then declined and was absent from the squares with 81-100% burning, whereas kestrel was present at a consistent level across all muirburn categories up to 81%. Interpretation of prevalence at the 81% plus muirburn category is likely confounded by small sample size. Both lesser redpoll and whinchat showed consistent levels of prevalence at low to moderate levels of muirburn and showed increases in prevalence in the 61% and higher muirburn categories. Lesser redpoll prevalence peaked in the 61-80% burn category and the species was absent in the 81-100% category, while whinchat was most prevalent in the 81-100% category.

However, Newey et al point out that their study was restricted to the area for which muirburn data was available and that this was largely from areas where grouse moor management was known to be an important land use. Other areas where burning, either controlled or wildfire, occurred were not studied which. Newey *et al.'s* study is impressive, without a control (an area of moorland where grouse management does not take place but that is subject to burning), thus it is not possible to say that their findings are applicable to all situations. In addition, as they point out, species may be responding to aspects of moorland management other than Muirburn and for the bird species occurrence was likely influenced by the wider landscape.

The management of moorland to support grouse numbers may also benefit some raptor species. Ludwig, Roos, *et al.*(2020) carried out a 27-year study as part of the Langholm experiment. They found that ground-nesting raptors, hen harrier (*circus cyaneus*) and merlin (*Falco columbarius*), increased during periods of grouse moor management and had a higher proportion of successful nesting attempts. Predation was the main apparent cause of breeding failure. In contrast, grouse moor management did not influence either abundance or breeding success of tree- and crag-nesting species, i.e., peregrine (*Falco peregrinus*), common buzzard (B*uteo buteo*), and raven. Buzzard sightings increased during the study, in line with their national recovery, whereas peregrine and raven showed little change in abundance. The results of this study suggest that management for red grouse can benefit both hen harrier and merlin.

Our review of the literature leads us to the conclusion that the maintenance of a mosaic of moorland vegetation (Watt, 1947) as a result of management, and control of predators (chiefly fox, stoat, weasel and crow) results in a habitat that is important for the survival of many rare (Red Listed) bird species.

5.3.9 INVERTEBRATES

Grant *et al* (2012) in their research report (for the RSPB) point out that an understanding of the effects of grouse moor management on moorland invertebrates is limited. While rotational muirburn on dry dwarf shrub heath increased the diversity and abundance of some invertebrate groups (e.g. ground beetles), via increase in the structural diversity of vegetation, unmanaged and degenerate *Calluna* stands were found important for other groups (e.g. lepidopteran larvae). Although invertebrate diversity tends to be relatively low when compared with other habitats, rare species are associated with moorland, including moths, bees, butterflies, various money spider species, craneflies, and ground beetles (Backshall, 2001). For example, the bilberry or mountain bumblebee is only found in bilberry-rich moorlands with heather, which provides nectar late in the summer and protection from the weather. The GWCT and RSPB agree that different management regimes suit different species of invertebrate; butterflies and moths tend to be more diverse and abundant on moorland areas when heather is older, compared to recently burnt areas. Importantly, while the number of species of plants or animals found on heather moorland can be fairly low, those species that thrive are often specialist species not found elsewhere, highlighting the importance of a mosaic of maintained heather moorland for their conservation.

Newey *et al.* (2020) agree with the fundamental point that the invertebrate fauna of moorland tends to reflect its structural diversity and can be quite rich. They observe that invertebrate species respond differently to climatic conditions, vegetation and soil types, and management regimes. Thus, green hairstreak butterflies were most prevalent at low to moderate levels of burning and showed a general decline in prevalence with very high levels of burning. However, the pattern in change in prevalence with increasing burning is not clear. It is possible that more invertebrates are detected in areas that have been intensively burnt because they are easier to find than in areas of dense, high heather and grass.

Eyre, Luff and Woodward (2003) carried out a valuable research project over a five-year period in the Scottish borders with areas of land subject to three different management regimes; management by burning, management by cutting, and management by herbicide application. They recorded 39 nationally rare and scarce species of invertebrate, as well as more commonly occurring species and found that the management of dry *Calluna* moor had a positive effect on the habitat diversity for ground beetles and plant bugs but had little effect on rove beetles and spiders. The most important habitat proved to be on streamside sites, especially sediment. Unsurprisingly perhaps, a number of these rarer species were restricted to sites managed by burning and cutting but other species were only found on unmanaged wet *Calluna* moor. Molinia-dominated moor was generally of poorer quality than *Calluna* sites, with fewer rare and scarce species and lower site rarity values based on the ground beetle species recorded. The highest median site rarity scores were for dry, open, managed *Calluna* sites. They concluded that, in order to maximise both habitat diversity and the incidence of rare and scarce species on grouse moor, a mosaic of both managed and undisturbed patches differing in soil characteristics, plant composition and vegetation structure appears to be required. This recommendation was reinforced by Buchanan *et al.* (2006) who pointed out that, "the differing habitat associations of invertebrates mean that sites with a mosaic of habitat types are liable to support a greater diversity and abundance of invertebrates than homogeneous sites." More recently, Sanderson, Newton and Selvidge (2020) found more invertebrates in the vegetation building-phase (seven-year-old) cut heather than in fresh cut or mature vegetation. Importantly, the GMMRG report concluded that, "there is also evidence that regular muirburn managed in accordance with the Muirburn Code can increase above-ground biodiversity (evidence includes plants, birds, invertebrates) compared with unburnt moorland, particularly in dry heaths, through the creation of mosaics of different ages of heather giving a mix of habitat structures."

The literature strongly suggests that integrated moorland management, including management regimes to enable grouse shooting to take place, by producing a patchwork of heather and other vegetation, is likely to support a richer population and diversity of invertebrates than a heather dominant moor without regenerating burnt, cut or grazed heather patches. However, at the risk of being repetitious, more research is needed before firm conclusions can be drawn.

5.3.10 DISEASES, PESTS AND PARASITES

All environments harbour organisms that are commonly classified as pests or parasites, many of which can cause disease among both plants and animals. This report does not set out to enumerate and describe all diseases, pests and parasites found on moorland, rather it summarizes the literature relevant to those that are most common, and which can have significant economic consequences and implications for the sustainability of DGS.

5.3.10.1 Ticks and Bracken

Probably the most high-profile disease-causing parasite on moorland is the tick. Over 20 species of ticks are found throughout the UK but the Sheep Tick (*Ixodes ricinus*) is most prevalent in upland areas where the creatures they feed on (sheep, deer, rabbits, hares, birds, lizards and rodents) live. However, they are increasing their distribution, especially in woodlands and are now found in urban areas and even on beaches. The 'headline' disease caught by humans from tick bites is Lyme disease (not all ticks carry Lyme disease). Lyme disease is an infection caused bacteria belonging to the *Borrelia* genus, notably *Borrelia burgdorferi*. *Borrelia* are spirochete (spiral-shaped) bacteria, and have many similarities to the syphilis organism. The number of people that contract Lyme disease in a year is unknown, but evidence suggests it is rising. Data from Public Health England show that there were 1,534 confirmed cases of Lyme disease in England in 2017, compared with 1,134 cases in 2016[183]. There is, however, likely to be significant under-reporting owing to a combination of factors. It was estimated at an internal NIHR (National Institute for Health Research) working meeting in February 2020 that there could be as many as 18,000 new cases of Lyme Disease confirmed in the UK in 2020, against about 4,000 in 2015[184].

The risks to health from tick-borne diseases are serious, and under-estimated[185]. Professor Roy Brown has written that, "the number of tick-borne diseases is increasing dramatically (seven diseases currently pose serious health risks to birds, mammals and people in the UK). The rates of infection in ticks and multiple pathogen loads are also increasing. New pathogen strains (e.g. the Flavivirus causing Tick Borne Encephalitis [TBE]) have become 'native' in the UK in the very recent past. " Lyme Disease is a 'headline' problem but there are several other chronic (as well as acute) tick transmitted infections affecting a much larger number of people, as well as companion animals, stock and wild mammals and birds."

The impact of tick-borne disease, such as louping ill[186], tickborne fever, babesiosis and tick pyaemia, on moorland livestock can be very serious. Sheep can be badly affected by louping ill virus, as one moorland owner said, "our shepherd began to notice symptoms in some of the lambs and at that point we had sheep and grouse tested for the louping ill virus. The tests proved 84% positive and the vet said it was the worst case he had seen." [187]

In moorland areas ticks are particularly prevalent in bracken. Dense bracken covers about 900,000 hectares in the UK and is increasing by between 1 – 2% p.a. Bracken is present and increasing on a further 700,000 hectares. A bracken control company director[188] pointed out that bracken, "holds c. 70% of the tick load on

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[183] https://www.guidelinesinpractice.co.uk/infection/lyme-disease-when-to-suspect-and-how-to-manage/454252.article

[184] Professor Roy Brown, 29 May 2020. Professor Brown is Visiting Professor in Epidemiology and Invasive Species Control at the University of Lincoln and a specialist researcher/consultant working in the environmental control of hard bodied ticks and Tick-Borne Diseases in the Northern Hemisphere at the habitat/landscape scale through the research company ' R & D Applied Biology' in North Yorkshire.

[185] Tick-borne diseases include arborvirus (which includes Tick-Borne Encephalitis and the Flavivirus group. Ebola and Zika are members of this group); protistans; bacteria (including Lyme Disease); tick paralysis; and alpha gal syndrome.

[186] Louping ill seems to have been present in the UK for c. 800 years, and has been recorded for more than 200 years in sheep flocks. As sheep farming expanded to the uplands in the nineteenth century, grouse were exposed to louping ill https://www.gwct.org.uk/research/species/birds/red-grouse/controlling-louping-ill/#:~:text=From%20the%20blood%20samples%20we,start%20of%20the%20shooting%20season.

[187] GWCT (2020) Moorland Conservationists: The Untold Story https://www.gwctshop.org.uk/products/moorland-conservationists-the-untold-story

[188] Interviewed on 20 May 2020 by S Denny

a moor". Moreover, in the UK changes in land use policy and the climatic gradient have encouraged bracken growth over the last 30 years and not only does the plant hold the majority of the ticks on a moor, but tick numbers are increasing rapidly. Moor owners and gamekeepers in England and, especially, North Wales and Scotland report ticks as being a 'massive problem'. In Scotland ticks were described by an owner of a 25,000 estate as endemic[189].

As well as being a host for ticks, bracken is also a disease-causing organism in its own right. Although the young fronds of bracken are eaten by people in some parts of the world (for example Japan) it is toxic containing carcinogens linked with, among other illnesses, oesophageal and stomach cancer, ovotoxicity, bone marrow depression and blindness. In addition to this direct toxicity to animals and humans due to a number of poisoning and growth impacting chemical groups within the spores, frond, rhizome and true root systems, bracken also impacts through the action of the living plant and litter on the soil and water systems in the habitat, including direct toxicity in drinking water (O'Driscoll et al 2016).

On estates where grouse shooting occurs, landowners, gamekeepers and farmers/graziers combine activities to control both bracken and tick numbers. The reduction in tick burden on managed moors reduces the health risks for both wild and domesticated animals, and humans. However, the steady increase in the distribution and numbers of ticks means that their impact on animals, including humans, is likely to continue to be a significant problem unless treatments evolve with diseases

5.3.10.2 The diseases of grouse

Grouse can be very seriously affected by louping ill, and the virus is associated with high levels of mortality, with 79% of grouse chicks dying from the virus in both laboratory and field conditions.[190] Fortunately sheep can be vaccinated and treating with tick-killing pesticides such as acaricides, and where this is done both sheep and other animals, including grouse, are less likely to suffer from louping ill. The development of acaricide resistance by ticks is a, as yet unrecorded, concern.[191]

In addition to diseases carried by ticks, the red grouse is also assailed by other maladies including the strongyle worm and respiratory cryptosporidiosis[192].

Trichostrongylus tenuis, also known as the strongyle worm, is a gut nematode found in the United Kingdom. This endoparasite causes a condition often called strongylosis or 'grouse disease'. When the adult worm burrows into the caeca walls it causes a lot of damage and internal bleeding which in itself is harmful to the grouse. The worms ultimately reduce the digestive efficiency thus affecting the condition of the grouse. The GMMRG report, November 2019, pointed out that the presence of the strongyle worm in the gut of red grouse can cause cyclical fluctuations in grouse numbers every 6-9 years. Strongylosis can be controlled by using a medicated grit, normally quartz, coated with a worming agent, currently flubendazole, which is also

[189] Interviewed on 20 May 2020 by S Denny

[190] https://www.gwct.org.uk/research/species/birds/red-grouse/controlling-louping-ill/#:~:text=From%20the%20blood%20samples%20we,start%20of%20the%20shooting%20season.

[191] https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/acaricide

[192] The protozoan parasite *Cryptosporidium* infects all major vertebrate groups and causes significant diarrhoea in humans, with a spectrum of diseases ranging from asymptomatic to life-threatening. Children and immunodeficient individuals are disproportionately affected, especially in developing countries, where cryptosporidiosis contributes substantially to morbidity and mortality in preschool-age children. Despite the enormous disease burden from cryptosporidiosis, no antiprotozoal agent or vaccine exists for effective treatment or prevention. Source: Sponseller et al (2014)

commonly used to treat worm burdens in humans, sheep and cattle. This medication is only available for use with a veterinary prescription and must be withdrawn from use at least 28 days before the grouse are shot and put into the food chain. The use of medicated grit, which should be placed on bespoke trays across a moor, has substantially suppressed strongylosis. As the GMMRG report points out, given that previous efforts at controlling the strongyle worm without medicated grit were unsuccessful, and ever-increasing pressure on grouse by protected predators (as evidenced from the Langholm Moor projects), its use is now deemed essential if grouse levels are to be kept high enough to yield a harvestable surplus. The GMMRG stated that, 'having reviewed the written and verbal evidence presented to the Group we find that, when used correctly, flubendazole is a widespread treatment that has proved highly effective in reducing endemic strongyle worm levels in grouse guts. Also, when used correctly, its residues in grouse for human consumption currently appear to present a very low risk. As past efforts of controlling strongyle worm burdens have not worked, the use of medicated grit is a key factor in maintaining consistent grouse numbers year on year.' Best practice guides for the use of medicated grit are readily available[193].

It is important to note that, in common with nearly all aspects of integrated moorland management, there are a number of important evidence gaps in the use of medicated grit. As the GMMRG report observes 'although there is as yet little evidence of a resistance problem with the use of medicated grit, more research is required on the potential development of such resistance and its implications….there is some evidence that flubendazole is toxic to aquatic organisms; accordingly GWCT guidance recommends that grit trays be located no closer than 5m to running or standing waters. At present the Scottish Environment Protection Agency (SEPA) does not test for the presence of flubendazole contamination in water bodies. Current testing for flubendazole residues in the food chain is based on a small number of grouse samples each year and it is unclear what level of contamination would constitute a threat to human health.' There is also a possibility that if many grouse visit a grit tray, *Cryptosporidium* might spread. However, this disease had only been detected once on grouse moors in Scotland up to 2019.

The first instance of a grouse in the UK infected by *Cryptosporidium baileyi* was diagnosed in 2010. By 2013, signs of infection were reported from grouse on half of all grouse moors in northern England, bringing severe concerns of economic losses to grouse shooting (Baines et al 2020). The prevalence of respiratory cryptosporidiosis has been shown to vary with age, being twice as common in juveniles (4.5%) as in adult birds (2.4%). Birds shot later in the season are more like to have the disease than those killed earlier. Baines et al suggest that disease incidence is highest in naïve juveniles that have previously not been exposed to infection, with prevalence dropping as birds develop immunity. Their study, "found no evidence of increased prevalence over time, and fears of escalated disease prevalence, bringing with it increased mortality and lowered productivity, that may have significant impacts on the economic viability of shoots, have not yet been realized."

5.3.10.3 Heather Beetle

The heather beetle *Lochmaea suturalis* is a naturally occurring species in the heather dominated landscapes of the United Kingdom (Gilingham, 2016; Pinder et al., 2015). The beetles' favoured diet seems to be *Calluna vulgaris* (ling heather) but it can also feed on ericaceous heaths such as bell heather and cross-leaved heath which are both also common in moorland areas. The beetle attacks heather by scraping the plant's outer

[193] See for example, https://www.gwct.org.uk/media/502626/medicated-grit-guidelines.pdf

surface that helps its leaves retain water, thus exposing the plant to risk of drying out. The plant responds to this risk by cutting nutrient supply to the affected parts, thus causing it to appear dead. The Heather Trust[194] points out that, "periodically, heather beetle populations expand into huge outbreaks, in which millions of beetle grubs can decimate hundreds of hectares of carefully managed heather. The Trust has long been concerned about the potential for heather beetle to devastate heather moorland on a wide scale." Whether or not heather dies or survives a heather beetle outbreak appears linked to the stress that the plant is already under; pre-existing drought, waterlogging, crushing and heavy grazing are common features where heather dies back after beetle damage.

Different methods of controlling heather beetle numbers have been tried, but there does not appear to be a 'best practice' management regime at present. A study commissioned by the Heather Trust (The Peak District Heather Beetle Project[195]) reported in 2019 that there was no difference in heather regeneration from plots treated with the three different management approaches of cutting, burning or control (i.e. do nothing) when considered in the long term. This suggests that many heather beds affected by the beetles are as likely to recover in the absence of specific active management as with it. It is possible that biological controls based on the heather beetle's natural predators and parasites might be developed. However, more research will be needed in order to properly assess the effectiveness of such methods.

The impact of severe outbreaks of heather beetle on grouse numbers is significant and, in some years, results in too few birds to enable shooting (either driven or walked-up) to take place. As the section on the economic impacts of driven grouse shooting points out, the negative consequences of seasons with no shooting are not limited to moor owners but affect a wide range of businesses and individuals.

5.3.11 BIOLOGICAL DIVERSITY

As Feest et al (2010) pointed out, there is no internationally accepted definition of biodiversity, the contracted term used for the concept of biological diversity. However, for the purposes of this report the authors will use the term biodiversity to mean the variety and variability of living organisms (Levin 2001) found on and in moors where integrated moorland management includes driven grouse shooting.

Assessing the biodiversity of an area is not simple. Detailed surveys of flora and fauna, as well as geological forms, take a great deal of time and effort. As a result, important areas for conservation are typically identified using a subset of well- known species, commonly termed surrogate or indicator groups. Birds have been commonly used as biodiversity surrogates due to the good level of knowledge on their taxonomy, ecology and distribution. Raptors in particular have been often proposed as an effective surrogate for other biodiversity based on their dietary diversity, being at the top of the food chain, their preference for highly productive areas, their generally threatened status and high public appeal. However, using raptors for this purpose may be a mistake. Santangeli and Girardello (2021) found that raptors perform marginally worse than all other avian species in representing important biodiversity areas and ecoregions. If the findings of this recent study are replicated, then the attention given by some groups to hen harriers and other charismatic raptor species might need to be re-thought.

In the UK SSSIs are areas that are deemed important for biodiversity. According to the Department for Environment, Food and Rural Affairs (Defra) In England SSSIs cover approximately 50% of habitat considered

[194] https://www.heathertrust.co.uk/heather-beetle

[195] https://01a393a3-c4d4-4ca5-885d-c2330c108548.filesusr.com/ugd/fdc287_d96c2aa4f7874c2a983a61c94ac98c8f.pdf

to be of conservation priority under the UK Biodiversity Action Plan. This includes 95% of key coastal habitat, 86% of woodland and 72% of heathland. There are over 4,000 Sites of Special Scientific Interest (SSSIs) in England, covering about 7% of England's land area. Over half of them, by area, are internationally important for their wildlife, and designated as Special Areas of Conservation (SACs), Special Protection Areas (SPAs) or Ramsar sites. The purpose of SSSIs is to safeguard, for present and future generations, the diversity and geographic range of habitats, species, and geological and physiographical interest features. In Scotland there are 1,422 SSSIs, covering around 1,011,000 hectares or 12.6% of Scotland's land area. Sites range in size from the very small, like Bo'mains Meadow SSSI, at just under a hectare, to the vast Cairngorms SSSI, which extends to more than 29,000 hectares.

The amount of land designated as SSSI can be used as an approximate measure of environmental quality and biodiversity. Based on this logic, it is interesting to note the findings of the GWCT's Grouse Moor Survey[196]. The results of the survey showed that, on average, SSSIs make up 16% of the upland area of Britain, and the shooting estates in the GWCT survey covered 15% of upland areas. However, shooting estates accounted for 29% of upland SSSI areas, compared with an expected 16% if grouse moors were randomly distributed. The GWCT states that, "many SSSI designations in the uplands were originally made because of the habitats and species on moorland, which can be supported by grouse management. Some of the best examples of heather moorland in the UK are designated as Sites of Special Scientific Interest (SSSIs) and 'Natura' sites – Special Protection Areas (SPA) and Special Areas of Conservation (SAC) – in recognition of their importance. In England, 74% of upland SPAs are managed as grouse moors. However, on some grouse moors inappropriate burning or the lack of agreed heather management plans have led to the classification of the site as being in unfavourable condition."

Inevitably the evidence for the contribution of integrated moorland management, including grouse shooting, to biodiversity is incomplete. However, compared with upland areas where grouse shooting does not take place, the biodiversity of 'grouse moors' seems to be at least as rich, if not richer.

5.3.12 MULTIPLE STAKEHOLDERS

Integrated moorland management involves multiple stakeholders. At a very local level there can be different stakeholders trying to make a living from an area of land. For example, an owner of a moor in Wearside has shooting rights over c. 5,500 acres (c. 2,226 hectares) of land, consisting of three pieces of joined moor. He has his own sheep on one area of land that he farms in-hand, and graziers have the sheep rights over the other two areas. Another landowner near Alston in Northumberland owns a moor that is part common land, and part freehold. He has to work with 10 long-established local upland farms to coordinate moorland management activities, as well as shooting. A land agent observes that a lot of grouse moor in England is common land, "there are different interests: who owns the land, who has grazing rights, who has shooting rights; these can all be different people."[197] As well as those individuals directly involved in activities on the moors, governmental agencies, interest groups, and local communities all have a legitimate interest in moorland management and its outcomes. Unsurprisingly, disputes between stakeholders do arise. A lawyer, specializing in land disputes, remarked, "you do get areas of dispute where parties have competing interests

[196] https://www.gwct.org.uk/research/species/birds/red-grouse/grouse-moor-survey/

[197] Interview with S Denny 15 May 2020

on the land. I have not come across disputes between local communities and shoots, it tends to be specific action groups that take action",[198] an interesting observation.

Disputes between stakeholders are not inevitable and multi-stakeholder initiatives can be successful in tackling complex sustainability issues, provided that different perspectives can be reconciled, which is not always possible (Dentoni, Bitzer and Schouten, 2018). However, other studies have demonstrated that the application and deliberation of shared mental schemata for making sense of the world can result in shifts in entrenched positions and positive shared outcomes provided, of course, that participants are open to reason and discussion (Zimmermann, Albers and Kenter, 2021). As noted elsewhere in this report, the criminal damage[199] and threatening behaviour of some individuals opposed to grouse shooting suggest that they are not interested in developing shared outcomes with other stakeholders.

From media reports it is possible to get the impression that there is always conflict between some groups of stakeholders, for example between gamekeepers and the RSPB. However, at a local level it is clear that very often there is close collaboration between these of stakeholders. On the Finzean Estate in Royal Deeside, Aberdeenshire, the gamekeeper has worked with local RSPB officials to ring golden eagle nestlings whose parents have breed successfully on the estate for some years[200]. The Edinglassie estate, also in Aberdeenshire, is part of the RSPB Grampian Wader and Wetland Initiative, while the Bolton Castle estate in Wensleydale, North Yorkshire, hosts an annual curlew conference and works closely with the British Trust for Ornithology, the local Nosterfield Nature Reserve, and members of the International Wader Study Group[201]. As well as individual initiatives, some organisations overtly set out to bring people with different perspectives and beliefs together. The Heather Trust has as its mission, 'To develop and promote sustainable, resilient moorlands through facilitation and collaboration; engagement and representation; education and demonstration based on research, experience and best practice.'[202] The Trust was described by its Director as a 'reconciliation project' that aims to bring together the various interest groups that are involved with land use on the moors[203].

Evidence from both primary sources and the literature indicates that where people and groups are prepared to discuss their points of view, share information about what they do and the impacts they have, accommodation and cooperation are common. Multiple stakeholder working is sustainable provided that people act in accordance with the law.

[198] Interview with S Denny 5 June 2020

[199] In 2021 a single moor in the North of England had over 80 legal predator traps destroyed by people opposed to grouse shooting.

[200] GWCT (2020) Moorland Conservationists: The Untold Story https://www.gwctshop.org.uk/products/moorland-conservationists-the-untold-story

[201] Ibid.

[202] https://www.heathertrust.co.uk/

[203] Interview with S Denny, 22 May 2020

5.3.13 ARE THE BIODIVERSITY IMPACTS OF INTEGRATED MOORLAND MANAGEMENT SUSTAINABLE?

The range of economic activities involved in integrated moorland management suggests that the majority of areas where driven grouse shooting takes place have developed a sustainable model of operation; although in some areas there is a dependency on landowners and tenants who are prepared to subsidise moorland management[204]. These areas have developed over the centuries a unique, diverse and apparently sustainable flora and fauna, the extent and richness of which has been (and presumably will continue to be) influenced by government policy and funding regimes. So, while heather cover was reduced by overgrazing encouraged by a desire to increase food production, it has increased (in some areas) by different policies designed to achieve a more diverse natural environment. Legislation protecting raptors and other species has resulted in their reappearance or increase on many moors.

If people, both the public and governments, continue to value heather moorland landscapes, then they will need to be maintained. The authors conclude that the current model of integrated moorland management, that includes as part of the economic and social mix, DGS, is a sustainable approach to maintaining such landscapes. It is not clear what other management regimes would deliver the same result. The evidence presented in the section 6.5 on Alternative Uses makes clear that these alternatives would not maintain the current landscape and biodiversity but result in very different impacts. It depends on what is valued.

However, there are threats to the sustainability of the integrated moorland management model. Whether driven by rising temperatures or other factors, the increasing numbers of ticks, the increasing number of dangerous diseases they transmit, and their possible future resistance to pesticides, could pose a significant problem for humans and other animals that venture onto the moors. In addition, there is always the risk of existing grouse disease control measures becoming ineffective, or new diseases emerging for which treatment is not available. Finally, if rising temperatures do lead to increased populations of heather beetle, then the sustainability of the heather-clad moorland, and the grouse, will be seriously compromised. Of course, all alternative uses of moorland face future threats.

We conclude that, assuming government policy is based on evidence rather than emotions of a limited number of individuals and groups, the biodiversity of integrated moorland management, including DGS is sustainable and should be maintained. However, we are less sanguine about the long-term sustainability of the model in the face of rising temperatures and disease.

[204] The fact that some landowners and tenants subsidize integrated moorland management does not mean that it is unsustainable. As we point out in section 4.3, grouse moor ownership may result from inheritance, but is more frequently as a result of purchase. Assuming the UK will continue to have, or attract, rich people some of them are likely to invest in moorlands.

5.4 INTEGRATED MOORLAND MANAGEMENT: SUSTAINABLE NATURAL CAPITAL?

It is difficult to do much with moorland. A combination of bedrock, soil types, climate and altitude has produced a landscape and vegetation that cannot support intensive agriculture, or forestry 500 – 600 m. above sea level. Moreover, most of the UK's moorland is remote and sparsely populated. Although mineral extraction has taken place on some moors in the past, few viable deposits remain. With the exception of some light industry[205], the economy of moorland areas is dominated by agriculture and forestry, tourism, and integrated moorland management.

What governments and society want and need from moorlands has evolved over time, and wants and needs have not always been the same. The post-1945 focus on maximizing food production and increasing commercial non-native forestry has now been modified, at least for the short term. Single, or non-integrated, policy approaches are now being cited as contributors to a loss of biodiversity, a degradation of vegetation and soil, and increases in carbon release and flooding. Partly in consequence of these negative impacts, policy makers in the UK currently have a focus on natural capital and ecosystem services. This chapter will explore the extent to which integrated moorland management, including DGS, provides natural capital and delivers ecosystem[206] services. It will highlight that we are an early stage in our development and application of these concepts.

5.4.1 WHAT ARE NATURAL CAPITAL AND ECOSYSTEM SERVICES?

The publication in 1980 of a 'World Conservation Strategy', and the 1991 document 'Caring for the Earth', by the International Union for Conservation of Nature (IUCN)[207] are some of the earlier initiatives in shaping the concept of natural capital. The IUCN's emphasis on sustainable use "based on scientific and socio-economic standards, taking into account traditional knowledge, and the principle of the equitable allocation of resources and the distribution of benefits" has informed thinking about natural capital. The IUCN has also strongly influenced this current report's examination of the sustainability of driven grouse shooting against environmental, economic and social dimensions.

Inevitably, there are different definitions of natural capital and ecosystem services, although the differences are typically only minor. The Natural Capital Forum[208] defines natural capital as the world's stock of natural assets, which include geology, soil, air, water and all living things. Ecosystem services are services that people derive from natural capital (a top-down model) and which make human life possible (Bouma and van Beukering, 2015). Therefore, ecosystems services include food, water, plant materials used for fuel, building materials and medicine, but also climate regulation and natural flood defences provided by forests, carbon stored in peat, and pollination of crops by insects. Additionally, and importantly, there are cultural ecosystem services resulting from the cultural, educational and amenity-based social impacts people that people get from the environment. Defra takes a slightly different view in defining natural capital as the sum of

[205] Such as the Wensleydale Creamery https://en.wikipedia.org/wiki/Wensleydale_Creamery

[206] The term 'ecosystem' was coined by Tansley, (1935) as a way of describing the basic units in nature in which plants, animals and habitat factors of soil and climate interact in one system.

[207] https://www.iucn.org/

[208] http://naturalcapitalforum.com/about

ecosystems (a bottom-up model) that provide food, clean air and water, wildlife, energy, wood, recreation and protection from hazards.[209]

In theory the natural capital and ecosystems services models lend themselves to measurement. Several natural capital accounting tools and key indicators have been developed and tentative steps have been made to put financial values on both positive (benefits) and negative (costs) impacts of ecosystems. In March 2015, as part of the Office for National Statistics and Department for Environment, Food and Rural Affairs (ONS-Defra) Natural Capital Project, the Natural Capital Accounting 2020 Roadmap was published[210]. This roadmap set as one of its objectives the development of eight habitat-based ecosystem accounts, one of which was for mountains, moorlands and healthlands (MMH). The development of an ecosystem account for MMH was described in 2017[211] and feedback was sought from 'experts in all disciplines'. In July 2019 ONS published its first iteration of UK natural capital: mountains, moorland and heath accounts[212]. However, measurement systems such as that developed by the ONS, while noble in intent, suffer from a common weakness in that they are attempting to measure the immeasurable with imperfect instruments, a situation the ONS recognises. Moreover, the research on which ecosystems accounts are based do not always consider all the evidence, and inevitably they are not up-to-date. To give just two examples: firstly, the ONS MMH ecosystems account of 2019 includes the positive impacts of wind turbines, but does not take into account the negative ones, which we explore in the section of this report examining renewable energy. Secondly, the document describing the development of a MMH ecosystem account (ONS, 2017) claimed that golden eagles and other raptors were an indicator of biodiversity[213]. However, as we note in section 5.3, Integrated Moorland Management: Sustainable Biodiversity, Santangeli and Girardello (2021) found that raptors *perform marginally worse than all other avian species* in representing important biodiversity areas and ecoregions.

However, while accepting the inevitable imperfection of such ecosystem services instruments that do exist, we believe the concept that natural capital results in benefits to mankind is helpful. Furthermore, applying (albeit with caveats) the indicators and measurements that exist may enable indicative comparisons between different land-management regimes to be made.

The 2019 ONS MMH ecosystems account publication states that MMH areas provide many services both to the economy and to society and presents "initial and highly experimental estimates" of the flow of services expressed in monetary and non-monetary units. The ONS points out that MMH ecosystem services accounts presented "are partial as it was not possible to estimate monetary and non-monetary units for all of the services that MMH provide and there are some services provided that are not captured in the account." The ecosystem services are split into provisioning, regulating and cultural services, detailed in table 5.2 below. Despite their admitted imperfections, the analyses produced by ONS are worth examining as they indicate how policy makers are thinking about categorizing the goods and services produced by the natural environment, and how they are beginning to be valued in financial terms. Any examination of the

[209] https://www.gov.uk/government/news/natural-capital-tool-launched-to-help-protect-the-environment

[210] https://webarchive.nationalarchives.gov.uk/20160106130009/http://www.ons.gov.uk/ons/rel/environmental/uk-natural-capital/natural-capital-accounting-2020-roadmap--interim-review-and-forward-look/index.html

[211] https://www.ons.gov.uk/economy/environmentalaccounts/articles/uknaturalcapitaldevelopingukmountainmoorlandandheathlandecosystemaccounts/2017-07-21

[212] https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/uknaturalcapital/mountainsmoorlandandheathaccounts#what-is-the-asset-value-of-mountains-moorlands-and-heath

[213] The recommended sources for this claim were the Breeding Bird Survey, the RSPB and Scottish Natural Heritage.

sustainability of DGS must take account of this thinking and identify evidence that contributes to the accuracy and relevance of these models.

TABLE 5.2 EXTRACT FROM ONS 2019 PUBLICATION SHOWING ENVIRONMENTAL SERVICES PROVIDED BY MMH. SOURCE: OFFICE FOR NATIONAL STATISTICS[214]

Natural service provided by MMH	Included in ONS 2019	Not included in ONH 2019
Provisioning	Wind power	Reared animals and their outputs
Products such as food, water and fuel		Wild animals[215] Freshwater Peat extraction Biomass-based energy resources
Regulating	Carbon sequestration	Flood risk mitigation
Benefits such as water purification, climate regulation, noise and air pollution reduction and flood hazard reduction	Air pollution removal by vegetation Waste detoxification	
Cultural	Recreation	Science and education
Non-material benefits, for example recreational enjoyment and aesthetic experience	Field game sports[216]	Spiritual, symbolic and other interactions

ONS estimates the asset values of these services as being worth over £20 billion a year to the UK, as shown in table 5.3. It is stressed that the figures in table 5.3 are indicative only.

[214] https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/uknaturalcapital/mountainsmoorlandandheathaccounts#what-ecosystem-services-do-mountains-moorlands-and-heath-provide

[215] As we observe in section 5.2, on The Economics of Driven Grouse Shooting, grouse are a valuable commodity and people pay significant sums to both shoot and eat them.

[216] We point out in section 5.5 that field sports have long been a cultural phenomenon for many people, rather than purely recreation.

TABLE 5.3 **UK MOUNTAINS, MOORLANDS AND HEATH ASSET VALUES (£ MILLIONS) BY SERVICE, 2014 AND 2017: SOURCE OFFICE FOR NATIONAL STATISTICS**[217]

Service	Value 2014	Value 2017
Carbon sequestration	9,898	10,576
Air pollution removal	385	391
Recreation	9,769	9,174
Total	20,052	20,141

On a much smaller scale, NatureScot has also attempted to estimate the financial benefits derived from the natural capital produced from National Nature Reserves in Scotland[218]. The publication, 'Piloting Natural Capital Accounts on SNH Land'[219] presents a balance sheet of public and private costs and benefits. For example, public benefits include gains for free such as carbon sequestration and private benefits include the income that SNH receives from sales of food raised on nature reserves. It should be noted that the values are for the benefits provided during the life of the asset of 60 years, in line with government guidance. NatureScot estimates that the total sum of private and public benefits over 60 years is £683 million. Perhaps inevitably, the services and benefits that NatureScot identifies are slightly different from those considered by the ONS. The benefits that have monetary values attached to them by NatureScot are: food, energy, carbon sequestration, air quality, physical health, recreation and tourism, education and volunteering, and wildlife. Again, it is stressed that the figures in table 5.3 are indicative only.

5.4.2 INTEGRATED MOORLAND MANAGEMENT AND NATURAL CAPITAL

In section 5.5 on the social impacts of DGS we review the cultural indicators of natural capital in some detail and which we suggest contribute new thinking to the understanding of ecosystem services. We examine the economic outputs of MMH in section 5.2 and, again, believe that our model of benefits is new and adds value. In addition, we have examined recent evidence on the implications of integrated moorland management on biodiversity. Therefore, in this section we focus on the key natural capital indicators of air, water and carbon sequestration. This focus requires an examination of the literature on vegetation management especially burning and particle emission, water quality and water levels, and peat formation, topics which are intimately integrated with each other. These issues are not purely of academic interest. Achieving net zero greenhouse gas emissions by 2050 is now a statutory requirement for the UK.[220]

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[217] https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/uknaturalcapital/mountainsmoorlandandheathaccounts#what-is-the-asset-value-of-mountains-moorlands-and-heath

[218] Not all National Nature Reserves in Scotland are classified as MMH, see https://www.nature.scot/enjoying-outdoors/scotlands-national-nature-reserves

[219] https://www.nature.scot/sites/default/files/2019-12/Testing%20a%20Natural%20Capital%20approach%20on%20SNH%20land%20-summary_0.pdf

[220] http://publications.naturalengland.org.uk/publication/5419124441481216

5.4.3 PEATLANDS AND CARBON

Peatlands are a type of wetland that occur in most countries. They are defined by the dominance of peat, a soil with an organic content greater than 35%. The high organic content results from dead vegetation which only partially decays due to waterlogged conditions; peat accumulates where the production of organic matter exceeds its decomposition. Importantly for a world where climate change is a major problem, carbon is the key component of peat. Some estimates suggest that the world's peatlands store twice as much carbon as all the world's forests[221]. Globally, peatlands have been severely over-exploited and damaged by drainage, agricultural conversion, burning and mining for fuel. At a national level, the British Ecological Society has identified that a priority for nature-based solutions (NbS) is the restoration of the UK's peatlands, which could contain around three billion tonnes of carbon, but may be emitting 2.3 million tonnes of CO_2 annually[222]. The accumulation (sequestration) of carbon and limited release (storage) is significant in action against climate change because of the huge amounts of carbon stored in UK peat, and its potential release as a greenhouse gas. But in 2021 Natural England stated that less than 1.3% of England's peatlands remain in a near natural state, with the rest having been affected by peat extraction, grazing, fire, and drainage for agriculture and forestry planting[223].

Over 25% of the UK land area is classified as uplands, the bulk of which have vegetation comprised of blanket bog, dwarf-shrub heath (including heather) and acid grassland. Long-term bog development in the UK, mainly since the end of the last glacial period, has resulted in extensive peat cover, except on steeply sloping ground. Blanket bog is a long-term carbon sink, but has the potential to emit large amounts of methane potentially causing a net positive contribution to greenhouse gas (GHG) emissions and thus to global warming (Heinemeyer et al., 2019). Importantly, the UK has about 15% of the globally rare blanket bog habitat (Ibid).

While most peatland in the UK is not found on moorland, it is estimated that England's total upland peat area emits around 603,000 tonnes of CO_2 per year, which is 5.6% of the total peatland greenhouse gas emissions in England. The remaining 94% of England's peatland emissions come from lowland peat[224]. The GWCT points out that peatland under grouse moor management represents only a portion of this upland peat, although c. 30% of the UK's blanket bog is managed for red grouse by encouraging ling heather (*Calluna vulgaris*) cover (Heinemeyer et al., 2019). Using data from the Moorland Association, GWCT estimates put the amount of carbon stored in peat on grouse moors at between 66 and 205 million tonnes, which is 11-35% of the total carbon stored all English peatlands. The organization goes on to estimate CO_2 emissions from grouse moors and found that English grouse moors emit around 1-5% of the net CO_2 emissions from England's peatlands per year. Thus the GWCT claims that English grouse moor CO_2 emissions are therefore proportionally well below the proportion of carbon that they store, compared to other peatland uses[225]. In addition, there have been considerable efforts made over the last couple of decades to reverse blanket bog degradation and increase resilience to climate change through restoration measures including blocking of grips and gullies, revegetating bare peat, reintroducing Sphagnum and other vegetation species, removing trees and scrub, and use of mowing to encourage an active blanket bog vegetation (Heinemeyer et al., 2019). It is recognized that there is considerable potential from peatland restoration and moving away from

[221] www.unep.org/news-and-stories/story/peatlands-store-twice-much-carbon-all-worlds-forests 1 Feb 2019

[222] https://www.britishecologicalsociety.org/event/nature-based-solutions-for-climate-change-in-the-uk/

[223] http://publications.naturalengland.org.uk/publication/5419124441481216

[224] https://www.gwct.org.uk/policy/briefings/carbon-storage-on-grouse-moors/

[225] https://www.gwct.org.uk/policy/briefings/carbon-storage-on-grouse-moors/

management practices driven by single policies (e.g. maximizing food production, or afforestation) that should result in peat formation and long-term carbon sequestration (Ibid.)

Before examining the literature on the impacts of integrated moorland management on CO_2 emissions or sequestration, it is important to note that terms such as moorland, peatland and blanket bog are often used interchangeably, either deliberately or casually. As the IUCN points out, in the UK there is 'no single formal definition of 'peat' and 'peatland, differing interest groups having differing definitions[226]. Although the UK is a signatory to the IUCN, management of peatlands is devolved, which has resulted in both differing definitions of such terms as 'deep peat'[227] and different regulatory and thus differing management regimes. The lack of consistency in definition and management poses problems for the identification and measurement of ecosystem services. Additionally, in the UK the term 'peatland' is only broadly descriptive. The areas of 'peatland' encompass a mosaic (Watt, 1947) of management; different surface flora (and fauna); variable qualities of organic 'peat' soils; dry to saturated soil (the hydrology); and different approaches to preventing damage and enhancing function. It has been estimated that England has 14,185km^2 of peatland with 34% of that classified as deep peat and 25% blanket bog. However, in England deep peat and blanket bog are not synonymous – almost all blanket bog is deep peat, but there are large areas of deep peat that are fens (often badly degraded)[228]. Moorland is a term which is often, and incorrectly, used interchangeably with peatland. In fact, moorland includes upland heathland, blanket bog, upland grassland, bracken, scrub, native woodland and exposed rock as well as peat. There is peat, including deep peat, on moorland, but not all moorland is peatland.

5.4.4 AIR, WATER AND CARBON

As noted above, the focus of this section is on how integrated moorland management impacts on natural capital and ecosystem services. Therefore, it is necessary to examine the ways in which management regimes affect air and water quality, and carbon capture or release. It is also necessary to compare the impacts of integrated moorland management with the alternative uses of moorland that this report has identified. This examination and comparison are not simple and will neither be comprehensive nor present an 'answer'. The science is simply not extensive or good enough. Although management regimes impact on air, water and carbon in a holistic way, nearly all research (inevitably) looks at current moorland management impacts in discrete ways. For example, Whitehead *et al* (2021) in an article in *Ecological Indicators*, a respected and peer-reviewed journal, examined impacts of burning on moorland vegetation, but not the impacts of cutting, or the implications for water quality or carbon sequestration as these were outside the scope of their study.

5.4.5 BURNING

The practice of muirburn, the controlled burning of vegetation in moorland areas, in order to maintain open moorland, is centuries, if not millennia, old. It is not a practice that started on, or is confined to, grouse moors. As noted in the previous chapter, in the nineteen century keepers in Scotland were concerned that sheep farmers were burning too much and too often (Durie, 1998). As would be expected, research on the impacts of burning on the ecosystem is sometimes contradictory. While Noble et al (2019) found no evidence to support the use of burning as a tool to increase existing *Sphagnum* or promote *Sphagnum* re-

[226] https://www.iucn.org/

[227] In England deep peat is defined as soil with a surface peat layer of 40 cm or more. In Scotland it is defined as 50 cm or more.

[228] http://publications.naturalengland.org.uk/publication/5419124441481216

establishment success; Whitehead *et al* (2021) concluded that prescribed burning at regular intervals could increase *Sphagnum* cover.

If the science is not definitive, one thing is clear: burning arouses very strong passions. *Revive*, an organization that advocates 'grouse moor reform' (although the organisations that make up the *Revive* coalition seem more intent on banning grouse shooting than on any reform), is just one of the organizations calling for the practice to be banned.[229] However, such demands seem to ignore two factors. Firstly, despite its climate, fire is an important natural force both in Scotland (Montiel and Kraus, 2010) and in England. Due to frequent short-term droughts, in the past lightening has caused large-scale fires in both conifer woods and heath and moorland. Studies of one estate in the eastern highlands of Scotland indicated a natural fire return interval of between 80 and 100 years over the last 400 years. If fire is ignored, rather than studied, there is a risk that an important ecological process is not recognized. Secondly, it is claimed that controlled burning can reduce the risk of wildfire, as explained in the following paragraph.

Wildfires are a major source of CO_2 emissions (Turetsky, Donahue and Benscoter, 2011). The 2019 wildfire of Scotland's Flow Country resulted in 22 square miles of a UNESCO world heritage site being damaged and c. 700,000 tonnes of carbon emission. In 2018 Scottish Natural Heritage and the Scottish Fire and Rescue Service (SFRS) examined the correlation between the number of wildfires where the SFRS was called out and heather burning. Out of a total of 153 fires, only four were in areas of moorland managed for grouse, and none were during the burning season, but were rather the result of accident or arson.[230] Wildfires are typically large, burn out of control and can cover extensive areas. They are frequently described as 'hot burns' as opposed to prescribed fires which are described as 'cool burns'. Wildfires occasionally result from lightning strikes but the vast majority are due to either accidental[231] or deliberation actions, which tend to be in the spring or summer, often at weekends or on Bank Holidays. The 2018 wildfire on the RSPB's Saddleworth Moor in 2018 was partly enabled by a spell of dry weather and heather vegetation that had become 'leggy' as it had not been managed. Professor R Marrs, Liverpool University, claimed that the fire would not have spread too easily or penetrated the underlying peat if the vegetation had been managed by occasional burning. He was quoted as saying, "leaving the land alone causes much more damage than controlled burning because there's more heather to burn so it gets hotter and spreads to the peat, which in turn spreads the fire."[232] It is estimated that the fire resulted in seven centimetres of peat being lost, which could take c. 200 years to replace. Marrs *et al.* (2019) presented data showing that appropriate prescribed burning can both mitigate wildfire risk in a warmer world and produce relatively fast peat growth and sustained carbon sequestration.

It appears that there is a balance to be struck between wildfire as an important natural ecological force, and our current desire to reduce CO_2 emissions. Are there alternatives to muirburn that strike this balance and

[229] https://revive.scot/scotlands-controversial-muirburn-season-begins-again-following-a-temporary-ban-during-lockdown/

[230] Countryside Alliance Briefing Note: Grouse Shooting Petitions Committee - Westminster Hall Debate, Monday 25 January 2021

[231] Such as the wildfire on Marsden Moor of April 2021. A box of fireworks was discovered at the scene of the fire https://www.bbc.co.uk/news/uk-england-leeds-56901934 Police interviewed a man and a woman and subsequently submitted a file to the Crown Prosecution Service https://www.bbc.co.uk/news/uk-england-leeds-56931147

[232] https://www.bbc.co.uk/news/uk-england-manchester-44648348

are sustainable? The GMMRG report notes that there is relatively little comparative information on the impacts of heather burning versus cutting and from the few studies that it found (up to 2019), the differences were 'apparently not simple'. Natural England pointed out that there are evidence gaps on the state and potential for carbon storage and sequestration for blanket bogs[233]. Heinemeyer and Ashby (2021) and Ashby and Heinemeyer (2021) conducted a meta-analysis of the research on moor burning compared with both cutting moorland vegetation and not managing it as part of their constructive criticism of the IUCN's position statement 'Burning and Wetlands'[234]. They identified three points that they suggest should be considered when making any decision about muirburn. As these points are based on their meta-analysis, we believe they are worthy of consideration.

1. To date, no study has assessed rotational burning impacts using a real-world approach, with measurements made across active grouse moors and extending over a complete management cycle. Thus, the current evidence base cannot be used to draw robust conclusions about ecosystem services impacts, particularly in relation to carbon storage, greenhouse gas (GHG) emissions, flooding and water quality.

2. The results of many burning studies are unreliable because they use experimental designs that are unable to detect causal relationships and/or make significant statistical errors. They suggest that the entire evidence base needs to be reviewed on this basis. Indeed, this is crucial to obtain robust evidence on which to base policy.

3. Due to the uncertainties within the evidence base, the precautionary principle is often cited as a reason to halt prescribed burning on peatlands. However, it is rarely (if ever) applied when considering other even more understudied or unproven peatland management options e.g. mowing or cutting of heather or no management, as well as restoration measures like rewetting. These management options are also likely to cause negative impacts when applied in certain contexts. The precautionary principle should not be used as a basis for decision-making solely for burning.

Table 5.4 presents a summary of the meta-analysis conducted by Ashby and Heinemeyer (2021). As muirburn is intimately integrated with other moorland management issues such as water levels (drainage) and peat formation, their meta-analysis inevitably covers more than vegetation management. For reasons of brevity, the table does not detail the many references cited by Ashby and Heinemeyer (2021) and readers should refer to their article in the journal *Wetlands*[235] if so desired.

[233] http://publications.naturalengland.org.uk/publication/5419124441481216

[234] https://www.iucn-uk-peatlandprogramme.org/news/burning-peatlands-position-statement

[235] See references.

TABLE 5.4 SUMMARY OF META-ANALYSIS REVIEWING THE EVIDENCE FOR BURNING, MOWING AND NON-MANAGED MOORLAND	
Common Assertions made about integrated moorland management incorporating muirburn	**Summary of Ashby and Heinemeyer (2021) meta-analysis**
Burning is damaging to peatlands	No consensus in literature that prescribed burning is damaging to peatlands. The overall effect of burning on peatlands is unclear due to insufficient, contradictory or unreliable evidence on carbon, water quality and biodiversity. Bare ground resulting from muirburn short lived and small scale. Large carbon emissions cited are largely based on lowland arable peatlands. There is no net greenhouse gas data from managed grouse moors.
Peat-forming species and specific indicators and muirburn	Environmental conditions regulate peat formation: hydrology, pH, litter quality, and other factors. Any species can form peat in the right conditions. *Sphagnum* and *Eriophorum* are not specific indicators of peat formation, and may not be the most sensitive habitat indicators. Burnt areas can support similar levels of *Sphagnum* and *Eriophorum* to comparable unburnt or not recently burnt areas.
Burning promotes drier communities	Burning was historically associated with drainage. Drier communities were likely to be due to lowering of water tables due to drainage and not solely due to burning. Many drainage ditches are now blocked (or are being blocked) or have naturally infilled. Claims of micro-erosion networks and increased tussock formation due to burning are speculative and not linked to impacts on ecosystem functions. Wildfires can dramatically alter vegetation, but should not be confused with impacts of prescribed burning on deep peat with high water tables.
Impacts of rewetting	Little evidence that peatlands in their natural state only ever provide ecological and environmental benefits. Rain falling on saturated peat will pool or run off. Runoff from saturated peat can exacerbate downstream flooding. Peatland with high water tables emit large amounts of methane[236], especially in high temperatures. Wetness reduces burn damage to moss, litter and peat layers.
Habitat state of peatlands	Habitat status is currently based on vegetation composition using criteria that do not measure ecosystem parameters and functions, but plant traits are poor indicators for defining ecosystem functions. Criteria should be based on ecosystem functions and systems, with measurement of peat accumulation, water storage etc. In current system bogs classed as degraded could be in good ecological condition, and vice versa. Different management regimes will lead to conflicting outcomes for ecosystem services e.g. permanently saturated peatland will have lower flood mitigation potential and high methane emissions.
Rotational 'cool' burning vs. uncontrolled 'hot' burns	Moss and peat layer in wet blanket bog ecosystems are generally buffered from the effects of prescribed burning (minimal moss damage, no peat ignition)[237]. Prescribed burning converts c. 5 – 10% of biomass carbon into charcoal, a long-term carbon store resulting in high soil carbon accumulation. Mowing allows nearly all biomass to decompose over time, locking away c. 1 – 2%

[236] Methane is a powerful greenhouses gas with a 100-year global warming potential 28-34 times that of CO_2. Measured over a 20-year period, that ratio grows to 84-86 times. https://unece.org/challenge#:~:text=Methane%20is%20a%20powerful%20greenhouses,are%20due%20to%20human%20activities.&text=Coal%20is%20another%20important%20source%20of%20methane%20emissions.

[237] For a fascinating demonstration of the impacts of prescribed burning on sub-surface temperatures, see the 'Mars Bar vs Muirburn' film at https://m365.eu.vadesecure.com/safeproxy/v4?f=r4GS8Rc2mPXY6Bxq4p_m4BAkHPGUt2NEhZQLKVVvE9Q12OKupP0hEmRHY9RRKRYf1zuIP_WU60W3AOIDglts2A&i=lrcKD8tORo1HXwDa5hMlVTKOiPOqHGxBkGU1ONT9V0d6qg0_cNbVnnfTAW3_o32ibH2KernAJEwBPDOdeSXcag&k=9CRQ&r=EnlIGYTA4jHJUjNRrTgWj2nZVNDQRQWxGE-r90jiaA5uNjIvfPnUCbTY7GnJB4hFMquD3FRArV2TybWotH6tIg&s=a5b8b0f944058279324d7b4d32ce9b6ab1add0bc4419481691222af6b07dbc760&u=https%3A%2F%2Fwww.facebook.com%2FTomatinMG%2Fvideos%2Fm-a-r-s-b-a-r-vs-m-u-i-r-b-u-r-n%2F379362616482584%2F

	of biomass carbon. Wildfires lead to far greater losses of peat and carbon. Any assessment of burning impacts on carbon and greenhouse gas emission must consider methane fluxes. Low severity fires may suppress peatland methane emissions. Mowed and unmanaged sites emit far more methane that sites managed by prescribed burning.
Burning of peat after rewetting and under uncontrolled hot burns	The wildfire mitigation of peatland rewetting has never been tested in UK context. Bog vegetation dries in summer, especially in prolonged dry spells, and becomes more flammable. Even on largely undisturbed peatland, the water table draws down by 20 – 30 cm in summer. Normally wet peat is flammable during drought conditions.[238]
Burning and water storage	There is no evidence that burning increases flood peaks. The slightly lower water tables (about 2 – 3 cm) in burnt vs. mown areas might offer additional water storage under conditions when wet sites are saturated.
Long-term vs. short term impacts	No study has fully assessed rotational burning impacts using a real-world approach, with measurements taken across active grouse moors and extending over a complete management cycle, or longer. The impacts of prescribed burning on UK peatlands are unknown and have not been adequately assessed using the correct spatiotemporal context. Many studies have failed to take pre-burn measurements, and crucial post-burn measurements are usually only taken for c. 3 years at the start of a burning rotation. The current short-term approach to the study of prescribed burning is biased towards finding adverse effects as all forms of habitat disturbance cause immediate ecological 'damage'. When negative impacts are reported, they are often for short-term effects or for effects that are so small they may not be ecologically significant.
Methodological issues	Many studies of burning are unreliable and cannot be generalized due to poor experimental designs and/or significant statistical errors. Many reported impacts cannot be solely attributed to burning. The well-known and much cited EMBER report should not be cited to support the claim to burning has a 'significant adverse impact on peatland biodiversity, carbon emissions, drinking water quality and flow management. A much wider evidence base is needed.
Research needs	Robust experimental research is needed at a broad range of nationally representative sites and/or assessments to validate proxies or tests of ecological functions (i.e. peat accumulation) that can be rapidly applied in the field. Assessments will be complicated due to differing management regimes and site conditions. The ecosystem services to be measured will impact assessment. Catchment-scale experiments to ascertain the flood mitigation potential of peatlands in different hydrological, vegetative, and management states are urgently needed. More data about the net greenhouse gas budget impacts of peatland management are required, especially given future climate scenarios with warmer summers. Prescribed burning and alternative management impacts need to be measured over a 15 – 25-year timescale.
Uncertain alternative management methods	Mowing is understudied, but causes damage to surface vegetation and peat, increase sedge grasses and associated methane emissions, and reduces cranefly emergence, which has negative impacts on upland birds. The IUCN[239] recommends that the precautionary principle means that burning should be avoided, and should apply this concept to mowing. IUCN advocates the use of rewetting as a way of reducing wildfire risk, but there is no direct evidence to support this position. Rewetting could lead to increased methane emissions, increased run-off in hilly areas, and reduced water quality.

[238] In April 2021 a wildfire broke out on Marsden Moor that burnt for three days https://www.bbc.co.uk/news/uk-england-leeds-56931147 The moor, owned by the National Trust, had been rewet in places and coir used to create dams. These coir dams burnt for longer than the surrounding vegetation. Winter flooding in the areas of the dams had killed surface vegetation, exposing areas of peat that burnt in the fire. A similar blaze broke out on the same moor in 2019

[239] IUCN (2020) International Union for Conservation of Nature UK Peatland Programme: Burning and Peatlands Position Paper. Version 2, 31 March 2020, IUCN, Edinburgh, UK

Habitat condition vs. ecosystem functions	Ecosystem functioning is the critical issue. There is a lack of specific evidence in support of burning and alternative management in relation to ecosystem functioning factors. Clearly defined habitat conditions and objective restoration goals based on ecological/ecosystem function are required. A series of moorland sites across the UK with different conditions, implementing alternative management regimes should be established to enable a long-term, moorland-scale experimental/monitoring approach.
Independent assessment of the evidence towards policy advice	An independent assessment of the prescribed burning evidence should evaluate studies according to their methodological strength, and unreliable studies should be rejected from consideration. There is a need to properly assess the potential of prescribed burning in wildfire mitigation. A set of ecosystem function thresholds based on actual ecological data and an agreed upon and evidenced set of definitions concerning habitat status within an applied context is needed.

Ashby and Heinemeyer's very extensive review of the literature is revealing. They highlighted the conclusion that isolated, relatively small-scale studies, even if carried out over 10 years or more, do not provide an evidence base for decision-making about the ecosystem services provided by different moorland management regimes. The natural capital concept and the ecosystem services model are important (especially in a period of climate change), but the data about how differing moorland management regimes impact on climate change, water quality and flood risk, and wildfire mitigation is simply not robust. A new, multi-site, long-term research project is required that assesses the impact of differing management methods. At present there is no robust evidence to indicate whether grouse moors using traditional management methods are more or less ecologically sustainable than alternative uses for moorland; livestock production, afforestation, alternative energy production, re-wilding or conservation.

However, the evidence base is slowly building. Heinemeyer *et al.* (2021)[240] report interim results from the Peatland-ES-UK project, part of the Ecological Continuity Trust's long-term monitoring network. The study is based on a Before-After Control-Impact design approach. They presented long-term data from a previously government-funded (currently multi-funded) 10 year-long (to date) extended, peatland management project investigating ecosystem functions from plot-to-catchment scales on three grouse moor sites across Northern England. The project involves the monitoring of hydrology, water budgets, carbon cycling, greenhouse gas emissions, peat properties, vegetation composition and biodiversity. The authors promise to provide, "new and sometimes surprising and even challenging insights into blanket bog ecosystem functioning in an ecosystem services and habitat status context, highlighting the importance of long-term monitoring, experimental design, spatio-temporal changes and remaining uncertainties." As pointed out in the introduction to this report, we intend our work to be a living document that is constantly updated as new findings emerge. We await the publication of Heinemeyer et al (2021) with considerable interest.

Crucially, it is important here to repeat a key point already referred to in this report: nearly all 'grouse moors' have multiple functions. The landscape on which driven grouse shooting takes place is utilised for a range of income-generating activities including livestock production, alternative energy production, and forestry, as well as tourism and leisure. Although some landowners control all these activities themselves, many have to collaborate and coordinate with multiple stakeholders, including graziers and farmers. Moreover, grouse shooting takes place on both owned and leased land. Gathering valid and reliable evidence about the

[240] In press and under embargo.

ecological sustainability of 'grouse moors' will involve studying driven grouse shooting as a part of the complex and holistic mix that is integrated moorland management, not as an isolated phenomenon.

5.4.6 AN ECOSYSTEM LEAGUE TABLE?

It would be helpful for policy makers, practitioners, and others if researchers were able to construct a 'league table' ranking the alternative uses of moorland in terms of their impact on carbon capture and release, water quality and flood risk, and wildfire mitigation. However, as this chapter shows the current state of the evidence is neither robust nor extensive enough for the impacts of management practices associated with grouse shooting activities to be identified and ranked. The current evidence certainly does not encompass the reality of integrated moorland management. Watt (1947) observed that it is "one thing to study the plant community and assess the effect of factors which obviously and directly influence it, and another to study the interrelations of all the components of the ecosystem with an equal equipment in all branches of knowledge concerned." Limited research objectives result in prejudiced positions and critical understanding of ecosystem functions are set aside. The problems in nature are mostly problems of the ecosystem rather than of soil, animals or plants. Watt summed up the challenge for scientists and policy makers thus, "what I want to say is what T.S. Eliot said of Shakespeare's work: we must know all of it to know any of it." We conclude that it is not possible to say with any assurance that integrated moorland management, including the practices associated with grouse shooting, is less sustainable in terms of the ecosystem services (carbon emission and sequestration, water quality and flood mitigation) it provides than alternative uses of moorland. In fact, we tentatively suggest that the ecosystems services delivered by recent integrated moorland management regimes is, on many moors, delivering increasingly valuable ecosystems services.

5.4.7 FUTURE RESPONSIBILITIES

Climate change is everyone's problem. We cannot envisage any UK government removing the statutory requirement to achieve net zero GHG emissions by 2050. The change from the Common Agricultural Policy's Basic Payment Scheme to the Environmental Land Management (ELM) Scheme is part of a revolution[241]. Owners and directors of businesses will be held increasingly accountable for measuring, monitoring and reducing GHG emissions. Business owners will be penalized for excess emission, and rewarded for reducing emissions and for, especially, sequestering carbon and methane. Landowners, including owners of moorland, are running businesses. Financial institutions are looking at certain types of land as a new asset class. It is very conceivable that 'green bonds' based on natural capital credits could be developed in the next decade. Upland landowners are able to deliver public goods, which are the basis for receiving support from the ELM scheme. The challenge they face is to work with scientists to establish and implement practicable and effective systems that measurably deliver ecosystem benefits in a very complex and integrated ecosystem. It is a challenge that needs to be met by any moorland owner that wants to demonstrate that the ways in which they use their land is sustainable, and to be rewarded for increasing natural capital.

[241] Richard Benyon, Trustee of PlantLife, Plantlife Spring 2021, issue 89

5.5 THE SOCIAL IMPACTS OF DRIVEN GROUSE SHOOTING

5.5.1 OVERVIEW

Driven shooting, unlike walked-up shooting, involves a wide range of individuals from a variety of backgrounds, not just Guns, but also beaters, pickers up, drivers, flankers, caterers and supporters. This extensive 'cast list' facilitates contact between individuals from different social, economic, demographic and geographic backgrounds and maximises the potential for social impacts (Latham-Green, 2020b). When considering 'social impacts' this review considers what difference the presence of integrated moorland management makes to people's social and work lives and their health and well-being. These impacts may be on individuals, the community or wider society[242]. This report considers both social and community cohesion and the social determinants of health as defined by Dahlgren and Whitehead (1991) shown in Figure 5.5 below.

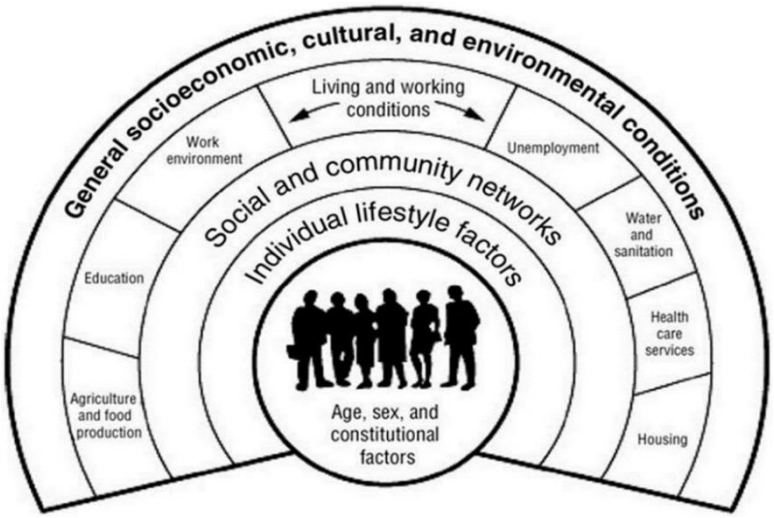

FIGURE 5.5 SOCIAL DETERMINANTS OF HEALTH (DAHLGREN AND WHITEHEAD, 1991)

The remote nature of the majority of moorland communities in areas where DGS takes place means that the value of strong community networks and a vibrant local economy can be particularly important, both subjectively to individuals in terms of their mental health and well-being, and quantitatively to society in terms of potential cost savings to taxpayer resulting from reduced demand on health services etc.

Participation in driven game shooting, including DGS, has been shown to have a statistically significant positive impact on participants mental health and well-being, measured using the nationally recognised short Warwick-Edinburgh mental well-being score (SWEMWBS), compared to the national average (Denny and Latham-Green, 2020; Latham-Green, 2020). This section explores some of the potential reasons for this positive impact on well-being, and on community and social cohesion in communities in areas where DGS is practiced.

[242] It is acknowledged that there are individuals who are opposed to shooting on ethical grounds, as noted in section 6.4. The presence of shooting may have social impacts on them as individuals (McMorran 2009). However, no studies of individuals living in moorland communities that are opposed to shooting have been identified. The negative impacts highlighted in Latham-Green's 2020 study into all aspects of driven game shooting related to conflicts between those for and against shooting and poor practice and wastage highlighted predominantly in the commercial pheasant and partridge shooting industry.

5.5.2 COMMUNITY AND SENSE OF BELONGING

A 2020 study into upland communities in areas where grouse moor management is practiced found that nearly three quarters (74%) of moorland community respondents took part in grouse shooting in some capacity, and it was an activity followed by all ages and both genders (Denny and Latham-Green, 2020). The study also found that moorland communities in areas where grouse shooting takes place have a high level of 'community' and a greater sense of belonging than the national average.

Identity and strong social networks, sometimes referred to as bonding social capital (Putnam, 2000; Claridge, 2018a), are intrinsically linked (Claridge, 2018a; b). People with a shared identity, for example those who take part in driven game shooting (Latham-Green, 2020), or who live in upland communities with a strong cultural and heritage identity (McMorran et al., 2013; McMorran, 2009), have been shown to build strong friendships or 'social and community networks', based on their shared understandings and sense of belonging (Latham-Green, 2020). Previous studies into upland communities have identified positive community support either facilitated by or directly provided by many estates (McMorran et al., 2013; McMorran, 2009; Glass, Bryce and McMorran, 2015).

Strong social and community networks can reduce the risk of loneliness. Residents in upland, moorland English communities where grouse moor estates are present have statistically lower levels of loneliness than the national average (Denny and Latham-Green, 2020) and participants in driven game shooting (of all quarry types) were also found to have lower levels of loneliness than the national average (Latham-Green, 2020). Reducing levels of loneliness matters: the societal and health costs of loneliness have been estimated at £6,000 per person over ten years (Mcdaid, Bauer and Park, 2017)

Where moorland areas are managed for DGS, research has shown a wide range of community activities, clubs, societies and resources are available (Denny and Latham-Green, 2020). Events are frequently organised by and even funded discreetly by landholders of grouse moors (Denny and Latham-Green, 2020), highlighting the commitment to community of those landholders, as illustrated in this quote from Denny and Latham-Green's 2020 study:

> *"The tenant is embedded in the community. The events he organises (and discretely funds) bring together the 40 – 50 people in the Dale. It is not charity, or bribery, but because the tenant feels he belongs and that his duty is to do things that others cannot."*

The presence of gamekeepers and other estate worker and contractors with young families getting involved in supporting community activities as well as regularly using local facilities (McMorran, 2009; Glass, Bryce and McMorran, 2015; Denny and Latham-Green, 2020), contributes to ensuring a vibrant and active community in upland areas throughout the year, not just during the tourist season. The majority of McMorran's 2015 study respondents believed there were community-level benefits of grouse shooting, with 70% in the Angus Glens and 53% in the Monadhliath noting community-level benefits, only only 8% in Angus Glens and 15% in the Monadhliath not noting any community benefits (Glass, Bryce and McMorran, 2015).

Studies considering the impact of grouse moor management have highlighted the positive impact of grouse shooting estates in ensuring that communities maintain an intergenerational mix (Glass, Bryce and McMorran, 2015; McMorran et al., 2013; McMorran, 2009; Denny and Latham-Green, 2020). Inter-generational relationships and the building of intergenerational understanding and respect have been recognised as an important element of social cohesion and social capital (Commision On Integration And

Cohesion, 2007; Hatton-Yeo and Batty, 2011). It has been recognised that more resilient communities help deliver positive impacts for health and well-being, through intergenerational connection (O'Connor et al., 2019). The proportion of those aged over 65 in the UK is expected to rise to 26% by 2041, with the greatest number residing in rural and coastal areas (Office for National Statistics (ONS), 2018). This increase is likely to be partly as a result of the outflow of young people to towns and cities to find employment; young people in rural areas have been found to be at higher risk of unemployment due to their spatial isolation and to the narrow range of opportunities which are available (Cartmel and Furlong, 2000). Rural out-migration of youth and in-migration of retirees has been recognized as a threat to sustainable, rural communities (Thomson, 2012), indicating the importance of creating a sustainable local economy with diverse work opportunities, as explored in the next section.

5.5.3 WIDER DETERMINANTS OF HEALTH

Whilst employment is covered in more detail in section 5.2 of this report relating to economic impacts, it is important to note the wider social impacts of employment and training. These have been shown in Figure 5.5, and have been identified as social determinants of health by Dahlgren and Whitehead (1991). Employment in particular is recognised as one of the key determinants of both good health and a key means for tackling inequalities (Dahlgren and Whitehead, 1991; Bartley, et al 2005, Ellis and Fry, 2010).

Having a variety of skilled employment opportunities is particularly important in the more remote, rural areas of the UK where alternative employment is often limited and/or seasonal (Scottish Government, 2012; Monk et al., 1999). Communities in areas where integrated moorland management, including DGS, is practiced have a more diverse economy, and are less reliant on tourism than comparable upland areas where land management practices do not include DGS (Denny and Latham-Green, 2020). In his 2009 study of Tomintoul and Strathdon Communities, McMorran found that grouse shooting made a very significant contribution to the local economy, in terms of employment and benefit to local businesses, with 81% of respondents agreeing that the community received benefits from the existence of the grouse shooting industry and 58% feeling that grouse shooting was a major employer in the area. The indirect impacts of employment on the wider community have also been highlighted in many areas, one local garage reporting 80% of its business came from the grouse shooting estates (McMorran, 2009). Interestingly, McMorran found that while only10% of his respondents were directly employed by the grouse shooting industry, 18% of respondents said their livelihood was directly dependent on it (McMorran, 2009). McMorran's later report considering the 'Economic, Social and Environmental Contribution of Landowners in the Cairngorms National Park' found that out of season gamekeepers and estate workers used local cafes, shops and restaurants which themselves provided local employment and helped overall to sustain a local economy and community that would otherwise not be viable (McMorran et al., 2013). A job can enable people to build relationships and a social network, together with contacts for future opportunities for themselves or their families (Dreiling et al., 2015). Employment can also contribute to an individual's role identity and sense of purpose/belonging (Stets and Burke, 2000; Walsh and Gordon, 2008), which positively impacts well-being (Haslam et al., 2009).

A lack of diverse training and skills development opportunities in rural areas has been recognised as an issue due to a number of factors including transport and access to Further Education (Monk et al., 1999; Scottish Government, 2012; The Commission for Rural Communities, 2012). Development of skills has been shown to potentially positively impact well-being through increasing self-esteem and self-efficacy (Denny et al., 2011; Hazenberg, Seddon and Denny, 2015). Careers directly linked to shooting include game-keeping, gun

dog training, gunsmithing, land conservation, ecosystem management and shotgun tuition. Training is currently widely available, with BASC listing 29 colleges offering game-keeping courses (BASC, 2018). The wider industries supported by the presence of grouse shooting in remote, upland areas, such as the hospitality and retail industries, provide indirect career opportunities (McMorran, 2009; McMorran *et al.*, 2013; Glass, Bryce and McMorran, 2015; Denny and Latham-Green, 2020; Latham-Green, 2020).

5.5.4 INTANGIBLE FACTORS – IDENTITY AND INTANGIBLE CULTURAL HERITAGE

Those who live in rural communities, such as the uplands, often have a strong rural identity and sense of place, which they hold dear (Williams, 2011). Identity has been recognised as a key element of building strong social networks, one of the key determinants of health (Dahlgren and Whitehead, 1991). An individual's strong feeling of identity can have positive impacts on their mental well-being. It can "provide individuals with a sense of meaning, purpose, and belonging (i.e. a positive sense of social identity)" (Haslam et al., 2009), which usually has positive psychological consequences (Haslam et al., 2009). Rural identity has been explored in prior research (Heley, 2011, 2010), with those involved in shooting expressing clear rural identities (Hillyard and Burridge, 2012; Latham-Green, 2020), and, for some respondents, links to their cultural heritage (McMorran et al., 2013), and valuing activities which were grounded in 'rural realities' (McMorran, 2009). A recent study looking at the social impact of participation in all forms of driven game shooting found that 91.3% of participants surveyed (n=2,424) felt a strong identity with the countryside, which was not dependent on residence in a rural area., No significant statistical differences in the sense of rural identity were found when comparing responses from rural and urban dwellers, but was rather connected to the rural activity in which they participated, driven game shooting (Latham Green 2020).

UNESCO identifies the concept of intangible cultural heritage (ICH), which relates to social practices, knowledge and seasonal events that some individuals and communities recognise to be part of their cultural heritage, as an important factor in the well-being of individuals (United Nations Educational Scientific and Cultural Organization (UNESCO), 2018). Cultural heritage does not begin and end with monuments. It also includes "living expressions ... such as oral traditions, performing arts, social practices, rituals, festive events, knowledge and practices concerning nature and the universe or the knowledge and skills to produce traditional crafts" (UNESCO, 2003). Whilst the UK is not yet a signatory to the UNESCO ICH treaty, there has been research into its relevance in areas such as the importance of safeguarding traditional craft and skills in the Midlands (Harrison, 2019) and the social and cultural wellbeing of Cornish coastal communities (Urquhart and Acott, 2014). The place of cultural services as a constituent of the UK's natural capital are recognised by the Office for National Statistics[243], Natural England[244] and Defra[245].

As noted above, many respondents, including beaters, pickers-up and the Guns, felt a strong sense of heritage through their participating in shooting (Latham-Green 2020 study). They believed that taking part in shooting represented a link to their heritage and returning to their roots, a seasonal ritual which was often shared across generations, a finding that was particularly true for those who grew up in rural areas but now live in urban areas (Latham-Green, 2020). In his study into the Economic, Social and Environmental Contribution of Landowners in the Cairngorms National Park, McMorran (2013) found that participants felt

[243] https://www.ons.gov.uk/economy/environmentalaccounts/articles/uknaturalcapitaldevelopingukmountainmoorlandandheathlandecosystemaccounts/2017-07-21

[244] https://naturalengland.blog.gov.uk/2020/02/19/natural-england-publishes-a-new-report-on-the-state-of-our-natural-capital

[245] https://www.gov.uk/government/news/natural-capital-tool-launched-to-help-protect-the-environment

grouse moor management contributed to preservation of a 'culturally significant activity and landscape'. In this 2013 study most respondents (75%) 'agreed' or 'strongly agreed' that grouse shooting was an important part of the culture and history of the community (McMorran et al., 2013).

This connection to heritage was also apparent in a study which explored the motivations of grouse moor owners and leaseholders, finding that many grouse moor owners expressed a connection to the land they managed across the generations (Denny and Latham-Green, 2020). This study found that individuals that manage or lease grouse moor estates see themselves as custodians of the land. All grouse moor owners and leaseholders surveyed (n=73) believed it was very important that they leave a positive legacy, and an environment better than the one they inherited. Indeed, the majority of grouse moor owners surveyed (47 out of 73) did not require their moor to make a profit in order for them to continue to fund its operations. In support of this finding, a college lecturer interviewed as part of the study noted that:

> *"Having watched from the side-lines and listened at various meetings, what I got out of it was a group of individuals who were very committed not just to improving upland management practice in their area but with a very strong belief that they wanted to pass something on to the future, that really old-fashioned idea that you don't inherit a landscape from your ancestors, you hold it in trust for your children. They had the attitude they wanted to put something in place that was better than when they started. I have sat in similar meetings where the general impression of the meeting is how much can I get out of it and these guys didn't generally think like that."*
>
> (Denny and Latham-Green, 2020)

5.5.5 GREEN SPACES ACCESS, WELL-BEING AND EXERCISE

Most estate owners in areas where DGS takes place facilitate access to the public. This allows both those who participate in shooting, and those who do not, to access green spaces. Participation in driven game shooting in *any* role has been shown to facilitate regular physical exercise, with distances of 14km or more walked on a DGS day by some participants (Latham-Green, 2020). A study into upland, moorland communities where grouse moor management is practiced found that 84% of survey respondents regularly exercised on the moors, with seven out of ten of them doing at least 150 minutes of moderate exercise a week, more than the national average (Denny and Latham-Green, 2020)[246]. The camaraderie and social capital built through participation in DGS encourages exercise in all weathers (Latham-Green, 2020) and the maintenance of pathways and tracks that facilitate access by estates enables access all year round for tourists and local communities alike (Denny and Latham-Green, 2020).

Exercise outdoors has been shown to have a greater positive benefit than exercise indoors (Zhang, 2017; Thompson Coon et al., 2011; Loureiro, Veloso and Veloso, 2014; Frühauf *et al.,* 2016). Access to green spaces has been shown to help increase activity and reduce obesity (Coombes, Jones and Hillsdon, 2010; Countryside Recreation Network, 2006). Physical inactivity and obesity can lead to long term conditions such as diabetes and cardiovascular disease (Leong and Wilding, 1999), which are costly to manage in the NHS. A 2014 study indicated that obesity had a burden of around £47 billion a year on UK society (circa 3% of GDP), making it the greatest impact after smoking (Dobbs *et al.,* 2014). The availability of accessible green spaces to encourage physical activity is likely to reduce this economic burden on society. The 2014 PACEC study

[246] Not all respondents took part in DGS

into all types of shooting, found that the majority of the demographic group engaged in shooting (of all types) were male and over 40 (Public and Corporate Economic Consultants (PACEC), 2014) and Latham-Green's 2020 study found that 86.7% of participants were male with a median age of 57 (Latham-Green, 2020). The value of regular exercise, to both the individual and society in preventing the costs of ill-health, is higher for individuals 45 and over (World Health Organisation (WHO), 2019). It has been estimated that only 40% of men complete moderate physical exercise (30 minutes a day, five or more days-a-week, (Pollard, 2010). It has been suggested the best form of exercise for men reluctant to take up physical activity is to find something they enjoy and can easily include in everyday activities, with walking being considered one of the best options (Pollard, 2010). An analysis of 18 observational studies, from a review of 4,295 studies on walking from 1970, found that walking reduced the risk of heart problems by 31% and the risk of death by 32% during the study period (Harvard Men's Health Watch, 2009; Pollard, 2010). In 2016 Public Health England estimated that a lack of physical activity was costing the UK £7.4 billion per year (England, 2016).

Latham-Green (2020) calculated the indicative value of physical health benefits resulting from regular exercise for number of beaters and pickers-up in the UK, using the WHO Health Economic Assessment Tool (HEAT) for walking and cycling (World Health Organisation (WHO), 2019). The calculation took into account age, distances walked and frequency of participation, with those who participated less than once a week not included in the calculation. The study found that, based upon the HEAT tool, an *indicative* value of around £547 million[247] per year can be suggested as the health-related financial impact of participation in all types of driven game shooting by beaters and pickers-up, due to the increased walking that this group participates in. The same study found that the average distance walked by grouse beaters was 14km and the average age of participants was over 45 (median age 57). Using this data, and assuming beaters were out twice a week for the entire four-month season, a value can be estimated for the exercise completed by each beater aged over 45 using the using the HEAT tool. An *indicative* societal value of up to £1,966[248] per beater per year can be identified as the health-related societal financial impact of their participation in DGS. Over the full assessment period of ten years, the total economic impact is up to £19,658[249] per grouse beater aged 45 or over[250]. For those under 45 the values are lower. For each beater aged under 45, grouse beating twice a week, a value of up to £211[251] per year (£2,115 over 10 years[252]) can be suggested as the health-related financial impact of this participation.

Spending time outdoors has been shown to have positive mental well-being benefits (Frühauf *et al*., 2016; Kerr *et al.,* 2012; Ryan *et al*., 2010). These figures, while indicative, are very significant. There are quantifiable health benefits gained by thousands of people a year as a result of their participation in DGS. Proponents of alternative uses for moorlands should calculate the potential health benefits delivered by these uses if they are to have a comprehensive case for change.

Additionally, the role of land in enhancing human spirituality, some connection with a perceived god in a place of 'therapeutic stillness', has been considered in relation to overall human well-being (Winter, 2012). In a comparative study of two upland communites, 69% of respondents agreed that the landscapes resulting from grouse moor management were beautiful (McMorran, 2009). Areas such as the uplands, even when

[247] Converted from EUR to GBP at a rate of 0.8453 on 11.02.2020. (Bank of England, 2019)

[248] Converted from 2,270 Eur to GBP at a rate of 0.8666 on 09.04.2021 (Bank of England, 2021)

[249] Converted from 22,700 Eur GBP at a rate of 0.8666 on 09.04.2021 (Bank of England, 2021)

[250] Discounted to 2021 values at an annual rate of 5% the total economic impact is £15,194

[251] Converted from EUR to GBP at a rate of 0.8666 09.04.2021 (Bank of England, 2021)

[252] At a discounted rate of 5% the value is £1,632.

they are some distance from individuals' homes, have been shown to be areas to which people hold strong attachments (Williams, 2011).

Integrated moorland management, including DGS, has been shown to increase biodiversity of some bird species, as detailed in section 5.3. Predator control on moorland increases numbers of various bird species including Red Grouse, Golden Plover, Curlew and Lapwing (Baines et al., 2014). Research has shown that there is high usage of upland moors for birdwatching and walking by both people who live in upland moor areas (Glass, Bryce and McMorran, 2015) and the wider UK population. The RSPB estimated in 2007 that upland areas of the UK host 100 million day-visits per year. Birdwatching is a pastime enjoyed by many individuals throughout the UK, with birdsong enhancing individuals' experiences of the countryside. The RSPB has over 12,000 volunteers and over a million members (RSPB, 2017) and these individuals, along with many other people throughout the UK, value birds in the natural environment and gain enjoyment through birdwatching, a positive social impact, especially when groups of birdwatchers meet up to enjoy their pastime together.

As noted in the introduction to this social impacts section, participation in driven game shooting, including DGS, has been found to have a statistically significant impact on participants' mental health and well-being measured using the nationally recognised short Warwick-Edinburgh mental well-being score (SWEMWBS) when compared to the national average (Denny and Latham-Green, 2020; Latham-Green, 2020). The costs of poor mental health in the UK have been estimated at £105 billion per annum (Department of Health Independent Mental Health Taskforce, 2016). There are few studies that attempt to value subjective well-being (Maccagnan et al., 2019). However, a 2019 study suggested that maintaining well-being could be valued at £10,560 per person per year[253] (Cox, Bowen and Kempton, 2012 in Maccagnan *et al.,* 2019).

[253] This valuation compares loss of subjective well-being with severe mental health problem development, using Quality Adjusted Life Year (QALY) health economist assessed weights[253] (Maccagnan et al. ibid).

5.5.6 CONCLUSION

Driven shooting, unlike walked-up shooting, involves a wide range of individuals from a variety of backgrounds, not just Guns, but also beaters, pickers up, drivers, flankers, caterers, supporters and others, facilitating contact between individuals from different class backgrounds and maximising the potential for social impacts. This chapter has described how moorland management regimes that facilitate DGS enable people to take part in activities, both as part of DGS and separate to it, that result in positive impacts on their social and work lives, and their physical and mental health and well-being. It is possible to calculate the indicative values of some of these activities to individuals, and to groups of people, and these values are often significant. Individuals, communities and the state benefit from many of the social impacts of DGS. As we note in the introduction to this report, sustainability has three dimensions; economic, environmental and social. The evidence from the existing literature is that in terms of social impacts, DGS should be seen as sustainable. Alternative uses of moorland will deliver different social impacts, but these have not yet been fully identified. Any decisions about the implementation of these alternative uses must take into account the potential loss, or gain, in social impact.

6 SUSTAINABLE DRIVEN GROUSE SHOOTING: OPPOSITION AND KEY ISSUES

6.1 RAPTORS AND SUSTAINABLE GROUSE SHOOTING

This section sets out the laws relating to raptor protection in the UK along with the conservation status and the range and population of raptors that are present countrywide. In addition to absolute population numbers, the report looks at relevant public policy considerations around raptor populations in the UK as a whole and regionally across the UK nations, including Favourable Conservation Status and resilient population levels. The section also explores how integrated moorland management can impact raptor numbers. The Joint Raptor Study Langholm Moor Demonstration Project that took place between 1992 and 2018, is examined in some detail as it is the most robust long-term study of its kind. The illegal persecution of raptors is discussed and finally the conflict between those for and against DGS is explored, along with the specific situation in relation to hen harriers.

6.1.1 THE LAW RELATING TO RAPTORS AND PROTECTED SPECIES

Since 1954, most raptors have been fully protected in the UK[254] (Protection of Birds Act 1954). The Wildlife & Countryside Act (1981) as amended is now the primary legislation protecting all raptors in the UK (Wildlife and Countryside Act), with some species receiving additonal protection for nest sites. The killing, taking and damaging of raptors, whether via shooting or with the use of traps, including taking or damaging of their eggs and nests, is illegal except for in restricted circumstances when a licence is held, for limited reasons and for limited species, as detailed in section 6.2. In order to keep a wild bird for other activities, such as falconry, a licence is needed. Penalties that can be imposed for criminal offences in respect of a single bird, nest or egg contrary to the Wildlife and Countryside Act 1981 include at least an unlimited fine, up to six months imprisonment, or both. It is important to note that the detail of the regulation and penalties varying England & Wales or Scotland, and by the many and various amendments brought in since 1981.

6.1.2 REGIONAL RAPTOR POPULATIONS

Regional population status is relevant for two reasons: firstly, nature conservation targets are devolved matters, increasingly so within the UK and a UK-wide population status of is arguably less relevant in policy since the UK ceded from the European Union. Secondly, whilst some raptor populations may be in a favourable, resilient conservation status at a UK level, there are parts of the UK where the availability of suitable habitat and prey suggest that certain raptors should be more abundant than currently appears to be the case. Of particular relevance to upland moorland in this respect are golden eagle, peregrine, merlin and hen harrier. The uneven regional and landscape distribution of birds of prey, regardless of their total population size, is a key public policy driver of pressure on grouse moors.

The total Scottish, English, Welsh and Northern Irish raptor populations and their distribution have become a political issue. However, there is no consistent approach to reconciling the difference between the maximum number of raptors that an area can theoretically sustain (based only on a ‘snap-shot’ of environmental characteristics) and the maximum number of raptors an area should sustain (in order to co-

[254] The second schedule of this Act specified that Sparrowhawks could be killed or taken at any time by authorised persons.

exist in harmony with the social and economic requirements of human populations in the area), in line with the recognised three pillars of sustainability (Adams, 2006), and the EU 'Birds Directive'.

Moreover, there is no single, regularly updated, definitive source of data describing the populations of raptors for each UK nation, as the Avian Population Estimates Panel (APEP) does for the UK. It is curious that the British Trust for Ornithology (BTO) 'BirdTrends' app only shows UK regional data for some species, even when there might be thought to be an adequate sample size. For example, the trend for peregrines, whose national population in 2014 was between 1,600 and 1,900 pairs, is not broken down to UK nation level. In this report, data from the most recent peer reviewed papers has been used along with data taken from the BTO 'BirdAtlas' webapp and the BTO web page 'BirdTrends 2020: trends in numbers, breeding success and survival for UK breeding birds'[255] (Woodward et al., 2020) and the Scottish Raptor Study Group[256].

6.1.3 FAVOURABLE CONSERVATION STATUS AND RESILENT POPULATION LEVELS

Favourable Conservation Status (FCS) levels for raptors differ across the four UK nations. These are not always clear or well-defined, but there is broad acceptance among the statutory conservation agencies (NE, NatureScot, NRW, NIEA) that if suitable nesting and foraging habitat and prey are present, and the species is breeding well and populations trends are at least stable then species, such as raptors, should be at favourable conservation status in that area. A favourable conservation status for raptors is held, by dint of being enabled in law, to represent an ecological and social good. Achievement of FCS for a wide range of species and natural habitat types is the explicit aim of the EU Habitats Directive. The concept of Favourable Conservation Status (FCS) is based in international wildlife conservation, most notably the 1979 Bonn Convention on Migratory species (CMS).

Habitats

Conservation status of a natural habitat means the sum of the influences acting on a natural habitat and its typical species that may affect its long-term natural distribution, structure and functions as well as the long-term survival of its typical species within the territory referred to in Article 2. The conservation status of a natural habitat will be taken as 'favourable' when:

- its natural range and areas it covers within that range are stable or increasing,
- the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future,
- the conservation status of its typical species is favourable.....;

Birds

Conservation status of a species means the sum of the influences acting on the species concerned that may affect the long-term distribution and abundance of its populations within the territory referred to in Article 2; The conservation status of a species will be taken as 'favourable' when:

- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats,
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future,

FIGURE 6.1 DEFINITION OF FCS (Source: UK SNCB, 2018)

[255] https://www.bto.org/our-science/publications/birdtrends/2020

[256] https://www.scottishraptorstudygroup.org/raptors/

In 2018 the UK Statutory Nature Conservation Bodies (SNCBs) published a statement that expressed their common view on FCS, setting out the concept of FCS in a UK and UK country context, explaining its relevance and application in the UK and defining its contribution to UK nature conservation, including the wider legislative, ecological and geographical contexts (UK Statutory Nature Conservation Bodies, 2018). The definition of FCS from the statement is shown at Figure 6.1. It is not yet clear how the UK's departure from the EU will affect the application of the EU Habitats Directive in the UK.

As shown in Figure 6.1, the FCS considers habitat as well as the species status. Grouse moor management (predator control, maintenance of dwarf shrub heath and blanket bog), as detailed in Section 5.3, can provide a good habitat and prey base for many raptor species. This can result in a positive impact on numbers of raptors (Langholm Moor Project Demonstration Board, 2019), which research has also shown can be reversed when that intensive management ceases (Warren and Baines, 2012; Baines and Richardson, 2013). As has been detailed in other areas of this report, the habitat resulting from grouse moor management has not been primarily managed for conservation purposes; its role is to support economic and cultural activity, with impacts on communities and the wider nation, which form part of a complex web of land management and impacts (Denny and Latham-Green, 2020).

As noted above, the question of 'how many raptors are enough' (or too many) depends on scale. It would seem useful to have a co-produced understanding of what breeding density raptors should (rather than could theoretically) be on grouse moors, both as part of an overall UK population species plan, and for the good of local inward investment in moorland management. Such an approach would result in economic, social and environmental factors being considered in all policy decisions and would likely lead to improved sustainability of management for raptor conservation.

6.1.4 RAPTORS IN THE UK

Raptors of relevance in the UK uplands fall into three categories of conservation status, shown in Table 6.1.

Red List Species, of high conservation concern	Amber List Species, of medium conservation concern	Green List Species, of low conservation concern
Merlin White Tailed Eagle Hen Harrier	Honey Buzzard Marsh Harrier Montagu's Harrier Osprey Kestrel	Buzzard Red Kite[257] Peregrine Falcon Goshawk Golden Eagle[258] Sparrowhawk

TABLE 6.1 CONSERVATION STATUS OF UK BIRDS OF PREY (SOURCE: EATON *ET AL.*, 2015)

The Avian Population Estimates Panel (APEP) has produced reports detailing population estimates of birds in Britain and in the United Kingdom starting in 1997 with APEP 1 (Stone et al., 1997), then in 2006 - APEP 2 (Baker et al., 2006), 2013 - APEP 3 (Musgrove et al., 2013) and most recently in February 2020, publishing APEP 4 (Woodward et al., 2020). Using data in these reports it is possible to ascertain the trends in raptor species in Great Britain and the UK. These trends are not specific to grouse moors; they relate to the whole of the UK.

[257] The golden eagle and red kite were previously on the amber list.
[258] ibid

A significant challenge in making this report is the lack of current information. Many studies of both numbers of raptors and factors affecting them, including illegal killing, are at best five years old, sometimes over 10. Over this time, both legislation (for example in Scotland Vicarious Liability as regards illegal raptor killing) and projects (for example in England the hen harrier recovery project) have probably resulted in changed attitudes and behaviours towards raptors on grouse moors but the evidence has been slow to be collated. Given the contention that is associated with raptors and grouse moor we would like to see more ecological and attitudinal information collected more regularly.

6.1.5 GREEN AND AMBER LISTED RAPTOR SPECIES

Both red kites and golden eagles, now on the Green List, were formerly on the Amber List with populations successfully recovering, as shown in Figure 6.2 and Figure 6.3.

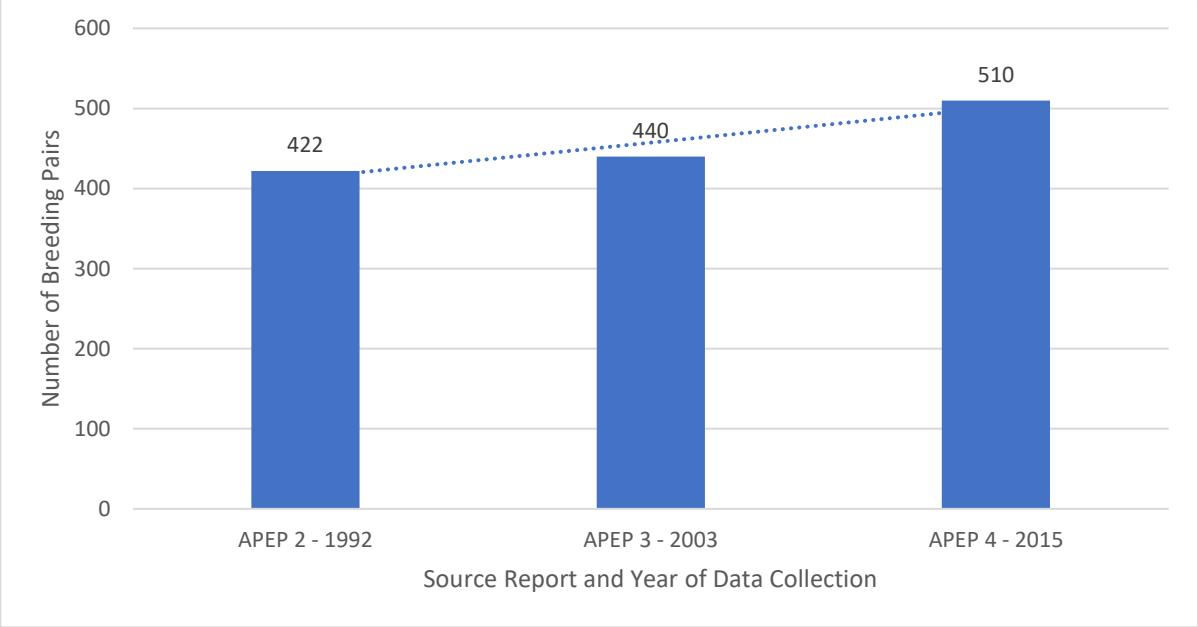

FIGURE 6.2 GOLDEN EAGLE PAIRS (UK) 1992-2015 (SOURCE: APEP 2-4)

Whilst golden eagle numbers are stable or increasing, they are doing this against the backdrop of being absent from England and Wales. However, in Scotland the population now meets the abundance target that defines FCS, although concern is still raised over low levels of home range occupancy particularly in the east Highlands and in the south-central Highlands, for which illegal persecution has been identified as a population constraint (Hayhow et al., 2017).

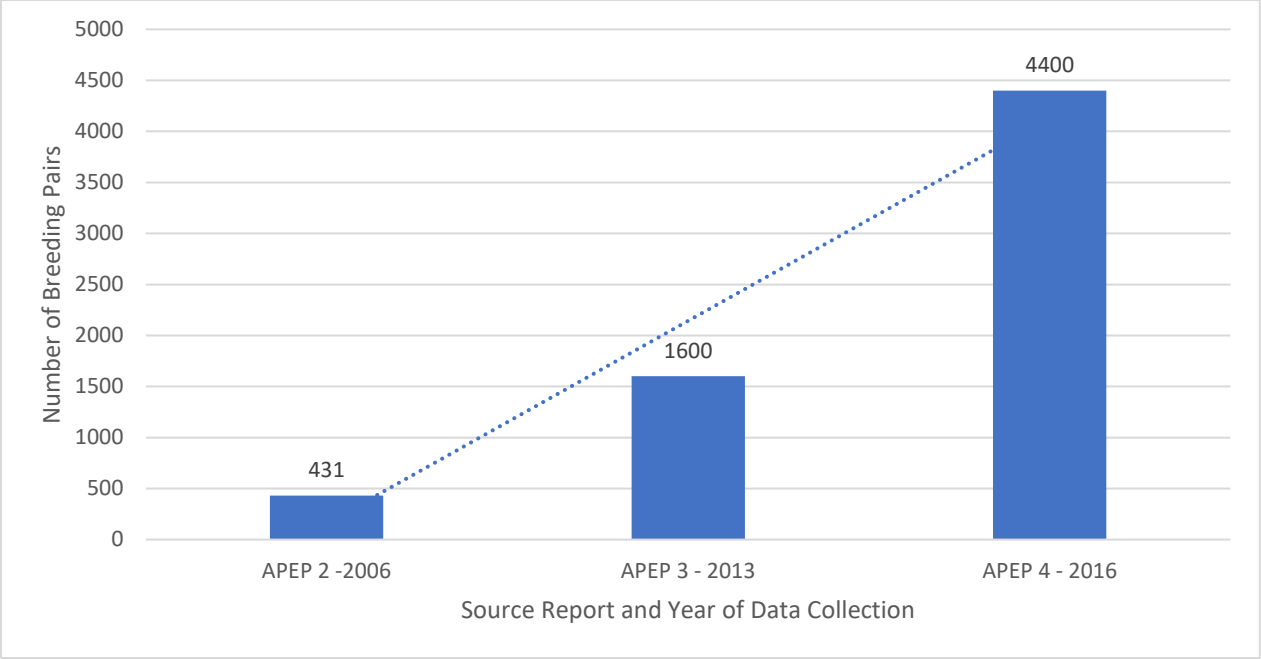

FIGURE 6.3 RED KITE PAIRS (UK) 2006-2016 (SOURCE: APEP 2-4)

In Scotland concern remains about the illegal killing of red kites (Smart et al., 2010; Sansom et al., 2016)[259] and illegal poisoning has been recognised as an issue in some areas of England (Molenaar et al., 2017). However, the population of this species has increased rapidly following reintroduction to Scotland and England as shown in Figure 6.3 and red kites were moved to the Green List in 2015 (Eaton et al., 2015). Red Kites are very common in many areas of England, and there have even been reports of this species attacking people in Oxfordshire[260].

Sparrowhawks are at a high risk of mortality from starvation and collisions with motor vehicles (Newton, Wyllie and Dale, 1999) and their populations, although not of concern, have dipped in recent years as shown in Figure 6.4. The BTO Bird Trend report does not give separate population data for individual nations other than England, which has a similar trend in populations to national data (Woodward *et al.*, 2020). Sparrowhawks are common and widespread in Scotland (Scottish Raptor Study Group, 2021).

[259] These references, from 2010 and 2016, support the statement made above that there is often a lack of current information about raptor persecution.

[260] https://www.itv.com/news/meridian/2021-06-03/concern-growing-over-number-of-attacks-on-people-by-birds-of-prey

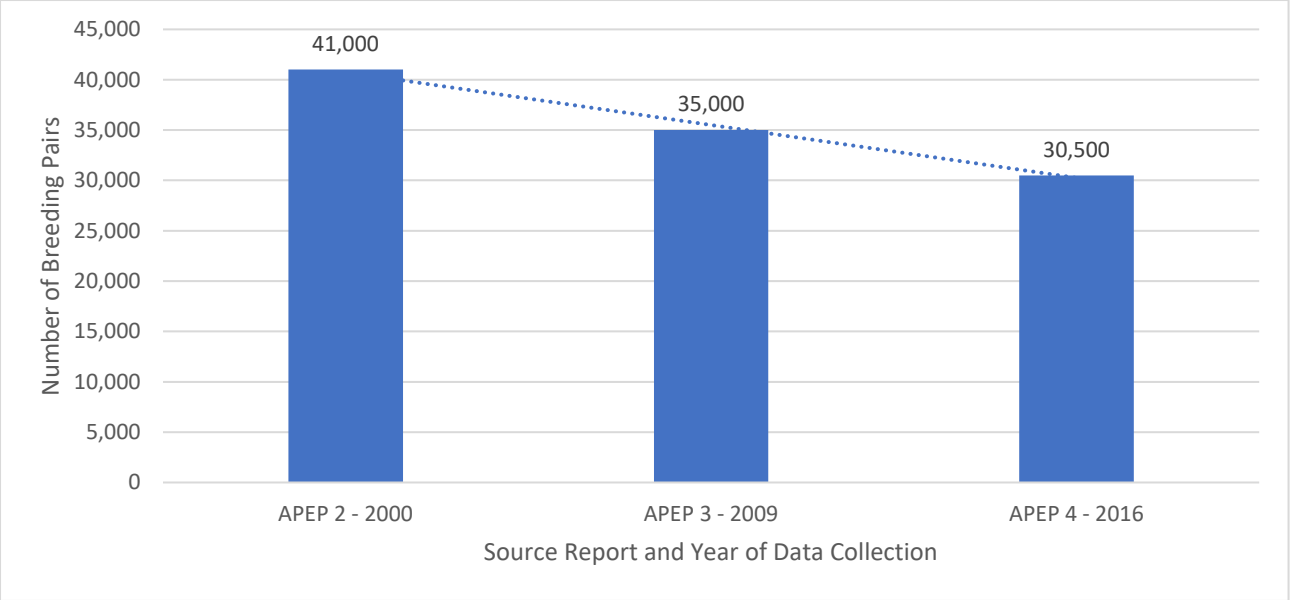

FIGURE 6.4 SPARROWHAWK PAIRS (UK) 2000 - 2016 (SOURCE: APEP 2-4)

Peregrine falcons have been a success story in the UK and are thriving. In 1963 their population had reduced to just 360 pairs, mainly related to organochloride pesticide poisoning. Enhanced protection and restrictions on pesticide use have seen steady increases in breeding pairs as shown in Figure 6.5.

However, much of this population increase is due to the expansion of lowland populations. The number of peregrines in Scotland is much lower than in England, reflecting the smaller land area and a number of possible factors including prey base (food abundance and availability), adverse effects of inter-specific competition with other raptors (eagles) and seabirds (fulmars) for breeding sites or prey, illegal killing both associated with management of upland gamebirds for shooting and by owners of racing pigeons, the bioaccumulation of toxic chemicals (Wilson et al., 2018). Whilst this does not pose a threat to the UK population, it could be important at a regional level (Wilson et al., 2018).

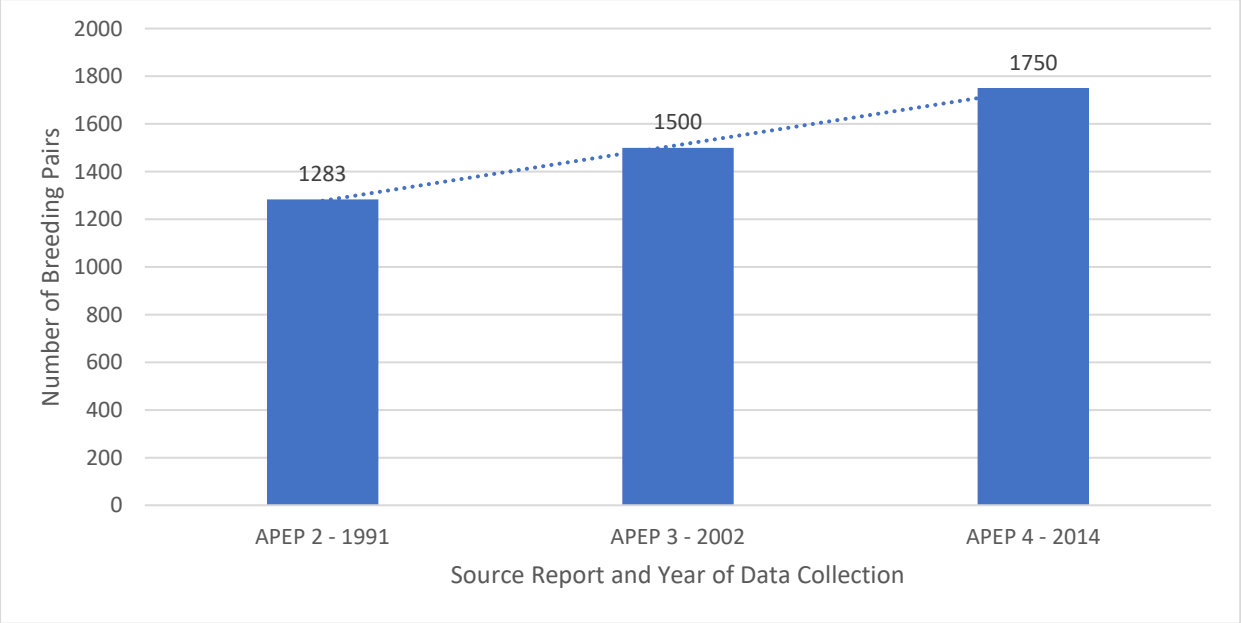

FIGURE 6.5 PEREGRINE FALCON PAIRS IN THE UK 1991 - 2014 (SOURCE: APEP 2-4)

Buzzards, heavily persecuted in the 1800s, are now the UK's most common bird of prey. Since 1994, buzzard numbers have been on an upward trend in England and Northern Ireland, but they have declined in Wales and in Scotland since c. 2000, as illustrated in the trend graphs Figure 6.6 below (Woodward *et al.* 2020)

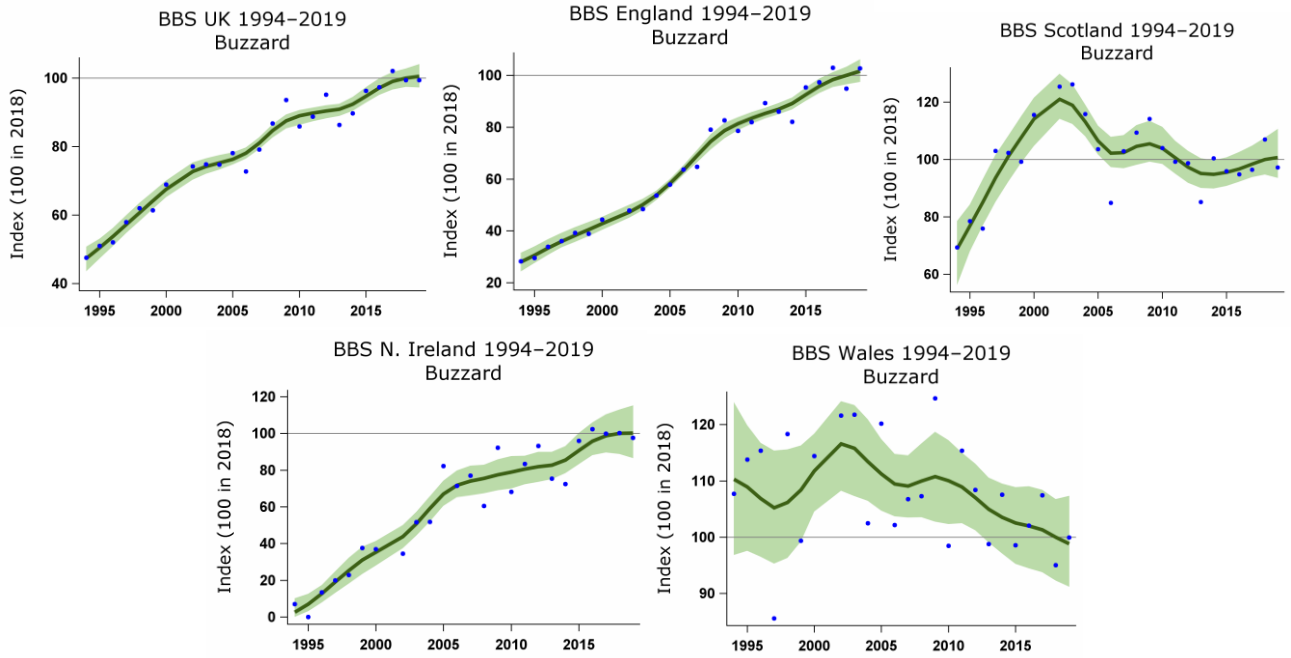

FIGURE 6.6 UK REGION TRENDS IN BUZZARD POPULATIONS (Woodward *et al.*, 2020)

The issuing of nine licences by Natural England between 2016 and 2018 to kill buzzards in order to reduce predation of young pheasants (which are classed as livestock), resulted in protests from a number of conservation organisations including the RSPB (Harper, 2016; Johnston, 2016). Further exploration of this area lies outside of the remit of this report as it relates to pheasant rearing rather than grouse moor land management. However, it has been recognised that further research into the issue of raptor control is required (GWCT, 2020b)).

Goshawk numbers, the final Green List species, are also increasing nationally, from 410 in 1995 (Baker et al., 2006) to 620 in the most recent APEP report (Woodward *et al.*, 2020). Figures for goshawk distribution across each of the UK nations could not be located, though the distribution maps at BTO webapp 'Mapstore' indicate increases in North East Scotland, the border area of Scotland and England and in Wales[261].

Of the five Amber List species, honey buzzards, marsh harriers and ospreys have increasing or stable populations. We were not able to locate data for their regional UK distribution. Kestrels remain on the Amber List with the population estimated at 31,000 pairs in 2016 (Woodward *et al.*, 2020), a reduction on the 46,000 pairs estimated in the UK in 2009. Research suggests that collisions with motor vehicles and starvation could be the main causes of mortality (Newton, Wyllie and Dale, 1999), with BTO data showing similar declines in both Scotland and England. Montagu Harrier numbers, having risen from 7 pairs to between 12-16 in 2006-2010 (Woodward et al., 2020), have now fallen to 8 pairs (Woodward *et al.*, 2020) and again, no regional UK data for this species could be sourced.

[261] https://app.bto.org/mapstore/StoreServlet?id=108

6.1.6 RED LISTED RAPTOR SPECIES

The largest of the UK's birds of prey, the white tailed eagle was extinct in the UK as a breeding species by 1916 (RSPB, 2020f). Between 1975 and 1985, 82 eaglets imported from Norway were introduced into western Scotland and then between 1993 and 1998, a further 58 young eagles from Norway were released by Scottish Natural Heritage (SNH) in Wester Ross. A third reintroduction project took place on Scotland's east coast between 2007 and 2012 (RSPB 2020f). The recovery of the species in the UK has been successful, as illustrated in Figure 6.7. The white tailed eagle is only found in Scotland at present, although there are plans to reintroduce the species to Norfolk.

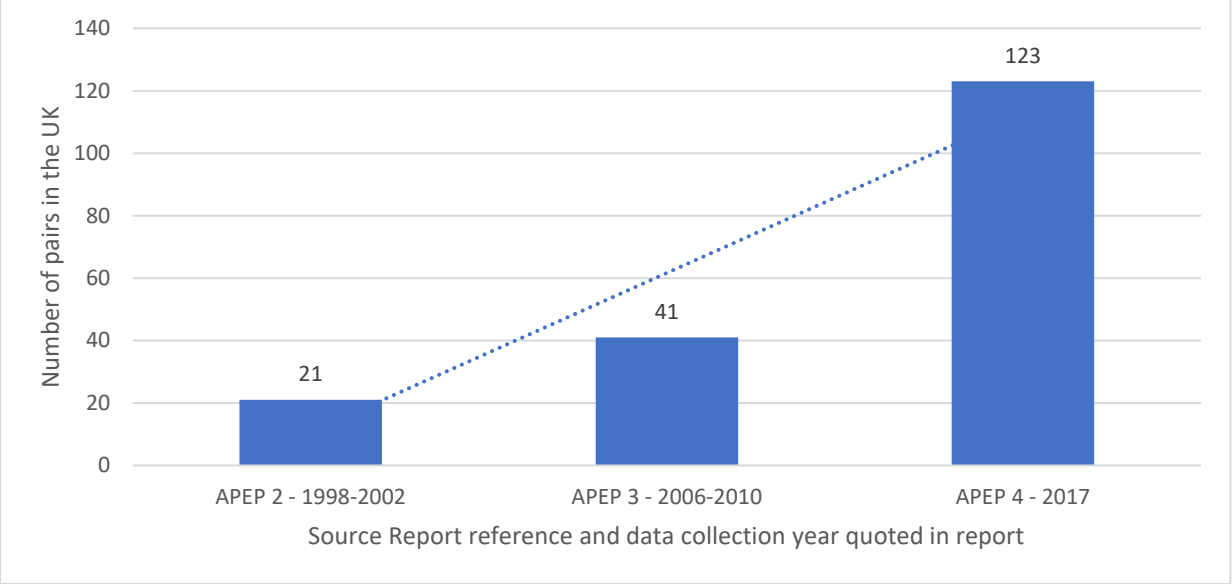

FIGURE 6.7 WHITE TAILED EAGLE PAIRS IN THE UK (SOURCE: APEP 2-4)

(The 2006-2010 figure is a mean average of the figures quoted in the APEP report of 37-44, Musgrove *et al.*, 2013).

Merlin, the UK's smallest bird of prey, are a ground nesting raptor that nests in moorland habitats. Between the 1950s and 1980s numbers declined to an estimated 550 pairs due to loss of moorland breeding habitat, predation and organochloride pesticides. Merlin have been shown to benefit from integrated moorland management at Langholm (Ludwig et al., 2020b), and another study has shown that merlin prevalence increased with increasing intensity of muirburn up to the 41-60% muirburn, and then declined and was absent from the squares with 81-100% burning (Newey et al. 2020).The merlin population has recovered well in the UK, with a 94 per cent increase on 1960 population levels. However, recovery has been hampered by habitat loss, mainly due to afforestation (RSPB 2020c). The most recent data estimates a population of between 890 and 1,450 breeding pairs UK wide. A 2008 study provides the most recent, peer-reviewed data, and suggests that the UK distribution of merlin as Scotland, 733 pairs; England, 301 pairs; Wales, 94 pairs, and Northern Ireland, 32 pairs. Several regional merlin populations noted declines, particularly in areas of northern England. The researchers in the 2008 study indicated the drivers of regional population change were not known but changes in land-use, prey populations and climate were believed to be important factors (Ewing et al., 2011). Grouse moor management appears very important to maintaining merlin populations as it is the only management regime which both conserves heather habitat and prey for merlin. Deliberate mis-management for merlin on grouse moors seems very unlikely, but the consequences of delivering very short heather habitats with low populations of meadow pipits and skylarks may have negative consequences locally.

Hen Harriers are typically ground nesting birds living in open areas with low vegetation, with their preferred breeding habitat in the UK being upland, heather moorland in the UK (RSPB 2020b). Hen Harrier numbers are at best stable in the UK, as illustrated in Figure 6.8. This is due to a number of factors including poor breeding success, prey availability, disturbance, predation by mammalian and avian predators and illegal persecution.

The population of hen harriers in the UK is very unevenly distributed. A 2016 study concluded that the combined breeding population of hen harriers in the UK had shown a non-significant decline between 2010 and 2016, but found notable decreases in the hen harrier population in England, Northern Ireland and Wales (Wotton et al., 2018):

> "The UK and Isle of Man hen harrier population was estimated at 575 territorial pairs (95% confidence limits, 477–694), a non-significant decline of 13% since 2010 but a significant decline of 24% since 2004. Scotland held the majority (80%) of the population with 460 (359–573) territorial pairs. Elsewhere, 46 territorial pairs were recorded in Northern Ireland, 35 in Wales, 30 in the Isle of Man and four in England. Significant decreases were recorded in the number of pairs in Scotland using grouse moor (−57%) and young forest (−54%)."
>
> (Wotton *et al.*, 2018)

The tendency of hen harriers to nest in aggregated areas in a semi-colonial way can lead to a large build up on grouse moors (Potts, 1998; GWCT, 2019), risking the economic sustainability of the moor. A conflict between grouse moor owners and anti-driven grouse shooting campaigners has developed (Avery, 2016). Many of these opponents believe DGS should be banned entirely. Potential solutions to this conflict are explored in section 6.1.10.

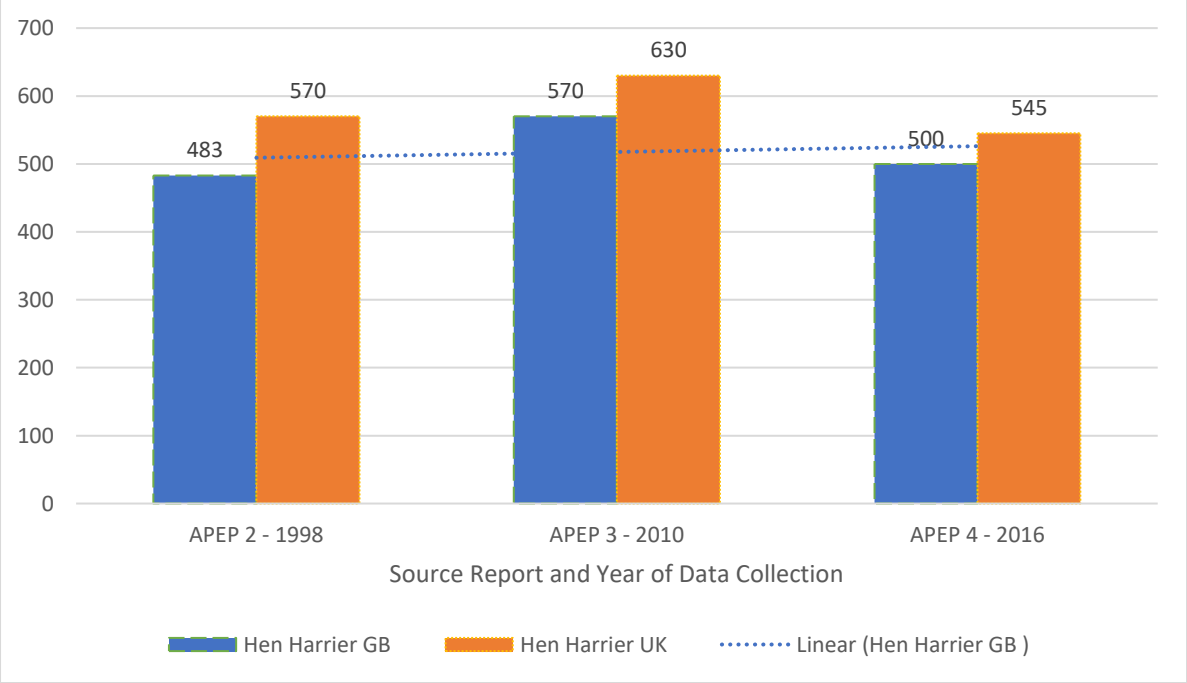

FIGURE 6.8 HEN HARRIER BREEDING PAIRS IN THE UK AND GB (SOURCE: APEP 2-4)

6.1.7 INTEGRATING GROUSE MOOR MANAGEMENT AND RAPTOR CONSERVATION

In the absence of illegal killing the management of moorland for grouse shooting can benefit ground-nesting raptor species, notably merlin and hen harriers (Ludwig et al., 2020b). Additionally, other raptors such as peregrine falcons, buzzards, short-eared owls, kestrels, golden eagles and red kites can and do thrive on moorland managed for grouse shooting (GWCT, 2011; Ludwig, Roos, *et al.*, 2020). Grouse moor management involves the use of predator control[262], habitat management and disease control, all of which reduce pressure on raptors and/or enhance the habitat and prey base.

This ecosystem enhancement makes moorland potentially attractive for raptors but also risky because historically the predator control element was extended to include raptors themselves.

Diversionary feeding and brood management are two novel management techniques that have been or are being tested to help integrate raptor conservation and grouse moor management. As part of the Langholm study detailed in Section 6.1.8, diversionary feeding was used to try and reduce predation of grouse chicks by raptors. Diversionary feeding involves "providing alternative food sources to predators with the aim of diverting them away from a more valued food source (e.g. gamebirds) which they might otherwise take" (DEFRA, 2016).

Brood Management is being trialled as part of the hen harrier recovery plan in the UK. It is a tool that has been used in France with some success in the recovery of montagu's harrier (GWCT, 2018). Once the density of hen harriers within an area reaches a certain level, some chicks are removed from the moor and reared in captivity, then released at an agreed site in the same landscape. The Hen Harrier Action Plan described the trial scheme as follows:

> "a trial scheme (licenced under Section 16(1)(a) of the Wildlife and Countryside Act 1981 for scientific, research or educational purposes) would be open to driven grouse moors that had brood numbers (of Hen Harrier) in excess of the modelled densities and would run for a minimum of 5 years. An agreed threshold, based on independently derived, objective criteria, and agreed by main stakeholders, would be set for contiguous groups of estates. When harrier numbers within estates increased above the density determined their eggs or broods could be moved to a rearing facility away from managed moorland. Young would be reared in pens (in heather habitat) until fledging, whereupon they would re-join the wild population. There is absolutely no lethal control involved. During the trial, young harriers would be fitted with satellite tags to measure movements and survival. If the trial scheme is successful, it would be available as an ongoing tool for grouse moors to conserve hen harriers, to be used under licence from Natural England."
>
> (DEFRA, 2016)

A success for the trial of the brood management scheme, would look like increased numbers of hen harriers in northern England and a change in the social attitudes of those involved in upland land management to accept the presence of hen harriers on grouse moors. It is also hoped that an improvement in the conservation status of hen harriers should help those who have sceptical

[262] Control of predators such as fox and stoat reduces the likelihood that ground nesting raptors have their eggs taken.

views about grouse moors recognise that moors can and do deliver a net gain in biodiversity. The first hen harrier chicks to be brood managed were in 2019.

6.1.8 THE JOINT RAPTOR STUDY AND LANGHOLM MOOR DEMONSTRATION PROJECT

Between 1992 and 2018 the Joint Raptor Study and the Langholm Moor Demonstration Project were carried out on Langholm in southern Scotland, an area dominated by heather and grass moorland which includes a Special Protection Area (SPA) for breeding hen harriers. Between 1992-1999 and then between 2008-2016, the moor was managed to produce a sustainable surplus of driven red grouse. During these periods, keepers legally controlled predators, undertook muirburn, controlled grazing pressure and treated grouse to control intestinal parasites. In the second period diversionary feeding of hen harriers was carried out. Between 2000-2007 and 2017-2018 the moor employed no full-time gamekeepers.

The study found that ground-nesting raptors such as merlin and hen harriers benefit from grouse moor management, mainly due to reductions in nest predation as a result of predator control (Ludwig et al., 2017). Hen harriers bred two to three times more successfully when the moor was managed (Ludwig et al., 2020b). Red grouse and wading bird abundance also increased with moor management. Numbers of breeding merlin only increased during the second period of moor management (Ludwig et al., 2020a). Grouse moor management did not significantly affect numbers or breeding success of the tree or crag-nesting peregrine, buzzard and raven, buzzard numbers increasing in line with national and regional trends (Ludwig et al., 2020a). The studies concluded that while grouse moor management processes can benefit hen harriers, the impact of illegal killing on and around grouse moors at the time of the studies more than outweighed those benefits at a national scale[263].

The researchers believed the illegal killing of hen harriers was caused by concerns that the consumption of red grouse by the raptors would undermine the economic viability of grouse moor management (Ludwig *et al.*, 2020). Indeed, the final report for the study noted that restoration of grouse moor management, in combination with diversionary feeding of harriers, did not result in a sufficiently increased grouse density to allow driven shooting on Langholm Moor. Unless predation pressure could have been further limited management for grouse shooting at Langholm moor was not currently considered economically viable (Langholm Moor Project Demonstration Board, 2019).

6.1.9 ILLEGAL PERSECUTION OF RAPTORS

Whilst there is evidence that illegal persecution of raptors occurs, within and outside of the DGS sector, it has also been noted that this involves a small proportion of those involved in shooting (Cross, 2020). In recent years there has been increased pressure from both inside and outside of the shooting industry to end illegal raptor persecution, with the use of a range of tools including satellite tagging, locational data, nest and winter roost protection and monitoring. A study using data from 58 satellite tracked hen harriers, found high rates of unexpected tag failure and low first year survival compared to other harrier populations, with the likelihood of harriers dying or disappearing increased as their use of grouse moors increased. The study used locational data and found that satellite fixes from the last week of life were distributed disproportionately on grouse moors in comparison to the overall use of such areas. However, it is very

[263] There are no recorded instances of the illegal killing of Merlin.

difficult to assess whether or not birds for whom satellite tracking had been lost were illegally killed. Satellite tags can fail unexpectedly, with two of the original 60 tags in the study noted above failing at the outset of the study. Evidence of failure can also be hidden by the perpetrators prior to location data being gathered, for example, in September 2020 a satellite tag from a missing golden eagle was found wrapped in lead on a river bank (BBC, 2020b)[264]. The outcomes of the 58 tagged birds are shown in Table 6.2. The researchers concluded that hen harriers in Britain suffer elevated levels of mortality on grouse moors, which they believed is most likely the result of illegal killing (Murgatroyd et al., 2019). The study found conclusively that three of the 58 tagged raptors had been illegally killed. However, what had happened to 38 of the 58 birds was simply not known.

Description	No of birds ascribed to each category (%)
Bird alive and still transmitting	7 (12%)
Bird recovered and cause of death established to be natural	5 (9%)
Bird dead, confirmed to have been illegally killed	3 (5%)
Tag harness recovered intact with no evidence of bird (therefore illegal killing suspected by researchers).	1 (2%)
Transmitter malfunctioned (tag ceased transmitting but bird subsequently seen alive)	2 (3%)
Transmitter malfunctioned (tag failure likely due to diagnostic plots)	2 (3%)
Transmitter suddenly stopped with no malfunction detected	38 (66%)

TABLE 6.2 THE FATE OF 58 TAGGED HEN HARRIERS (SOURCE: MURGATROYD *ET AL.*, 2019)

The RSPB argues that many cases of raptor persecution, including trapping and killing, reported to them do not result in prosecution (RSPB, 2019a). There have been some high profile cases of apparent deliberate hiding of or tampering with satellite tags reported by the RSPB (BBC, 2018, 2020b), but it is very difficult to accurately say who is complicit in any raptor persecution. Between 1990 and 2019 the RSPB reported that 181 individuals in the UK had been convicted of birds of prey persecution offences. Figure 6.9 shows that prosecutions for birds of prey offences were on a downward trajectory between 1990 and 2019, as shown in Figure 6.9.

[264] A number of gaps in the logic and evidence trail connected with this incident, for which nobody has ever been prosecuted, suggest that it is at least possible that it was a 'set up'.

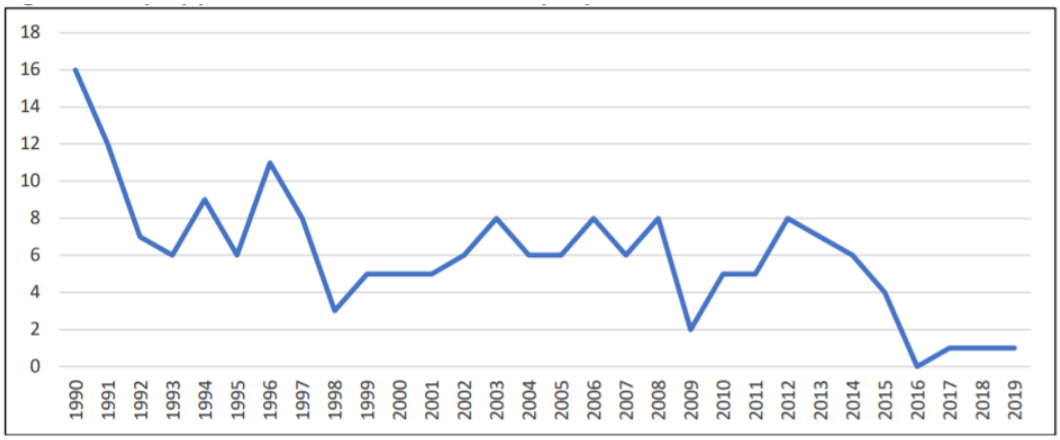

FIGURE 6.9 BIRDS OF PREY CONVICTIONS PER YEAR, 1990 TO 2019 (SOURCE: RSPB, 2019)

The researchers in the RSPB's 2019 study above recognised the limitations of the satellite tracking equipment used and noted that new tags with more frequent upload cycles and more regular fixes could help pinpoint illegal acts in a more timely and effective way (Murgatroyd *et al.*, 2019).

6.1.10 BIRDS OF PREY: ENSURING A LONG TERM-FUTURE

6.1.10.1 Ending raptor persecution and reducing conflict

The shooting community condemns illegal raptor persecution[265]. A joint 'zero tolerance' statement condemning raptor persecution was issued on 20th January 2020 (The Countryside Alliance (CA) *et al.*, 2020). The great majority of gamekeepers do not kill raptors, but a minority have been shown to do so. Unfortunately, the illegal actions of a minority of keepers has led some people to maintain that all gamekeepers kill raptors[266], which has increased the conflict between those for and against shooting.

It is not possible to accurately say how many gamekeepers intentionally harm birds of prey. A 2011 survey of gamekeepers found that most shoots had raptor species present, even those that were believed to be detrimental to shooting (GWCT, 2011), illustrating the positive impact that integrated moorland management can have on a range of raptors. Grouse moors cooperate with conservation groups on a number of projects designed to increase raptor numbers[267]. In spite of the fact that prosecutions for birds

[265] It should be noted that it was not until the passage of the Wildlife and Countryside Act (1981) that it became illegal to kill all raptors.

[266] Articles such as that written by Burnside, Pamment and Collins (2021), provocatively titled 'If it flies, it dies', published in the Journal of Rural Studies, reinforce this perception. However, the findings reported by the authors are derived from a sample of nine retired gamekeepers (only two of whom had experience on grouse moors). This sample was selected using 'snowball sampling' where existing study subjects recruit future subjects from among their acquaintances. This methodology suffers from community bias, is non-random, and has an unknown sampling population size. It is widely believed that it is impossible to make estimates from snowball samples as there is no assurance if the sample is an accurate reading of the entire population. The problems with snowball sampling were not addressed by the article's authors. Moreover, the article did not attempt to balance the information gathered from the small sample size with examples of gamekeepers and wildlife organisations, including the RSPB, working together to protect raptors. Burnside was a MSc criminology student when the article was written.

[267] See, for example, https://www.thescottishfarmer.co.uk/news/19375855.unlikely-alliance-grouse-moors-conservationists/?utm_source=All+Contacts&utm_campaign=4571377ef6-Non-Mem-NL-180621&utm_medium=email&utm_term=0_dd843c5cb6-4571377ef6-27564919&mc_cid=4571377ef6&mc_eid=1da0a5cac3

of prey persecution are decreasing, as detailed in Section 6.1.9, the RSPB included a graph in its 2019 report showing that 122 of the 181 individuals convicted for bird of prey persecution offences between 1990 and 2019 were gamekeepers. Whilst this data is factually correct, it is misleading as it does not reflect the reduction in raptor persecution convictions of gamekeepers. Only five gamekeepers were convicted between 2015 and 2019 (source RSPB Bird Crime Reports 2015 to 2019), supporting the view that it is a small number of individuals breaking the law. BASC reports that there are circa 5,000 full-time, and an unknown number of part-time, gamekeepers employed in the UK across all quarry types (not just grouse) (BASC, 2020).

It seems unreasonable for the many hundreds of gamekeepers in the uplands to be accused of regular raptor persecution, when only five, representing 0.001% of the total number of full-time gamekeepers in the UK, have been convicted of offences in recent years. The presentation of data in the RSPB report appears misleading and has the potential to increase conflict between those for and against shooting, exacerbating division and harming the possibilities for working together to benefit sustainable bird biodiversity in the UK. It should be noted that the RSPB has previously recognised the fact that it is a small proportion of individuals within the shooting industry who are responsible for illegal persecution (RSPB, 2015 Bird Crime Report), see figure 6.10.

A bad apple can spoil everything

Take the bloke who thinks it's okay to kill birds of prey.

Maybe you know him. He might even be someone who tells you it's part of the job. He understands that killing protected wildlife is illegal. He's aware that it drags the good name of gamekeeping through the mud. But who will end up in court, possibly prison, when it all goes wrong? He'll watch his own back. It's unlikely he'll be watching yours.

If you have any information about the illegal killing of birds of prey, call the RSPB's confidential hotline on **0845 466 3636***.

Together,
we can make a stand for what's right.

rspb.org.uk/goodmen

*Calls to this number are not recorded and will be treated in the strictest confidence.

The RSPB is a member of BirdLife International, a partnership of nature conservation organisations working to give nature a home around the world.

rspb giving nature a home

BirdLife INTERNATIONAL

Cover: red kite by Andrew Parkinson (rspb-images.com).
The RSPB is a registered charity in England and Wales 207076, in Scotland SC037654. 232-0443-15-16

FIGURE 6.10 EXCERPT FROM RSPB BIRD CRIME REPORT 2014 (RSPB, 2014)

6.1.10.2 The Hen Harrier

The hen harrier has become the focal species for those looking to ban DGS (Avery, 2016). Research published over 20 years ago identified that fear of loss of livelihoods, culture and other biodiversity has motivated some moor managers to kill harriers and other raptors illegally (Potts, 1998; Thirgood et al., 2000) and many years of research shows that the risk of raptor mortality is higher in the vicinity of managed grouse moors than other areas (Murgatroyd *et al.*, 2019). It is this combination of evidence that has led the GWCT to condemn crimes against wildlife and be committed to finding "effective and practical resolutions to conflicts", believing it is important to use a range of management techniques including disease control, diversionary feeding and brood management, to ensure a recovery of hen harrier numbers, whilst also recognising the positive conservation benefits outlined in Sections 5.3 and 5.4 of this report (GWCT, 2020e).

Following concerns raised by the RSPB that legal protection alone was not enough as hen harrier numbers were falling dramatically, the English Hen Harrier Recovery Plan was developed by a partnership consisting of Defra, the GWCT, the Moorland Association, the National Gamekeepers Organisation, National Parks UK, Natural England and, initially, the RSPB (DEFRA, 2016). The Action Plan set out a six-element plan to ensure the recovery and long-term sustainability of hen harrier populations in the UK. These elements were:

- Monitoring of populations in England and UK (utilising satellite tagging)
- Diversionary Feeding
- Work with Raptor Persecution Priority Delivery Group (RPPDG) to analyse monitoring information and build intelligence
- Nest and winter roost protection
- Southern re-introduction
- Trial brood management scheme

The success criteria for the plan were listed as follows:

"• The hen harrier has a self-sustaining and well dispersed breeding population in England across a range of habitats including a viable population present in the Special Protected Areas designated for hen harrier.

• The harrier population coexists with local business interests and its presence contributes to a thriving rural economy."

(DEFRA, 2016, p. 3)

It was felt by many within the shooting community that the Hen Harrier Action Plan provided the best opportunity to understand and reverse the decline of hen harriers in England. All six elements of the plan had a role to play, including the reintroduction of hen harriers to southern England, part of the approach to species reintroduction published by Defra in its 25-year Environment Plan.

As part of the Action Plan, a trial of licenced brood management began in 2018 (Natural England, 2018) and the licence was renewed in 2020 (Natural England, 2020), which saw the best year for hen harrier breeding in England since 2002. A total of 60 chicks fledged from 19 nests across Northumberland, Yorkshire Dales, Cumbria and Lancashire. Natural England put the success achieved in 2020 down to a number of factors including a high numbers of voles (a key food source), good weather, and strong partnership working between Natural England, Forestry Commission, the Moorland Association, United Utilities, the National Trust, and others (Department of Environment Food and Rural Affairs (DEFRA) and Natural England, 2020)). Figure 6.11 illustrates the success in utilising brood management in terms of the number of hen harrier chicks fledged.

However, although the RSPB were partners in the Uplands Stakeholder Forum that helped shape the Hen Harrier Action Plan, it resigned from the partnership shortly after it was published, saying that it did not believe lowland reintroduction was an appropriate action in the short term.

The brood management element of the Plan was supported by all parties except the RSPB, despite brood management being supported by the International Centre for Birds of Prey and the Hawk and Owl Trust. Brood management successfully unlocked the 20 year old conflict between Montagu's Harriers and arable farmers in France (GWCT, 2018). The RSPB has opposed brood management for some years and even took legal action at considerable expense, which was dismissed, to stop the brood management project. Mrs Justice Lang DBE, who was presiding on the case said: "There is simply no evidence to support the claimant's submission that Natural England is seeking to circumvent the overall statutory purpose of conservation of an endangered species" and, "The RSPB has not been able to identify any material information that was not available to the assessors and appears to have misread the conclusions reached in the report"(Lang, 2019).

It is also worth noting the RSPB took action to obstruct a collaboration between the field sports community, Natural England, and environmental organisations in France and Spain, which would have seen hen harrier chicks from Spain and France re-introduced into southern England. Documents obtained by the Countryside Alliance from Natural England and Defra through use of the Freedom of Information Act show that, based on conversations with French and Spanish colleagues, Natural England had come to the opinion that RSPB had been covertly undermining the project to reintroduce hen harriers into southern England[268]. This is odd as similar previous projects had been successful with red kites, ospreys and white-tailed eagles. The night before a Natural England envoy was due to meet with Spanish counterparts, information was received that '*they were not supportive of the project'* and were apparently, '*acting on behalf of their friends at the RSPB'*. As a result, despite Natural England having the infrastructure and staff in place they were prevented from obtaining any chicks.

It will be interesting to see the results of the Hen Harrier Action Plan in the years to come, and to report them in further editions of this living document. It will also be interesting to see if the RSPB continues to try to obstruct the implementation of the Plan.

[268] 'RSPB shoots down Hen Harrier Return', article published in My Countryside, the magazine of the Countryside Alliance, Autumn 2020 edition.

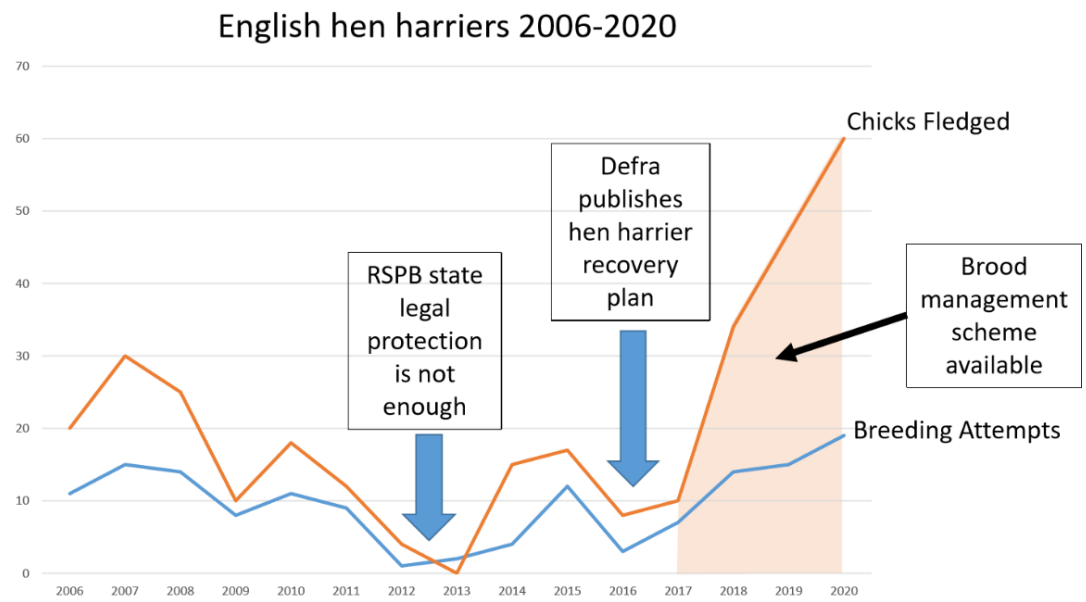

FIGURE 6.11 ENGLISH HEN HARRIERS 2006-2020 (SOURCE: GWCT, 2020)

6.1.11 CONCLUSION

As hen harriers can aggregate in specific locations (Potts, 1998), abundant local populations of hen harriers could have an unsustainable social and economic impact on upland communities that depend on grouse shooting without brood management. Such impacts would not be in line with the three recognised pillars of sustainability relating to environmental, economic and social impacts (Adams, 2006). Based on the amount of available habitat alone 1,660 hen harriers could be supported across the UK (Potts, 1998). However, this estimate does not take into account variables such as availability of prey, loss of habitat, predation on harriers and harrier nests or the willingness of moor owners to continue costly land management if they are not able to produce enough grouse to shoot (GWCT, 2019). If this number of hen harriers were dispersed across all of the suitable habitat in the UK, then the impact on grouse moors would be unlikely to be significant (Potts, 1998). However, as noted above they have a tendency to cluster together and for reasons not understood, to not use some habitats in the UK that are commonly used elsewhere in their global range. The trialling of brood management and a re-introduction of hen harriers to the southern uplands of England appears to be a sustainable way of increasing the numbers of this iconic raptor. However, consideration should also be given to what happens when hen harrier populations rise so high that, despite brood management and diversionary feeding, grouse shooting is interrupted. Solutions may have to include a a strategy to limit the breeding success of hen harrier and other raptor species when appropriate ceiling numbers are reached.

In order to meet the success criteria of the Joint Hen Harrier Recovery Plan as outlined above, brood management would seem to need to be carried out in parallel with the other elements of the Plan if the Hen Harrier population is to be self-sustaining and well dispersed across a range of habitats. A review of the evidence suggests that the RSPB's withdrawal from the Hen Harrier Action Plan, combined with its attempts to hamper the implementation of the Plan, may be linked to its avowed opposition to DGS.

6.2 THE LEGISLATIVE AND REGULATORY LANDSCAPE FOR DRIVEN GROUSE SHOOTING

People that own or lease moorland, and want to manage it, are subject to a range of legislation and regulation. If they employ other people to work on their behalf, then they are subject to additional laws and regulations. This section of the report will review the main legislation and regulation[269] that applies to landowners, tenants, estate managers and gamekeepers that work on moorland where DGS takes place. Our review groups legislation and regulation under three sub-headings: Licensing: Stewardship schemes; and People, Wild Animals[270] and Land management. We also look at the ways in which the shooting sector is developing and implementing self-regulation. We do not set out to list all legislation and regulation that applies to integrated moorland management, rather we aim to provide an understanding of the complexity of the laws, licences and regulations that landowners, their employees and their contractors have to contend with.

6.2.1 LICENSING

Along with habitat management and enhancement and activities designed to reduce disease, predator control is a key part of the job of a gamekeeper. Predator control has been subject to legislation for decades, with the Wildlife and Countryside Act 1981 (including its amendments) currently being the main legislation specifying which birds and animals can be controlled[271]. Though the principles are the same there are important differences to Scottish and English/Welsh versions of the Act, and in the use of the Act in regulation. **Please refer to the local country agency's (for example NatureScot or Natural England) website for specific information about licence requirements in that country.**

One of the provisions of the Act allows the country conservation agencies to licence the control of avian predators on moorland. In **England** for example: the Conservation licence GL34/GL40[272]; the Public health and safety licence GL35/GL41[273]; and the Serious damage licence GL36/GL42[274]. The General Licences (GL40, GL41 and GL42) came into effect throughout England on 1 January and will last for the whole of 2021. They include significant changes to the previous General Licences and are designed to be more legally robust and thus less likely to be the subject of legal challenges. The General Licences are issued by the Secretary of State for the Environment, a decision that was welcomed by the National Gamekeepers Organisation (NGO)[275].

Gamekeepers have to understand, comply with General Licences and, in some cases, apply for these specific licences: for example, GL40 only applies to control of crow and magpie in relation to the conservation of Red and Amber listed birds of conservation concern. Thus, crow and magpie can be controlled to protect hen harrier and curlew (Red Listed) and red grouse (Amber Listed) but not wild pheasant[276]. If a moorland keeper

[269] We do not include the regulation and licensing relevant to alternative uses of moorland such as forestry, alternative energy production, rewilding, tourism etc., even though many landowners that practice integrated moorland management are involved in these activities.

[270] We do not include legislation and regulation relevant to domesticated animals found on the moor, such as sheep and cattle, or to the laws relating to working dogs.

[271] The Act is covered further in section 6.2.3

[272] https://www.gov.uk/government/publications/wild-birds-licence-to-kill-or-take-for-conservation-purposes-gl34

[273] https://www.gov.uk/government/publications/wild-birds-licence-to-kill-or-take-for-public-health-or-safety-gl35

[274] : https://www.gov.uk/government/publications/wild-birds-licence-to-kill-or-take-to-prevent-serious-damage-gl36

[275] https://www.nationalgamekeepers.org.uk/articles/general-licences-for-2021

[276] Some moorland does have wild Pheasant present, especially on the lowland/upland boundary zone.

has wild pheasant on their land, they can only be protected from crow and magpie if an individual licence is applied for and granted. Rook and jackdaw are not covered by the 2021 GL40, although both species do predate the eggs of Red Listed birds[277]. The licences also contain some apparently odd clauses, for example jackdaw can be controlled under GL42 to prevent the spread of animal disease, but not under GL41 to prevent the spread of human disease. The new licences can be used in and around protected sites (SPAs and SACs) although some additional conditions apply. Both the NGO[278], the National Farmers Union[279] have welcomed the new General Licences, although the NGO has expressed some concerns about the possible delays in granting individual licences.

It should be noted herring gull and lesser black-backed gull have been removed from general licences[280] although grouse moor gamekeepers and the Moorland Association claim they predate the nests and chicks of Red and Amber Listed birds[281]. Owing to their poor conservation status, these species were not included in Defra's general licences. The breeding population of herring gull has fallen by 60% in recent decades, with lesser black-backed gulls declining by an estimated 48%. Licences for the control of these gulls remains with Natural England which has issued a class licence to permit any wild bird control necessary to preserve air safety which covers herring gulls and lesser black-backed gulls. Apart from air safety, Natural England licenses gull control through individual licences, which are prioritised. Natural England considers the strength of need in each licence application individually but generally protecting human life and health will be the overriding priority[282]. Any control undertaken under other purposes such as preventing serious damage and conserving wild birds and flora or fauna has to be targeted. In rural areas, such as moorland, Natural England has established a sustainable number of birds that could be killed or taken - equivalent to no more than 5% of the natural mortality total of each species - without harming their conservation status. By contrast, control levels of nests, eggs and chicks is not be limited in urban areas, where populations are thought to have better breeding success rates.

We are certain that the licencing regime that is relevant to integrated moorland management will continue to evolve[283], and we will report changes and developments in our regular updates of this report.

[277] S Denny has watch Lapwing nests being predated by Rooks on a farm in Bedfordshire each year since 2011. Lapwing commonly nest on moorland.

[278] https://www.nationalgamekeepers.org.uk/articles/new-general-licences-for-england-2021

[279] https://www.fwi.co.uk/news/2021-general-licences-issued-for-shooting-pest-bird-species

[280] https://www.gov.uk/government/news/changes-to-licensing-of-the-lethal-control-of-herring-gull-and-lesser-black-backed-gull

[281] https://www.moorlandassociation.org/2020/01/moorland-association-respond-to-new-gull-licences/

[282] See, https://naturalengland.blog.gov.uk/2020/04/21/update-on-licences-for-the-control-of-herring-gull-and-lesser-black-backed-gull/

[283] For example, NatureScot is able to withdraw General Licences from areas of Scotland where there is a civil burden of proof that raptors are being illegally killed. We would be surprise if this authority was not granted to English and Welsh authorities.

6.2.2 STEWARDSHIP SCHEMES

In the UK nations environmental schemes provide public financial incentives for farmers, woodland owners, foresters and land managers to look after and improve the environment[284]. The schemes (Agri Environment and Climate Change scheme in Scotland, Glastir in Wales and Countryside Stewardship in England) vary considerably between the nations.

In England the Countryside Stewardship (CS) scheme aims to look after and improving the environment by:

- conserving and restoring wildlife habitats
- flood risk management
- woodland creation and management
- reducing widespread water pollution from agriculture
- keeping the character of the countryside
- preserving historical features in the landscape
- encouraging educational access

The scheme has five main elements: Mid-Tier, Wildlife Offers, Higher Tier, Capital grants, and Woodland support grants. It is open to eligible landowners and managers, including those operating in the English uplands. Landowners and their agents can apply for CS grants (taxpayer funded subsidies) through a competitive process managed by the Rural Payments Agency where applications are scored against local priority targets to maximise environmental benefits. As noted in section 5.2 of this report, many moorland landowners have been successful in applying for CS grants, both as individual units and as part of consortia of farmers and graziers etc. Peat restoration and other measures aimed at improving biodiversity and natural capital that are undertaken on grouse moors are often part-funded by CS grants, again as noted in section 5.2.

In February 2021 the CS scheme opened for 2022 agreements[285]. The 2022 scheme is designed to be simpler that previous iterations of the scheme and provide more options for landowners. The changes that have been made to the scheme include:

- new options to help improve air quality, water quality and reduce ammonia emissions
- improving the capital grant offer, making 67 options available which can sit alongside a wildlife offer
- creating new wood pasture options in the uplands, at payment rates suitable for upland application, providing a mosaic habitat of grassland, scrub and trees
- making the capital offer available to Higher Level Stewardship (HLS) agreement holders, where the options are compatible
- improving woodland options, including bringing bracken control and stone wall options into woodland management and combining Woodland Creation and Woodland Maintenance grants
- increasing the number of capital items that farmers can apply for using the Rural Payments service, covering water capital, hedgerows and boundaries and air quality

[284] For an overview of the scheme as it operated in 2020 see, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/996741/Countryside_Stewardship_2020_Overview_leaflet_online.pdf

[285] https://defrafarming.blog.gov.uk/2021/02/09/opening-countryside-stewardship-for-2022-agreements/

- expanding eligibility criteria for the upland option UP2 (management of rough grazing for birds), enabling more land managers to access this option and further improve the upland offer.

Around the end of 2024 the CS scheme will be replaced with the new Environmental Land Management (ELM) scheme.

6.2.3 PEOPLE, WILD ANIMALS AND LAND MANAGEMENT

6.2.3.1 People

Like all other employers, upland landowners are subject to the Health and Safety at Work Act 1974, the primary piece of legislation covering occupational health and safety in Great Britain. The Act sets out the general duties which employers have towards employees and members of the public; employees have to themselves and to each other; and certain self-employed have towards themselves and others.

One of the key requirements for any employer is to have a Health & Safety Policy, and employers and the self-employed must carry out risk assessments for effects on staff, and other people that might be affected. The most common areas of operation that require risk assessments are:

- Safety[286]
- Substances Hazardous to Health[287]
- Fire
- Personal Protective Equipment (PPE)
- Legionella
- Asbestos

If a landowner or tenant has five or more employees, the health & safety policy, risk assessments and subsequent arrangements for their implementation & management must be in a written form and must be provided to employees. Employers must also provide relevant health & safety information to persons other than their employees who might be affected by their operations, such as contractors. To assist them to comply with health and safety legislation and regulations, many landowners engage specialist consultancies, for example Green's of Haddington[288].

In Scotland Vicarious Liability is a major person management issue which imposes additional requirements on employers.

6.2.3.2 Wild Animals

The largest piece of legislation relevant to the ways in which integrated moorland management impacts on wildlife is the Wildlife and Countryside Act 1981, including amendments to the act and special versions for Scotland and England & Wales. This Act was implemented to comply with European Council Directive 2009/147/EC on the conservation of wild birds[289] and amended to adopt the EU Habitats Directive. The Act gives protection to native species (especially those at threat), controls the release of non-native species, enhances the protection of SSSIs and builds upon the rights of way rules in the National Parks and Access to the Countryside Act 1949[290]. The Act is split into four parts covering 74 sections; it also includes 17 schedules. The legislation has strength; many amendments have been made to it, and it has acted as a foundation for later legislation to build upon. The compulsory five-year review of schedules 5 and 8 make it dynamic in terms of the species which it protects. The Act guides the development of numerous regulations, such as

[286] We will not list all the relevant safety regulations covering machines and substances. However, as an example the regulations for the use of chainsaws mean that by law, chainsaw operators must have received adequate training relevant to the type of work they undertake. They are also required to wear appropriate chainsaw protective clothing whenever they use a chainsaw, see https://www.hse.gov.uk/treework/safety-topics/chainsaw-operator.htm

[287] substances hazardous to health are covered in detail by the control of substances hazardous to health regulations 2002 (COSHH)

[288] https://www.greensofhaddington.co.uk/about-us/

[289] https://en.wikipedia.org/wiki/Birds_Directive

[290] https://en.wikipedia.org/wiki/National_Parks_and_Access_to_the_Countryside_Act_1949

The Humane Trapping Standards Regulations 2019[291]. Several organisations publish guidance and instructions and run training courses to ensure their members can understand and comply with the Act and its associated regulations, including BASC (https://basc.org.uk/advice/), GWCT (https://www.gwct.org.uk/advisory/), the Moorland Association[292] and the NGO[293].

There are many other pieces of wildlife management legislation relevant to moorland, often UK country specific, which regulate almost every part of the moorland wildlife management portfolio among them the use spring traps, snares, middens, deer control and hare conservation.

6.2.3.3 Land and Livestock Management

A wealth of legislation and regulation relates to the management of moorland and the livestock that are an integral part of it, with recent developments being intended to enhance environmental natural capital and increase ecosystem services.

Perhaps the most high-profile regulations relate to muirburn, with each of the countries of the UK, and the Isle of Man, having its own code[294]. Not all moorland is on deep peat. However, those that do have deep peat will have noted that in January 2021 the Westminster Government announced plans to bring forward legislation to prevent the burning of heather and other vegetation on protected blanket bog habitats in England[295]. The new regulations will prevent the burning of any specified vegetation on areas of deep peat (over 40cm depth) on a SSSI that is also a Special Area of Conservation or a Special Protection Area, unless a licence has been granted or the land is steep or rocky. It is interesting to note that the Westminster Government announcement claimed that there is a consensus that burning of vegetation on blanket bog is damaging to peatland formation and habitat condition as it makes it more difficult or impossible to restore these habitats to their natural state and to restore their hydrology. This claim is disputed by some scientists, such as Heinemeyer and Ashby (2001). The government did recognise that if moorland is unmanaged, there is a risk of wildfire and that this risk has increased due to climate change. Therefore, the government said that it intends to work with land owners and managers to develop local wildfire control plans[296].

While Natural England's Chair, Tony Juniper, welcomed the announcement, saying it would see better protections for the UK's globally important peatlands, the NGO took a different view, saying that "gamekeepers responsible for looking after internationally important areas of moorland with blanket bog

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[291] https://www.legislation.gov.uk/ukdsi/2019/9780111174722/contents

[292] https://www.moorlandassociation.org/publications/

[293] https://www.nationalgamekeepers.org.uk/training

[294] The Heather Trust https://www.heathertrust.co.uk/heather-management contains details of relevant moorland management regulations, including the https://muirburncode.org.uk/

[295] https://www.gov.uk/government/news/englands-national-rainforests-to-be-protected-by-new-rules

[296] The Uplands Management Group was commissioned by Defra to develop guidance on preventing and managing wildfires that sets out the requirements for a risk assessment approach to planning and preparing for wildfire incidents[296] and includes a wildfire management plan template and associated guidance. These recommendations include templates that are intended to help landowners and land managers develop a wildfire risk assessment and wildfire plans that will establish good upland management practices to protect people, businesses, land and property, sensitive habitats and the provision of ecosystem (natural) services. The target areas covered within the Uplands Management Group's report are upland habitats, including heathland, blanket bog, grass moorland, cotton grass moorland, rough grazing, bracken and scrub, including gorse, broom, juniper and pioneer trees. Defra has pointed out that there is current emphasis on the restoration of blanket bog but that it is important that it is recognised that wildfire risk needs to be addressed across the full range of upland habitats. country situations.

habitats have reacted with disbelief as Defra and Natural England continue to overcomplicate the management of these areas."[297]

Interest groups such as the Moorland Association and Scotland's Moorland Forum have produced guides for landowners and contractors on best practice for managing blanket bog[298] and the burning and cutting of heather and moorland vegetation, an important option for moorland maintenance[299]. British Moorlands Ltd also provides advice on cutting in comparison to burning for grouse moor managers[300].

The chemicals used to help control bracken are subject to specific regulation[301], especially Asulam. An emergency authorisation to use Asulam for the control of bracken has been required since 2015, and it has been applied for annaully by the Bracken Control Group. It is worth noting the conditions that applied to the Emergeny Authorisation to gain an understanding of the detail of the regulations that moorland owners and managers have to comply with. The conditions of use for Asulam include:

Aerial application is approved subject to a 90m wide no-spray buffer zone against surface water bodies.

Ground-based application is authorised but restricted to conservation areas only, and the use in these areas must be under the direction of the relevant conservation body. See the full details in the Authorisation document.

Livestock must be removed from areas to be treated and must not be allowed to return until at least 1 month after treatment.

Livestock management is itself regulated to prevent overgrazing on designated sites, the pollution of watercourses by tick killing acaricides or strongyle worm killing wormers.

6.2.4 THE SHOOTING SECTOR AND SELF-REGULATION

The Shooting sector has taken a leading role in suggesting, or voluntarily imposing, new 'regulation', particularly in two areas: the move away from lead shot (covered in detail elsewhere in this report), and in developing The Principles of Sustainable Game Management, which we examine here.

The 'Principles of Sustainable Gamebird Management' have been developed by the GWCT[302] and are designed to complement the Government's 25-year environmental plan. The principles are based on agreed UK industry codes of practice, such as the Code of Good Shooting Practice and British Game Alliance standards, the UK legislative framework, (e.g. the Wildlife and Countryside Act, 1981, the Animal Welfare Act 2006 and the Wildlife and Natural Environment Act 2011) and align with international guidelines on sustainable use of natural resources, including the Bern Convention and the International Union for Conservation of Nature (IUCN).

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[297] https://www.nationalgamekeepers.org.uk/articles/burning-blanket-bog

[298] See, Blanket Bog Land Management Guidance https://www.moorlandassociation.org/wp-content/uploads/2015/03/Blanket-Bog-Land-Mgmt-Guidance-FAQs.pdf

[299] See, http://moorlandmanagement.org/guidance-2/

[300] See, https://www.britishmoorlands.com/grouse-management/cutting-alternative/

[301] See, https://www.brackencontrol.co.uk/

[302] See, https://www.gwct.org.uk/principles

In October 2020 leading countryside organisations, including the British Association for Shooting and Conservation (BASC), the Countryside Alliance (CA), the Moorland Association (MA), the National Gamekeepers' Organisation (NGO), the British Game Alliance (BGA), the Country Land and Business Association (CLA) and the Game Farmers' Association (GFA), urged the Government to support the Principles[303]. The level of commitment contained in the Principles is impressive and has potentially interesting, and positive, implications for biodiversity and natural capital, we thus list them overleaf:

[303] See, https://www.nationalgamekeepers.org.uk/articles/shooting-blueprint

The Principles of Sustainable Game Management

Biodiversity. All shoots, whether based on wild gamebirds, released gamebirds or a combination of both, should strive to achieve a net biodiversity gain on their land.

Landscape. Through active management of the rural landscape, effective game management supports the growth of game populations, allowing a sustainable harvest with positive benefits for other species whilst avoiding population levels which could damage other land uses such as farming, forestry and nature conservation.

Densities. Gamebirds should only be released and managed at densities appropriate to the local circumstances, so that there is a net environmental gain from undertaking such activity.

Diversity. Appropriate habitat creation, management and sometimes restoration is needed for all gamebirds. Maintaining this critical and appropriate diversity of habitats is a feature of our advice and recommendations, based on our scientific research and observation. Habitats created, restored and managed to support gamebirds include woodland, hedgerows, field margins, game cover crops, wild bird seed mixes, moorlands and wetlands.

Timing. Releasing gamebirds in the summer increases the number of birds available to shoot in the autumn and winter. Shoot managers should only release gamebirds in habitats that enable them to acclimatise quickly to life in the wild, following the guidelines and recommendations outlined in the Code of Good Shooting Practice and British Game Alliance standards.

Development. Following release of gamebirds, habitats should be provided to encompass their year-round needs. All birds should be fully adapted to life in the wild before the first shoot day.

Responsibility. Shoots should ensure that all game that is fit for human consumption is eaten.

Science. Grouse and wild partridge shoots should assess their proposed bag by calculating the sustainable yield based on annual game counts and follow GWCT recommendations for sustainable harvest of wild game.

Sustainability. Game management provides an incentive to privately fund the creation, restoration and management of habitats across large areas of the countryside specifically for wildlife – something which is usually only incidental to other forms of land use such as forestry or farming.

Wildlife. Habitats created and managed to support released gamebirds include woodland, hedgerows, field margins, game cover crops, wild bird seed mixes and wetlands. Much other wildlife benefits from this habitat provision. Alongside the habitat provided and managed for gamebirds, predation control and supplementary feeding are often important aspects of game management. These activities can benefit a wide range of other wildlife.

Balance. Predation control is undertaken to reduce predation pressure. This is especially important in spring, to reduce levels of predation on nesting birds, nests and chicks and during summer to protect young birds. Many species, including several of conservation concern, benefit from predation control undertaken to conserve gamebirds.

Legal control. The predators targeted are common and successful generalists so a temporary reduction in their numbers locally will not jeopardise their population or conservation status. Predation control activities should be undertaken according to best practice guidelines to ensure they are legal, humane and effective. In no circumstances should any protected species ever be illegally killed to protect game, nor should any predation control activity risk negatively effecting the conservation status of a species.

6.2.5 CONCLUSION

Landowners and their employees are not allowed to do what they like with and on their moorland. All aspects of integrated moorland management, including DGS, are tightly regulated and licensed. There are active audit regimes that have to be complied with, particularly if an area of moorland is part of a CS scheme. Moor owners, gamekeepers and contractors have to do a great deal of paperwork before they get out onto the moors, and they have to keep detailed records of their activities. Our updates to this report will include changes and additions to legislation and regulations.

6.3 THESSITUATION IN SCOTLAND

6.3.1 THE GROUSE MOOR MANAGEMENT REVIEW GROUP REPORT

In 2014 Scottish Natural Heritage Scientific Advisory Committee commissioned a sub-group to review sustainable moorland management in Scotland (Werritty et al., 2015). The grouse moor sector, SNH (now NatureScot) and Scottish Government made some, albeit slow, progress addressing the recommendations of this report. However, by 2017 the perception in Scottish Government was that there remained a significant problem with illegal raptor killing and with other aspects of moorland management. This perception seems to have been influence by two factors: research reviews, based on what some commentators have suggested was historical data and, intense social media lobbying from individuals and groups opposed to DGS.

In 2017 the Scottish government commissioned a further review of the environmental impacts of grouse moor management practices in Scotland including illegal raptor persecution, managed heather burning (muirburn), mountain hare culls, and the use of medicated grit. The purpose of the review was to advise on the need and benefit of licensing grouse shooting businesses in Scotland (Scottish Government, 2017a). The Grouse Moor Management Group included a range of members and advisers, with varied backgrounds, skills and experience (Scottish Government, 2017b).

The final report of the group, published in November 2019, recommended:

> "That a licensing scheme be introduced for the shooting of grouse if, within five years from the Scottish Government publishing this report, there is no marked improvement in the ecological sustainability of grouse moor management, as evidenced by the populations of breeding Golden Eagles, Hen Harriers and Peregrines on or within the vicinity of grouse moors being in favourable condition."
>
> (Grouse Moor Management Review Group, 2019, p.8)

The report noted that the recommendations reflected not only a review of the scientific data available, but also the opinions and values of the different members of the group and that any decision to licence grouse shooting was ultimately a political decision.

The report's Executive Summary noted several other key recommendations which were not linked to the licensed shooting of grouse. These include working with landowners and managers to minimise any negative impacts, and ensure good practice whilst penalising poor practice, including additional regulation in the form of licensing for muirburn, increased regulation of mountain hare management and a voluntary code of practice for the use of medicated grit. It was noted that mountain hare management and medicated grit use should be licensed if the regulatory changes suggested fail to be effective.

In June 2020 the Scottish Government took a political decision to protect mountain hares, something not recommended in the report and in November 2020 the Scottish government took another political decision to not follow the recommendations of the GMMRG. It announced its intention to introduce a licensing system in Scotland within the next parliamentary term noting:

> "The Scottish Government agrees that a licensing scheme should be introduced. However, we believe that it should be implemented earlier than the five-year timeframe suggested by the review group.....We intend to bring forward the legislation to license grouse moor management during the next parliamentary term. This will be preceded by a full public and

stakeholder consultation. The legislation will be accompanied by a new Code of Practice on grouse shooting."

(Scottish Government, 2020, paras 36, 41, 42)

6.3.2 LICENSING IN SCOTLAND

As in the rest of the UK, grouse moor management and grouse shooting in Scotland is extensively regulated. Licenses, regulations and codes of practice apply in a range of areas including (but not exclusively) general licences for predator control, muirburn regulation, medicated grit controls, the operation of machinery and power tools, the use of chemicals, the operation of snares, the welfare of livestock, as well as the regulation of the use of shotguns and firearms. Estates and landowners are subject to visits from the Health and Safety Executive and commission specialist companies to help them ensure they are complying with legislation[304]. This allowed the GMMRG's report to suggest ways in which the oversight of grouse moor management could be improved, through utilising and adapting the current regulatory frameworks and codes of practice, as noted in section 6.3.1 above.

In Scotland, general licences to control certain predator species are issued by NatureScot (formerly Scottish Natural Heritage) who can licence, for certain specific purposes, actions that would otherwise constitute an offence against a protected species (NatureScot, 2021c). As at February 2020 the most pertinent licences relating to grouse moor management in Scotland are:

- GL01/2020 - To kill or take birds for the conservation of wild birds - 1st April to 31st December
- GL02/2020 - To kill or take certain birds for the prevention of serious damage - 1st April to 31st December
- GL04/2020 - To take red grouse using certain methods in order to administer medication or collect samples - 1st April to 31st December
- GL14/2021 - To use certain traps to kill stoats for the conservation of wild birds or for prevention of serious damage to livestock

(NatureScot, 2021b)

Specific licences may be applied for from NatureScot for many activities, for example to take ravens, deer out of season, and gulls.

From 2011 until March 2021, the killing of both mountain and brown hares was regulated through closed seasons for each species (brown hare: 1 February to 30 September and mountain hare: 1 March to 31 July). From 1 April 2021 the mountain hares open season was rescinded making it illegal to take mountain hares at any time of the year without a specific licence. Licences to cull mountain hares at any time and brown hares during the closed season may be granted by NatureScot for specific purposes, including to prevent the spread of disease, to prevent serious crop damage and for social, economic or environmental purposes. Applicants must prove why alternatives such as fencing woodland or taking brown hares in the open season would not resolve the problem prior to a licence being granted (NatureScot, 2021a).

Muirburn (planned burning of heath, grass and whins) in Scotland is currently regulated by the Muirburn Code, which sets out a muirburn best practice for land managers. The muirburn season runs from 1 October to 15 April inclusive in Scotland at all altitudes. The standard season can be extended to 30 April at the landowner's discretion. NatureScot can also license out-of-season muirburn where it is necessary to

[304] For example, Green's of Haddington www.greensofhaddington.co.uk/

"conserve, restore, enhance or manage the natural environment, conduct research or protect public safety" (NatureScot, 2021c, para.6). The GMMRG noted that Muirburn has been a preferred management tool in Scotland for centuries and that the role of the code is to promote best practice and minimise the likelihood of detrimental impacts. However, the report also noted the lack of a robust system of compliance monitoring and few statutory provisions within the code, which meant the panel were unable to assess its effectiveness at the time of the review. Licensing of muirburn in Scotland was suggested by the GMMRG.

As in the rest of the UK medicated grit use is controlled by the Veterinary Medicines Regulations 2013 with Guidance Note 13 on 'The Use of Cascade' and the Wildlife & Countryside Act 1981 as amended. (Grouse Moor Management Review Group, 2019). In Scotland grouse moor managers wishing to enhance the effect of medicated grit or monitor its effect can use the general licence, GL04/2021, to take red grouse using certain methods in order to administer medication or collect samples. A voluntary code of practice, as already exists, was recommended by the Grouse Moor Management Review group.

The use of snares is regulated by the Wildlife and Countryside Act 1981, as amended by the Nature Conservation (Scotland) Act 2004.

The Snares (Scotland) Order 2010 requires that:

- Snares must be fitted with a safety stop appropriate for the target species and made free-running.
- Snares must be fixed in such a way that they cannot be dragged and where the target species will not become fully or partially suspend or drown. Do not, therefore, set snares where there is a risk of entanglement in branches, scrub vegetation or fences.
- Snares must be checked at least once every day at intervals of no more than 24 hours.

The Wildlife and Natural Environment (Scotland) Act 2011 demands that:

- Snare users must achieve approved accreditation, receive a personal ID number from the police, and attach an identification tag to every snare when set.
- Snare operators must keep specific records.
- Training and guidance on snare operation is offered by the GWCT

(GWCT, 2021e).

Annually renewable licences are required for the use of Larsen Traps, Larsen mate Traps, Larsen pod Traps and multi-catch crow traps use, as regulated by General Licences (GLs) detailed above, issued under section 16 of The Wildlife and Countryside Act, 1981. Separate licences are issued annually by NatureScot. All trap operators must be registered in advance with NatureScot in order to use traps under GLs. The use of Larsen traps, Larsen mates and Larsen pod traps is restricted to 'authorised persons', individuals rather than properties, who must understand and comply with their conditions. The licences only cover situations where Nature Scot is satisfied that there is no other satisfactory solution in respect of the species to which they relate and the circumstances in which the licensed action may be taken. GWCT provide a best practice guide on the use of Larsen traps (GWCT, 2021d; NatureScot, 2021d).

There has been concern within the shooting community that new grouse shooting or wildlife management licensing schemes could be used vexatiously to disrupt the work of legitimate, law abiding grouse moor management estates in a similar way that Wild Justice used the legislative review process to question the operation of General Licences in England and Wales. The suspension of General Licences is claimed to have caused damage and disruption to communities, businesses and wildlife, as detailed in Section 6.4, even though the legal challenges led to no significant changes to existing practices.

Concerns regarding both gamekeeper abuse and harassment, along with the potential vexatious use of unfounded complaints to hinder lawful grouse moor management practices, have been expressed by the MSP Ben Macpherson, Minister for Rural Affairs and the Natural Environment and his colleague, Conservative MSP Oliver Mundell, as detailed in section 6.4 of this report. (BASC, 2021b).

It is not just the introduction of new regulation that is of concern to organisations such as the BASC, but the lack of the use of current regulatory options, something reflected in recommendations 4 and 5 of the GMMRG report:

> "4. That where particular species are perceived to be limiting the populations of red and or amber-listed ground-nesting birds, including Red Grouse, greater use should be made of the Wildlife & Countryside Act 1981 s16. This existing licensing legislation allows SNH to permit under licence a range of lethal and non-lethal management options.
>
> 5. That the brood management programme for Hen Harriers in England should be monitored, and if it is deemed successful in producing an increase in the breeding numbers and distribution of Hen Harriers, then consideration should be given to introducing a similar programme in Scotland."
>
> (Grouse Moor Management Review Group, 2019)

The GWCT has raised concerns around the failure to adopt conservation programmes such as hen harrier brood management scheme in Scotland, noting that the Scottish government "bypassed both the recommendations of the expert group it commissioned to investigate licensing, and the 20 years of trials on Langholm Moor" (GWCT, 2020c). Brood management is part of the Hen Harrier Action Plan in England, involving partners from a range of shooting and conservation organisations (DEFRA, 2016), as detailed in Section 6.1 of this report, The Action Plan has resulted in an increase in breeding pairs and successful fledging of young in England, largely through Brood Management.

Though the GMMRG considered a number of moorland management practices, its focus on linking the illegal killing of raptors to the licensing of grouse shooting was evident. This focus may be considered a very narrow view of conservation status, if national or even regionally resilient populations of raptors is the aim. By focusing on success of raptors solely "on or within the vicinity of grouse moors" Scottish Government would appear not to be considering all of the factors in hen harrier and other raptor success across the UK, and the parameters for a sustainable recovery discussed in Section 6.1 of this report.

As of June 2021, the details of the new licensing scheme for grouse shooting in Scotland remain unclear. A public consultation is planned by the Scottish government as part of the process, for which no date had been set at time of the publication of the first edition of this report (July 2021), but we are dubious of the value of such an exercise, given that the public cannot be expected to have studied the relevant science in detail.

6.3.3 SCOTTISH LAND REFORMS

Land Reform in Scotland is an ongoing and often emotive issue. Arguments have been made against ownership of large areas of Scotland by very few individuals. Supporters of land reform argue that this land was gained through the claiming of common land during the periods of enclosures in the 18th and 19th centuries, resulting in clearance of the highland areas of Scotland (Wightman, Callander and Boyd, 2003). The Land Reform Act (2016) was brought in by the Scottish Government including a Community Right to Buy for Sustainable Development. This legislation permits Scottish ministers to approve the purchase of privately

owned land by a community body with a registered interest, and does not require the current landowner to agree to the land sale. Ministers are empowered to compel landowners to sell if they decide that the sale will further sustainable development in the area (Land Reform (Scotland) Act 2016), and both financial and administrative government support are available for organisations who wish to utilise the 'Community Right to Buy' for sustainable development (The Scottish Government, 2021a; b)

The Scottish Land Commission and Scotland's Rural College published its report entitled 'Investigation into the Issues Associated with Large Scale & Concentrated Landownership in Scotland' (Glenn et al., 2019). This report led to the Scottish Land Commission making further recommendations to change land ownership laws in Scotland, including a legally enforceable public interest test. The test is designed to ensure the sale has wider social or environmental benefit for sales of estates of over 10,000 hectares (24,710 acres), as well as sales of land of economic or ecological significance, such as entire islands. Failure of the public interest test suggested would result in a number of outcomes including a complete block of the sale or in less serious cases the sale could be allowed to go ahead with conditions attached (such as selling off land for housing or a legally enforceable management plan). The commission argue that significant landholdings by only a few individuals or organisations means that they have a high level of power that can stifle development and economic opportunities in an areas (Scottish Land Commission, 2019).

Alternative land uses to sporting management that offer the same or better biodiversity return with as good or better socio-economic activity and which do not rely on public subsidy are very hard to find, as both the Werritty review of 2015 and the SRUC/JHI reviews of 2019/20 identified. Alternative uses are explored in section 6.5.

6.4 THE OPPONENTS OF DRIVEN GROUSE SHOOTING

Unlike some other forms of game shooting, DGS does not involve rearing birds in pens, which can be the basis of ethical opposition for some to shooting (Humphreys, 2010). Grouse are not reared and released, but reproduction is enhanced through a combination of land management techniques designed to yield the maximum number of grouse each year. This is not a precise science, as there are factors outside of the control of gamekeepers, such as the weather, disease and predation.

Opposition to DGS can be for a variety of reasons and result in a range of actions. Organisations such as Animal Aid and the League Against Cruel Sports are opposed to all killing of animals by shooting sports on ethical grounds (Brady, 2015).

High profile supporters of banning DGS, such as the television presenter Chris Packham, and former RSPB Director of Conservation Mark Avery, have strong views, organising protest events (Avery, 2016) and online petitions to be debated in parliament, including a call for driven grouse shooting to end (UK Government and Parliament, 2019 and 2021). These high profile campaigners are proficient in the use of social media enabling them to articulate and disseminate their views in the media, something which those involved in shooting recognise they are less well-equipped to do in order to provide balance to the arguments (Latham-Green, 2020).

Different national organisations vary in their stance on shooting. Whilst the Royal Society for the Prevention of Cruelty to Animals (RSPCA) is opposed to sports game shooting entirely, including the use of any form of predator control (RSPCA, 2014), the National Trust supports low intensity grouse shooting, managed in a way in line with its ethos of recognising rural heritage, traditions and spirit, and fitting with its principal purposes of conservation and access, following recognised codes of practice (National Trust, 2015). The Royal Society for The Protection of Birds (RSPB) has questioned the impact of DGS and has called for a licensing system to be introduced UK wide (Royal Society for the Protection of Birds (RSPB), 2020a).

6.4.1 THE ARGUMENTS EMPLOYED AGAINST DRIVEN GROUSE SHOOTING

Whilst individuals and organisation some are opposed to DGS on ethical grounds, others use a range of arguments to support a ban, including:

1. DGS is not economically viable and there are better alternative uses for moorlands such as Tourism and Forestry.
2. Walked-up grouse shooting is a better alternative
3. Ongoing Raptor persecution
4. Opposition to predator control
5. Use of lead shot
6. Peat damage following heather burning
7. Flood risk (including drainage) following peat damage
8. The killing of Mountain Hares

We will examine the evidence relating to each of these arguments in turn[305].

6.4.1.1 Not Economically Viable

The alternative uses relating to economic viability are explored fully in Section 6.5, showing that alternative uses such as forestry and renewable energy require government subsidy to ensure profitability and those with the most viable economic opportunities have negative environmental and social impacts. Conservation (which is seldom adequately defined) as an alternative use would require subsidies both for environmental land management and in some cases either government funding, donations or a combination of both, to purchase the land from existing owners. As noted in Section 6.3, the Land Reform (Scotland) Act (2016) (Land Reform (Scotland) Act 2016) includes a Community Right to Buy land for Sustainable Development, permitting Scottish Ministers to approve the purchase of privately owned land by a community body with a registered interest, even if landowners do not want to sell the land. If Scottish ministers decide that the sale of land will further sustainable development in an area, they can compel a landowner to sell (Land Reform (Scotland) Act 2016). The Scottish government provide guidance (The Scottish Government, 2021a) and funding support through the Scottish Land Fund (The Scottish Government, 2021b), for community groups interested in buying community land.

Whilst tourism can provide economic returns, currently tourism exists within many upland areas where management for DGS takes place and high levels of income are generated over a relatively short time from between 12th August and 10th December, with the rest of the year already benefitting from tourism which is supported by the work of grouse estates in relation to access, track maintenance, biodiversity and landscapes as detailed in Section 5.2, 5.3 and 5.4. DGS is a form of tourism which has an important economic value as explored in Section 5.2.

6.4.1.2 Walked-up Grouse Shooting is a better alternative

Some individuals argue that they are not opposed to grouse shooting entirely, just DGS. They suggest a less intensive form of grouse shooting such as walked-up shooting would be acceptable. The problems with this alternative are dealt with in Section 6.5, The argument for walked-up shooting also fails to take account of the intangible, cultural associations expressed by those involved (Denny and Latham-Green, 2020; Latham-Green, 2020). It is not economically viable for land to managed solely for walked up grouse shooting (Sotherton, Tapper and Smith, 2009) and therefore alternative uses for upland estates would most likely be sought, with resultant negative economic, environmental and social impacts through loss of the benefits from DGS outlined in Sections 5.2 – 5.5.

[305] In advance of the 21 June 2021 debate of the Petitions Committee in Westminster Hall on the petition organized by Wild Justice calling for DGS to be banned, the organization sent an email (on 18 June 2021) urging its supporters to contact their MPs to support the petition. The email cited most of the arguments listed in section 6.4.1. add added three others: that few grouse that are shot are eaten (this is untrue), that a grouse moor is as 'unnatural as a car park or a wheat field', and that 'our upland National Parks have been de-wilded by grouse moor management'. We find it is hard to accept these latter two arguments given the literature review we have undertaken to produce this report. During the Petitions Committee debate, 11 MPs took part. Only two MPs were in favour of a ban on DGS, while the nine that were against a ban cited extensive evidence supporting the continuation of DGS. In closing the debate, Tom Hunt MP said that "with respect to the petitioners, there is clearly not support in this House for the petition. In fact there is probably less support than there was for years ago", when a similar petition to ben grouse shooting had been debated.

6.4.1.3 Raptor Persecution

Raptor persecution is explored in some detail in Section 6.1, showing that some species of raptor, such as white-tailed eagles and golden eagles, are thriving in the UK whilst others, such as the hen harrier, remain at risk (Stone et al., 1997; Baker et al., 2006; Musgrove et al., 2013; Woodward et al., 2020), although numbers vary regionally across the UK. The conflict between those against DGS and the shooting community has been exacerbated by organisations on both sides of the raptor persecution debate interpreting the available data in a way that either supports their interests and agendas or damages the image of opposing groups (Hodgson et al., 2018). Some question the sustainability of DGS in relation to hen harrier conservation, arguing that less intensive moor management is the only solution to the issues surrounding raptors (Thompson et al., 2009), others believe that in order to resolve the conflict between those for and against shooting for the benefit of raptors, a better understanding and dialogue needs to be built between the parties to enable collaborative working (Hodgson et al., 2018), as illustrated by DEFRA's successful Joint Hen Harrier Action Plan (DEFRA, 2016).

As noted in section 6.1, the shooting community opposes raptor persecution and has been working with Natural England and other partners on the Joint Hen Harrier Action plan (DEFRA, 2016), which has seen initial trials successful in increasing hen harrier breeding success in England (DEFRA and Natural England, 2020). Brood management is not universally accepted as a conservation tool and the values of individuals influence its acceptance. In a 2019 study examining the conflict between hunters and conservationists concerning driven grouse moor management and raptors that collated data from 536 respondents from field sport or nature conservation organisations, support for different conservation management methods varied by organisation type. Respondents were categorized according to the main objectives of their affiliated organisation: Field sport, Non-raptor, Pro-raptor, and Pro-bird (i.e., organisations promoting conservation of birds excluding raptors, raptors specifically, or birds generally). The study found that "Pro-bird affiliates showed clear preference for less invasive management, and along with Pro-raptor respondents did not support brood management (removal and later release of eggs/young when harrier density is high). Field sport individuals expressed a degree of support for all management types" (St John et al., 2019).

In Scotland a different approach was been taken, as detailed in Section 6.3, with the focus is on 'populations of breeding golden eagles, hen harriers and peregrines on or within the vicinity of grouse moors being in favourable condition'[306]. If we take hen harriers as an example in Scotland, as they have been shown to be the focus of conflict between those for and against DGS (Avery, 2016; Hodgson et al., 2018; Thompson et al., 2009). Hen harrier numbers are positively impacted by management of upland moorland for DGS, which requires a high-level investment both financially and in terms of man-power and expertise. In order to invest this time and money landowners require a return on investment. High numbers of hen harriers have been shown to make s driven grouse moor financially unsustainable, with diversionary feeding being trialled and found to be ineffective in reducing hen harrier predation of grouse (Langholm Moor Project Demonstration Board, 2019). Walked-up grouse shooting, as noted previously, is not a financially viable alternative to DGS and levels of moor management that benefit hen harriers and raptors would be unlikely to be maintained to facilitate walked-up shooting.

Langholm Moor has now been sold to a community organisation and previous levels of moor management for grouse for sports shooting are not being maintained, instead the land is being managed for grazing,

[306] However, this focus may change to result in the withdrawal of a licence to shoot grouse in the event of substantial evidence of raptor crime.

rewilding and carbon capture[307]. The discontinuation of moorland management for grouse could have long term consequences for the hen harrier and other species, as evidenced by Berwyn Special Protection Area, the most extensive tract of blanket bog and upland heath in Wales. The site was designated in 1998 as an SPA for its internationally significant numbers of hen harrier, merlin, peregrine and red kite, whilst also supporting significant proportions of Welsh populations of upland breeding waders. Grouse moor management declined on the site after the Second World War and by the late 1990s DGS had ceased. A 2012 report highlighted the changes in the numbers of red grouse and the abundance of other upland birds in the Berwyn using shooting bag records, grouse count data collected on four moors between 1995 and 2012; and repeat upland bird surveys in 1983-5 and 2002, illustrating the potential changes to environments when moorland management is discontinued. Whilst some species benefitted, research has found that both black and red grouse numbers decreased and hen harrier numbers decreased by half over time, after moor management for DGS ceased (Warren and Baines, 2012).

There is a risk with introducing inflexible licensing conditions in Scotland, which land owners and the shooting community fear will be used vexatiously to disrupt grouse moor management without foundation (as they believe has been the case with the 'Wild Justice' legal challenges). It may lead to owners pursuing alternative uses resulting in an end to land management that results in increased numbers of hen harriers and other ground nesting birds as detailed in Section 6.5. If moor management for driven grouse ceases, the food source for hen harriers will eventually drop, and predator numbers will increase. Whilst hen harrier numbers may rise initially, ultimately the cessation of moorland management for grouse would likely be bad for hen harriers. The cessation of DGS could lead to other land uses being introduced such as forestry or wind farms, both of which are unfavourable for ground-nesting raptors as detailed in Section 6.5. It is unclear if numbers of grouse can reach very high levels near some grouse moors in Scotland without brood management, as noted by the suggestion of 'ceiling numbers' for grouse following the Langholm study and the development of the brood management scheme within DEFRA's Joint Hen Harrier Action Plan (Langholm Moor Project Demonstration Board, 2019; DEFRA, 2016). Evidence suggests that hen harrier populations need to be evenly distributed across all suitable habitats in the UK (GWCT, 2019). Without a plan like the Hen Harrier Action Plan utilising brood management, it is difficult to see how this will work.

The brood management programme provides a workable compromise. Instead of villainising gamekeepers, who already suffer from abuse that can impact theirs and their families' mental health, as detailed in Section 6.4.2 (Thomson et al., 2020), it encourages their engagement with nature conservation partners in identifying and relocating hen harrier chicks above the agreed ceiling number for breeding pairs to alternative locations away from the driven grouse moor on which they work. This approach both provides an incentive against illegal persecution and enables DGS and its associated moor management to continue.

6.4.1.4 Opposition to Predator Control

Predator control is often cited as a reason to oppose driven grouse shooting by some individuals. However, grouse shooting estates are not alone in their use of predator control. The RSPB uses predator control to maintain its nature reserves[308] as part of a range of conservation tools including fencing off set areas, to give

[307] https://www.facebook.com/The-Langholm-Moor-Community-Buy-Out-Group-2378467672238517/

[308] The RSPB spent £6M on controlling stoats on Orkney, see:
https://www.pressandjournal.co.uk/fp/news/highlands/1759112/orkney-stoat-cull-row-erupts-over-trap-setting/
And https://www.nature.scot/professional-advice/land-and-sea-management/managing-wildlife/orkney-native-wildlife-project

at risk species such as hen harriers, curlews and lapwings the best chance of survival (Harper, 2018). Opponents say that the levels of predator control on grouse moors are too high, without citing authoritative studies, but in order to maintain a diverse range of species it can be a useful conservation tool, particularly for ground nesting birds such as lapwings and curlews, that are highly susceptible to predation from species such as foxes, as detailed in Section 5.3.

6.4.1.5 Lead Shot Use

The use of lead shot has been controversial for many years. Lead is a toxin and there are potential environmental and human health risks from using it in ammunition. Lead has been proven to have negative health impacts (Pain et al., 2010) and whilst careful butchering can minimise exposure to lead, some argue that there could be a risk that birds ingest shot whilst feeding (Quy, 2010). The Food Standards Agency (FSA) notes that to minimise risk, consumption of lead-shot game should not be eaten too frequently (FSA, 2015). In the UK lead shot is legal to use for shooting birds that are legal quarry (and mammals such as rabbits, hare and deer). However, there have been restrictions on the use of lead shot since 1999. The Environmental Protection (Restriction on Use of Lead Shot) (England) Regulations 1999, amended 2002 and 2003[309], prohibits the use of lead shot for all wildfowl, with further restrictions below the High Water mark of ordinary spring tides, and over specific SSSIs. Restrictions on lead ammunition are also in place in Northern Ireland, Scotland, and Wales. However, in the UK lead shot is legal to use for shooting birds that are legal quarry (and mammals such as rabbits, hare and deer).

In some European countries such as Denmark (Kanstrup et al., 2016) and the Netherlands lead shot has been banned completely. However, Norway reversed its decision to ban led shot in 2015 (Ares and Baker, 2015).

The evidence about the dangers of eating animals killed by lead shot is not conclusive, and of course lead is found in many things that people and animals eat. Pain et al. (2010) pointed out that the risk of lead in the diet for UK consumers eating gamebirds had been previously assessed as low. Moreover, many commonly eaten foodstuffs contain lead absorbed from the environment, with the most important contributors to lead dietary exposure being cereal products and grains, vegetables (especially potatoes and leafy vegetables) and tap water. (European Commission, 2018). Game that has been shot with lead is one of the foodstuffs the National Health Service advises pregnant women not to eat[310], along with anything made with unpasteurised milk, some types of fish, pates, undercooked meat and many others. However, it is animals that have been killed by lead shot that attract media attention and a response from food retailers; in 2019 Waitrose announced that from the 2020 – 2021 season all game it sold would not have been killed with lead shot.

The game shooting sector, supported by countryside organisations, appears to have moved swiftly to respond to market pressure. In 2020 the sector committed to a five-year phase out of lead ammunition for the shooting of live quarry with shotguns. As the British Game Alliance (BGA) said on its website[311], this commitment was made, "precisely because the stockists and retailers of BGA Assured Game were telling us that they would not tolerate lead-shot birds for long.". At the National Game Dealers Association (NGDA) annual general meeting of March 2021 members voted to commit to sourcing all feather and fur[312] game, as well as venison and wild boar, from lead-free supply chains from 1 July 2022. The British Game Alliance has

[309] https://www.legislation.gov.uk/uksi/2003/2512/made

[310] https://www.nhs.uk/pregnancy/keeping-well/foods-to-avoid/

[311] https://www.britishgamealliance.co.uk/bga-statement-on-ngda-annoucement-regarding-lead-shot/

[312] Fur game includes rabbits and hares for example.

also developed a 'lead-free' shoot assurance scheme, that will be audited[313]. Both these moves are in response to pressure from the largest retailers of game demanding a lead-free supply chain, and while the NGDA may only represents 30% of the game dealers in the UK, others are likely to follow suit.

As was pointed out in the chapter on the Economics of Driven Grouse Shooting, there is a strong market for grouse with birds commanding premium prices and many grouse moor owners rely on being able to put their slain birds into the food chain to defray some of their costs. By 2025 when the voluntary transition away from lead shot takes effect, lead shot on grouse moors will cease to be an issue.

6.4.1.6 Peat Damage – Wildfire risk and controlled burning

Rotational burning of heather or 'muirburn' is an emotive subject, for which incomplete or misleading evidence has been presented as noted in Section 6.6. Managed muirburn carried out in the correct season by skilled land managers does not burn peat, but rather produces a cool burn which, if done correctly, can help reduce the risk of wildfires and manage vegetation to allow maximum biodiversity and production of grouse. Alternatives to burning for this purpose are currently under investigation but further research is needed as to whether these alternatives, such as cutting and mowing, can produce the same benefits as part of a developed ecosystem. Section 5.4.5 covers burning in more detail and section 5.3 examines biodiversity and moorland management.

6.4.1.7 Flood Risk

Organisations against shooting have expressed concern over possible increased risk of flooding downstream from land managed for grouse shoots (University of Leeds, 2014). A report commissioned by the RSPB in 2012 found that evidence for flooding being negatively impacted by land management for game shooting purposes was inconclusive. It noted that drainage and land management can be found to have both positive and negative impacts on water flows and associated flood risk (Grant *et al.*, 2012a). It concluded that it is "difficult to disentangle the multiple and interacting effects of grazing, burning, drainage and habitat restoration on water flows without conducting further research at multiple scales" (Grant *et al.*, 2012a, p. 7).

Opponents mistakenly argue that the land is drained for grouse to be raised, but drainage ditches are not dug on moorland to support grouse:

> "Drainage ditches were dug on moorland mainly to improve grazing for agriculture, not to support grouse. The practice was most common in the 1950s to 1980s, primarily driven by Government grants paid to improve hill farming. Many grouse moor managers and other moorland landowners are now working to block up historical drains and re-wet moorland for the benefit of grouse."
>
> (GWCT, 2020a, para. 2)

Drainage of moorland was encouraged by government policy in the post war era to provide peat fuel for burning and to increase UK agricultural production (Holden, Chapman and Labadz, 2004; Werritty *et al.*,

[313] The lead-free scheme will be audited by SAI Global, an established name in the rural community, delivering certification for Red Tractor and LEAF Marque among many others. See https://www.britishgamealliance.co.uk/bga-launches-new-register-of-lead-free-shoots/

2015; GWCT, 2020a), but more recently the government has been subsidising conservation work to re-block drainage systems previously created on the moors and restore peatlands (DEFRA, 2018, 2019; IUCN) United Kingdom Peatland Programme, 2020). Drainage of moorland negatively impacts the success of grouse, as the young grouse chicks can fall into drainage ditches, and drying out moorland has been found to reduce the diversity and abundance of moorland insects, which are a key food source for grouse chicks (Coulson, Butterfield and Henderson, 1990).

The situation is complex. Section 5.4 of this report covers the range of ecosystem services related to moorland management in more detail, including re-wetting and draining of moors.

6.4.1.8 Mountain Hares

Mountain hares (*Lepus timidus*) are mainly found in the Scottish Highlands and northern upland areas of the UK. Having been superceded across most of the UK by the introduction of brown hares by the Romans, mountain hares were re-introduced to the English uplands in larger numbers in the 19th century as part of grouse moor management, including for sports shooting purposes[314]. Mountain hares appear to benefit from the management regimes employed to raise red grouse, including predator control and rotational burning (Hesford et al., 2019). As their numbers increase due to grouse moor management, mountain hares have been regularly harvested, either through culling or sports hare shooting, on Scottish moors managed for grouse. Whilst there is no substantive evidence to support the population control of mountain hares as part of a strategy of tick and/or Louping Ill virus control to benefit red grouse (Grouse Moor Management Review Group, 2019), disease control is often cited as a reason to cull mountain hares on grouse moors.

Mountain hares are a priority species under the UK Post-2010 Biodiversity Framework (The Wildlife Trusts, 2021) and are protected in the UK under the Wildlife and Countryside Act, 1981. In England and Wales, whilst they can be shot throughout the year on enclosed land, on moorland or unenclosed non-arable land, they can only be shot between 11 December and 31 March. In Northern Ireland, they can be shot between 12 August and 31 January. The situation in Scotland is currently changing, as detailed in Section 6.3, with a licensing and monitoring scheme in development. Up until March 2021, the killing of both mountain and brown hares was controlled using a closed season licence for hare culling, allowing mountain hares to be shot between 1 August and 29 February. At the time of publishing the first edition of this report, a licence for the culling of mountain hares is in development and due to be available as from July 2021. Currently, intentionally or recklessly killing, injuring or taking a mountain hare in the closed season is an offence under the amended Wildlife and Countryside Act 1981.

Concerns have been expressed that large-scale culls on grouse moors are contributing to population decline of mountain hares in Scotland. In 2019, following the publication of a study by Watson and Wilson (2018) suggesting steep long-term mountain hare declines, particularly in areas managed as grouse moors, organisations such as the RSPB in Scotland called for a complete ban on culling of mountain hares (RSPB, 2019). However, when considered in more detail, the results from this study appear inconclusive (GWCT, 2021b). It is important to note that there is a natural 10-year cycle of mountain hare population levels and it is notoriously difficult to count mountain hares as they are well-camouflaged and elusive, with the Mammal Society noting “No systematically collected information is available on long-term changes in

[314] https://www.gwct.org.uk/wildlife/research/mammals/mountain-hare/

numbers of mountain hares over and above the usual periodic 10-year fluctuations" (The Mammal Society, 2021). The Watson and Wilson (2018) study did not compare data that had been collected in a controlled way, at the same time of day, using the same method and or researchers and sometimes comparing areas up to 5km away from each other (GWCT, 2021b). Some studies analysed in the Watson and Wilson (2018) counted hare numbers during the day, which is problematic as mountain hares are active at night and tend to rest during the day in forms and scrapes, sometimes making burrows in the earth or in snow, particularly when young (The Mammal Society, 2021), making them very difficult to spot in the day. Therefore, comparing studies with counts at different times of the day could very easily result in incorrect population assumptions.

A three-year study responding to the need for a standard monitoring system to allow effective monitoring of mountain hare numbers found that:

"i) counts of mountain hares along transect lines at night with the aid of a high-power lamp (and to a similar degree, thermal imaging equipment), and ii) dung accumulation rates can both be used to provide simple and easy to use indices of mountain hare density. These indices can be applied at the local scale to obtain indices of mountain hare density to inform local mountain hare management."

(Newey et al., 2018)

Hesford *et al* (2019) found that on average there were stable numbers of mountain hares in Scotland and they were more abundant on grouse moors managed for driven grouse shooting than anywhere else. Hesford *et al* found that, over a 20-year period, trends in mountain hare abundance indices varied with region and grouse management intensity. Whilst in southern Scotland there were range contractions there was no change in north east Scotland. In north west Scotland their range expanded by 61% in areas where there was DGS but declined by 57% in areas of walked up grouse shooting, remaining low but stable in areas with no grouse shooting interest. The study concluded that "hare indices were higher and relatively stable on moors where driven grouse shooting was practised relative to lower indices and declines on moors where grouse were either walked-up or not shot... ..enhanced habitat management and control of generalist predators seem to be the most parsimonious explanation for higher abundances indices of mountain hare on driven grouse moors". The researchers believed that no relationship between culling of mountain hares and contraction in their range was evident and that the rises in numbers of hares killed over earlier surveys was likely to reflect natural population cycles and that other factors such as changes in habitat and management may be responsible for the reductions (Hesford et al., 2019, 2020)[315].

6.4.2 METHODS USED BY SOME OPPONENTS OF DRIVEN GROUSE SHOOTING

6.4.2.1 Violence, Intimidation and Abuse

Some opponents of driven grouse shooting use intimidation and disruption to driven grouse shoots to further their cause, often publicising the disruption and intimidation they have caused (Raptor Persecution UK, 2018). As an example, in August 2018 a group of hunt saboteurs dressed in black wearing balaclavas arrived at a shoot, where they tried to stone vehicles and intimidate shoot staff. The police were called to

[315] What the Science Says? A conservation fact checking website has produced a full analysis of the science relating to mountain hare numbers on grouse moors that can be accessed at https://www.whatthesciencesays.org/has-the-number-of-mountain-hares-fallen-on-grouse-moors/

disperse the individuals and the shoot was forced to end the day early (Darlington and Stockton Times, 2018). It is clear from Raptor Persecution UK's website that the incident caused discomfort to local people:

> "A villager from Reeth said: 'It was quite scary as the protesters had balaclavas on and there were so many police cars and vans.'"
>
> (Raptor Persecution UK, 2018, para.21)

However, the shoot days themselves are not the only target. Estates have faced intensive intimidation campaigns and vandalism[316]. Some estates now have to employ security teams.

Gamekeeper abuse is also an issue, both face to face and online (FarmingUK, 2021), with many organisations using covert and overt surveillance of gamekeepers going about their daily duties (Brown, 2019). This intimidation and abuse has been condemned by nature conservation groups and some local MPs (Cross, 2021; Chalmers, 2021).

A 2020 report which surveyed 162 Scottish gamekeepers about their working lives and conditions found:

> "About 8% of the respondents reported receiving abuse or threats from people outside of their profession on a regular basis (once or twice a month), whilst 56% had experienced such abuse/threats 'rarely' (once or twice per year)..... The majority of abuse received was verbal abuse although incidents of physical violence and online abuse were also reported"
>
> (Thomson et al., 2020, p.25)

The report publication led to the tabling of a motion in the Scottish Parliament by MSP Oliver Mundell, shown in Figure 6.2.

Motion S5M-23253: Oliver Mundell, Dumfriesshire, Scottish Conservative and Unionist Party, Date Lodged: 04/11/2020 - Scottish Government Research Highlights the Abuse Faced by Gamekeepers

That the Parliament acknowledges the findings of research commissioned by the Scottish Government on the employment rights of gamekeepers; notes that almost two thirds of the gamekeepers surveyed reported that they had experienced verbal or physical abuse of some kind and that almost 80% said that they were less optimistic about their future; understands that a lack of government support and concerted anti-shooting campaigns were strongly referenced as an explanation for this negative outlook, and notes calls from the British Association for Shooting and Conservation for the Scottish Government to do more to support the country's gamekeepers to help ensure the long-term future of gamekeeping.

FIGURE 6.2 MOTION TO SCOTTISH PARLIAMENT FROM MSP OLIVER MUNDELL (MUNDELL, 2020)

Unsurprisingly, this motion was not carried as it was only supported by Scottish Conservative MSPs, not MSPs from other parties. However, the tabling of the motion did result in the Minister for Rural Affairs and the Natural Environment, Ben Macpherson MSP, writing to BASC noting that he was "appalled to hear of the experiences" reported by Scotland's gamekeepers (BASC, 2021b).

A survey of more than 1,000 gamekeepers published in February 2021 by BASC found that almost two-thirds of respondents across the UK had received abuse and threats as a direct result of their profession (British

[316] One estate has CCTV evidence of an individual urinating on legal fox control snares leaving them inoperable (Brown, 2019).

Association for Shooting and Conservation (BASC), National Gamekeepers' Organisation (NGO) and The Countryside Alliance (CA), 2020). The key findings were:

- "Nearly two-thirds (64%) of gamekeepers have experienced abuse and/or threats because of their occupation.
- Abuse via social media channels is a rising issue for gamekeepers, with 56% of respondents recording an increase in the number of incidents over the last 12 months compared to previous years.
- Respondents who have been targeted also recorded increases in physical (32%) and verbal (37%) abuse.
- Some gamekeepers also reported that the pressure of being targeted for doing their job has led directly to the breakdown of personal relationships."

(BASC, 2021a, para. 4)

In response to these findings, the Environment Minister, George Eustace MP noted:

> "Gamekeepers do vital work as custodians of the land. They play an important role in the shooting industry, which delivers significant benefits to rural economies. Any form of abuse or intimidation is wholly unacceptable, and those responsible should feel the full force of the law. We will take the findings of this report on board."
>
> (BASC, 2021a, para. 5)

Most gamekeepers live in tied house on the estates, meaning there is no escape from the fear of intimidation when they go home after work. The Gamekeepers' Welfare Trust launched a counselling service in December 2020 to provide support to gamekeepers and their families, noting that many gamekeepers are facing increasing abuse targeted at both themselves and their families and even at school which can negatively impact their own and their families' mental health (Gamekeepers' Welfare Trust, 2020).

6.4.2.2 High Profile Supporters and Social Media

High profile supporters of a ban of DGS have used their power and influence on platforms such as Twitter and Facebook to further their cause. The founders of Wild Justice[317] have used these channels to instigate protests and debates in parliament on DGS (Knapton, 2017; UK Government and Parliament, 2019 and 2021). Chris Packham, with his high profile BBC role, has been accused of abusing his position to further personal views, with the Countryside Alliance repeatedly calling for action to be taken against him for damaging the BBC's impartiality (Bonner, 2018, 2020). Mr Packham's celebrity status and high-profile role at the BBC means that he has over 450,000 twitter followers. In September 2020 the incoming BBC Director General Tim Davie announced changes to the guidance on social media use for BBC employees and contractors noting that "If you want to be an opinionated columnist or a partisan campaigner on social media then that is a valid choice, but you should not be working at the BBC," (BBC, 2020a, para.34), promising sanctions would be introduced against those not sticking to the guidelines (BBC, 2020a). It is not clear what difference the new guidance has made.

When high profile individuals tweet inaccurate or false information, it can cause particular difficulties. In 2017 Mr Packham tweeted a claim that lapwings were being shot by people involved in game shooting, in order to encourage people to sign a petition calling for a moratorium on shooting. The claim made by Mr

[317] Wild Justice, a not-for-profit company, was created in February 2019 by three high profile opponents of driven grouse shooting Ruth Tingay, Mark Avery and Chris Packham

Packham was false, a fact later recognised by Packham and for which he later apologised (Farming UK, 2017). However, this was after the post had been 'retweeted' over 250 times. The dissemination of falsehoods might encourage people to sign petitions supported by high-profile individuals. It is also likely to exacerbate divisions between shooting and non-shooting communities, with potentially dangerous consequences for the well-being of gamekeepers and others that, legitimately, shoot. Waders including lapwings have benefitted from grouse moor management, which results in increased numbers of birds (Whitehead, Hesford and Baines, 2018; Baines et al., 2014). This has led to exasperated local communities in grouse shooting areas directly protesting against Mr Packham (Ward, 2019).

A 2020 study into participation in all forms of driven game shooting found that participants felt hindered by their lack of social media expertise, and unable to portray their pastime in a positive light to combat the negative representations in the media, which they felt threatened an activity integral to their way of life (Latham-Green, 2020). Driven game participants (and there are over 1.5 million of them) identified as an under-represented minority, whose participation in driven shooting was more than just a hobby, but a way of life with strong sense of belonging and shared understandings (Cohen, 1982), including a set of rituals and procedures that make up part of the recognised sociological aspect of taking part (Hillyard and Burridge, 2012). This way of life is, unsurprisingly, not understood by most people that do not identify as part of the shooting community (Tajfel and Turner, 1986). In the study, only 52.8% of shooting participants describing themselves as confident users of Facebook, and 14.1% felt they were confident users of twitter (Latham-Green, 2020). This result is most likely a reflection of the age demographic of participants in shooting (median age 57 years old). The age distribution of Twitter users is younger than the age distribution of the UK population (Sloan, 2017). This lack of twitter use reduces the ability for individuals to mobilise a social movement, as twitter has certain features that make it an ideal platform for successful social movements (Buente, 2017).

6.4.2.3 Legal Challenges

The stated objects of Wild Justice organisation are:

> "Nature conservation, primarily in UK.
> Advocacy to make UK laws, policies and practices more wildlife-friendly.
> Use of UK legal system to further nature conservation objectives.
> Encourage public participation in nature conservation issues."
>
> (Wild Justice, 2021, para.14)

To date Wild Justice has used legal challenges relating predominantly to shooting. They have focused on challenging the legality of General Licences, which are issued to allow the control of wild birds to prevent serious damage or disease to crops or livestock, thus protecting public health and conserving certain species of wild birds, as detailed in section 6.2.

In spring 2019 Wild Justice launched a legal challenge against the use of General Licences in England. This led to the immediate suspension of General Licences by Natural England. The suspension occurred between April and June 2019, and meant that farmers and others could no longer control pest birds on their land during the period when, for example, young lambs need protection from carrion crows and arable crops can be devastated by birds such as pigeons. The resulting damage to crops and livestock resulted in disruption to rural and farming communities, potentially exacerbating division between those in favour and those against shooting (Horton, 2019; Bentley, 2019). After the General Licences were suspended, an emergency online individual licensing scheme crashed and the new Natural England General Licences for crows, woodpigeons and canada geese, which contained a wide range of restrictions, were accused of being unfit for purpose and dangerous to rely on. DEFRA carried out a consultation and eventually Natural England developed new single licences to replace the general licence, as outlined in section 6.2, allowing most practices covered by the previous general licence scheme to take place (National Gamekeeper's Organisation (NGO), 2020). However, there were two key exceptions, described by the NGO in the following terms:

"You cannot use Defra's new General Licences in 'European protected sites' such as Special Protection Areas (SPA's), Special Areas of Conservation (SAC's) or RAMSAR wetland sites. To control pest birds in these sites you will need to hold an Individual Licence issued by Natural England. This is unsatisfactory but it may well be a temporary situation. Defra has pledged to work with the NGO and other bodies - and through a public consultation later this year – to find solutions but it is a complicated area of law and needs more time.

- Collared doves are no longer on the General Licences and are therefore fully protected."

(NGO, 2020)

It is the view of many in the upland game keeping community that gulls are now having a detrimental impact on red and amber listed ground nesting birds[318]. Since the Wild Justice intervention almost no gull licences have been issued in the rural environment. In order to obtain a licence to control gulls an individual is required to provide evidence. As this requirement is new, gamekeepers did not have historical

[318] https://www.c4pmc.co.uk/post/gulls-continue-to-decimate-ground-nesting-birds-thanks-to-the-infallible-threesome-at-wild-justice?fbclid=IwAR2r3GwvOkSsJ78JJsUb6QzHzUF4Otvk-Pe34PjW9rHSQharrsaYVVYkN8k

data to support applications for gull control measures. It is now claimed that gulls are predating vulnerable protected chicks and the keepers are unable to intervene[319].

Wild Justice issued a further legal challenge in March 2020 against Natural Resources Wales General Licences GL001, GL002 and GL004 (that had been issued by NRW on 1 January 2020) claiming as their grounds for a judicial evidence review:

> "All wild birds are protected by law and the exceptions to this full legal protection are well-defined and quite specific. Although NRW identify the purposes of their general licences (e.g. nature conservation, protecting crops from serious damage, human health etc) they do not identify the circumstances under which there is no non-lethal alternative to using lethal control. This, we argue, is unlawful and amounts to allowing casual killing of otherwise protected birds.
>
> Our three legal grounds are:
> Unlawful failure to specify circumstances
> Unlawful failure in relation to satisfactory alternatives
> Unlawful approach to derogations"
>
> (Wild Justice, 2020a, para.4)

An evidence review was granted in August 2020 (Wild Justice, 2020b). Following this evidence review, which considered the extent to which the licences specified the circumstances in which they may be relied on, and whether NRW had sufficient evidence to justify derogating from the general prohibition on the killing of wild birds, such as carrion crows, jays, magpies and jackdaws, in January 2021 the High Court ruled that Natural Resources Wales (NRW) General Licences are lawful (GWCT, 2021f).

Wild Justice has continued to use legal challenge to impede activities that are part of integrated moorland management, including muirburn[320].

Nature conservation is purportedly one of the key objects of Wild Justice. The Oxford Dictionary defines nature conservation as "the preservation of wild fauna and flora and natural habitats and ecosystems, especially from the effects of human exploitation, industrialisation, etc.", with its use originating in the 1920s in Scientific Monthly. The International Union for Conservation of Nature (IUCN), founded in 1948, is a membership Union composed 1,400 of both government and civil society member organisations recognised as the global authority on the status of the natural world and the measures needed to safeguard it (International Union for Conservation of Nature (IUCN), 2021).

The 'World Conservation Strategy' published by IUCN in 1980 was one of the earliest documents to define conservation objectives as follows:

- "To maintain essential ecological processes and life support systems
- To preserve genetic diversity, and
- To ensure the sustainable utilization of species and ecosystems"

(International Union for Conservation of Nature (IUCN), 1980)

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[319] See https://www.c4pmc.co.uk/post/gulls-continue-to-decimate-ground-nesting-birds-thanks-to-the-infallible-threesome-at-wild-justice

[320] See https://clicks.aweber.com/y/ct/?l=Mqm7e&m=3WbR22jY1_DTXDc&b=qrXxPdKtnweZgolh8VpolQ>) where Wild Justice asked, among other things, for regulation of burning of vegetation on peatlands.

The IUCN continues its mission to "influence, encourage and assist societies to conserve the integrity and diversity of nature and ensure that any use of natural resources is equitable and ecologically sustainable" (International Union for Conservation of Nature (IUCN), 2021).

This would suggest that to support nature conservation, one of Wild Justice's objects, it is important to ensure that vulnerable species are protected using suitable methods, such as predator control via the use of general licences, making sure abundant species do not thrive at the expense of more vulnerable species, as this would reduce diversity of nature. It is difficult to understand how the current legal challenges raised by Wild Justice to these conservation tools align to the organisation's objectives.

6.4.3 USE OF SELECTIVE EVIDENCE

6.4.3.1 RSPB Environmental Evidence Review – bias by omission

Some opponents of driven grouse shooting claim to use evidence to support their views. In some cases, the evidence they cite is valid and reliable. However, there are instances of opponents citing only some of the evidence available. This 'bias by omission' is (perhaps) understandable, as a pressure group wants to gain support for its views. However, there is a danger that policy makers will make decisions that have negative economic, social and environmental consequences if they are not given the full evidence available. In this section we examine an instance of the use of 'bias by omission' by the RSPB.

In 2016 a paper entitled 'Environmental impacts of high-output driven shooting of red grouse *Lagopus lagopus scotica* was published in the journal Ibis by RSPB authors. It suggested that the management regimes associated with DGS had a number of negative consequences. The paper was examined and responded to by the GWCT, which noted that "while the GWCT would agree with the evidence given, the paper did not present all of the relevant scientific evidence including that which puts forward an opposing view" (GWCT, 2017, para. 2). A response paper was published in the same journal, key elements of which were published on the GWCT website, showing both the RSPB's evidence under 'Thompson's view' and the GWCT response under 'Sotherton's view', an excerpt from which is included in Figure 6.3.

We are not taking sides in this debate. However, the excerpts we show clearly demonstrate that the use of selective evidence can present a partial case.

FIGURE 6.3 EXCERPT FROM GWCT RESPONSE: 'ENVIRONMENTAL IMPACTS OF HIGH-OUTPUT DRIVEN SHOOTING OF RED GROUSE LAGOPUS LAGOPUS SCOTICA'[321]

THOMPSON'S VIEW	SOTHERTON'S VIEW
PREDATOR CONTROL	
Predator control can be helpful for other threatened breeding birds on moorland, as well as grouse. But gamekeepers do not control only those species that are legally permitted, they also illegally kill other predator species, particularly birds of prey.	Moorland management for grouse shooting, including predator control, is a conservation success story that needs more emphasis: the improved breeding success and increasing abundance of breeding pairs of lapwing, curlew and golden plover, all species of conservation concern. The illegal killing of protected species has had an effect on some bird of prey populations, for instance hen harriers as well as eagles, red kites, buzzards. Grouse shooting cannot be thought of as environmentally sustainable if it relies on this behaviour. However, a study carried out at Langholm Moor in southwest Scotland showed that, in the absence of persecution, harriers benefited from the control of other predators by gamekeepers, with higher numbers and better breeding success. Additional evidence in Sotherton et al: Baines & Richardson paper, 2013: When predator control was performed, hen harriers at Langholm Moor successfully raised twice as many chicks as when it was not performed on the same land.

[321] Source:

https://www.gwct.org.uk/research/habitats/upland/a-response-to-the-viewpoint-paper-environmental-impact-of-grouse-shooting/

MANAGED HEATHER BURNING	
Managed burning can help maintain heather moorland, and this is a good habitat for some birds of conservation concern such as the curlew and golden plover. However, burning reduces nesting cover for some species that prefer deep heather, for example hen harriers and short eared owls. Maintenance of heather moorland by burning also makes the area less favourable for species which prefer grassy moorland, and prevents transition to scrub and the biodiversity associated with that habitat. **Burning is becoming more frequent, and is happening in areas which should not be burnt.** **They are concerned about the effect of burning on certain peat-forming moss species, the carbon cycle, and water.**	Managed burning helps to maintain important heather habitats that are rare and disappearing around the world, and are of international conservation importance. A recent study in the Peak District showed that managed burning on that study moor had been performed to best-practice standards of burn size, frequency and overall area burned. The scientific evidence looking at the effect of burning on carbon cycles, water flow and the reduction of wildfires is not clear, and often contradictory. More research is required before long-established techniques with known benefits are markedly altered or even condemned altogether. There is a possible role of managed burning in helping to prevent wildfire, which is not acknowledged by Thompson. Additional evidence in Sotherton et al: Allen paper, 2016: Used aerial photographs to examine a moor in the Peak District, and showed that burning practices followed best-practice guidelines with respect to burn size, area burned and frequency of burning. Sotherton et al recognise that this study is limited to one site, which may not necessarily be reflective of other sites, but still provides important evidence. Allen paper, 2013: Managed burning can reduce carbon loss caused by wildfire by significant amounts, with the most appropriate rotational burn cycle length determined by the likely interval between wildfires. Where wildfires could be expected every 50 to 100 years, short (8-year) rotational burn cycles could reduce carbon loss the most. Where wildfires were likely every 200 years, carbon loss was minimised by 25-year rotational burn cycles.
VETERINARY CARE – HARE CULLS AND MEDICATED GRIT	
The evidence that culling of mountain hares helps red grouse populations by reducing tick abundance and the prevalence of louping-ill virus is weak. **Medicated grit administration to treat gut worms happens routinely, rather than when infection is proven (as per best-practice guidelines), which could lead to effects on the environment, particularly in water. This raises wider concerns about regulation of veterinary medicines.** **Thompson highlights the possible problem of a disease called cryptosporidiosis, which has been reported in red grouse for the first time in 2010, and appears to be rising.**	Sotherton agrees that evidence for the role of mountain hare culling in red grouse disease management is weak, and more is urgently needed. Ticks can feed on other birds such as curlew, lapwing and black grouse, and at high levels can reduce their body condition, and in some cases, their survival. Sotherton points out that as tick numbers are increasing in the UK, this should be a concern for conservationists, and also the public, as ticks can transmit Lyme disease to humans. The treatment used in medicated grit for red grouse has passed environmental tests for veterinary medications. If genuine concerns remain about its use and environmental impact, more work is needed to address these. Additional evidence in Sotherton et al: Newborn paper, 2009: Ticks parasitize chicks of other ground-nesting birds including curlew and lapwing.

6.4.3.2 Misrepresentation of evidence in parliamentary debates

The misrepresentation of scientific evidence can happen debates in parliament. For example, on 18th November 2020, during a parliamentary debate on muirburn, Olivia Blake, Labour MP for Sheffield Hallam said:

> "Is the Hon. Member aware of some of the most recent research, which shows that 68% of wildfires in the higher uplands have actually been caused by so-called controlled cold fires?"
>
> (UK Parliament, 2020, para.49)

While this is a genuine figure from a report by Natural England published in 2020, the MP did not say in Parliament that the report said that only 10% of upland wildfires had known causes. Almost all upland fires (90%) had no recorded cause of ignition and were therefore not included in the Natural England report. The correct context for this figure is that 68% of the 10% of upland wildfires that have a known cause were from controlled burning, a very much smaller number than that implied by Ms Blake's statement.

As we point out in section 5.4.5 (above) in 2018 Scottish Natural Heritage and the Scottish Fire and Rescue Service (SFRS) examined the correlation between the number of wildfires where the SFRS was called out and heather burning. Out of a total of 153 fires, only four were in areas of moorland managed for grouse, and none were during the burning season, but were rather the result of accident or arson.[322] This evidence was not quoted by Ms Blake.

We note with interest that, following this debate, the UK Government announced a ban of cool burning on deep peat, except in specific and limited circumstances. It is of concern to many within the grouse moor management community that misrepresented evidence might have been a factor in this decision.

6.4.3.3 Interest Groups bias

Much of the existing research base into the impacts of shooting has been accused of bias as it was sponsored or commissioned by either those for or against shooting (PACEC, 2012, 2014; Cormack and Rotherham, 2014; BASC, 2016).

In addition, there have been interventions by politicians into reviews surrounding shooting, taking decisions based not on the evidence but, it has been argued by many within the shooting community, on party policies or personal opinions. In 2017 the Welsh Government reviewed shooting over land it controlled. Following an independent National Resources Wales (NRW) consultation and evidence review (Hillyard and Marvin, 2017), the NRW board made the recommendations that the Welsh government should:

> "continue to use firearms in managing the negative impacts of wild species on the land it manages to achieve the sustainable management of natural resources consistent with our land management objectives and our purpose" (National Resources Wales, 2018a, p.4)
>
> "continue to consider applications for permission to carry out control of wild species using firearms on the land we manage" (National Resources Wales, 2018a, p.5)
>
> "continue to consider the leasing of rights for pheasant shooting, wildfowling and other pursuits involving firearms on a case by case basis" (National Resources Wales, 2018a, p.6)

[322] Countryside Alliance Briefing Note: Grouse Shooting Petitions Committee - Westminster Hall Debate, Monday 25 January 2021

> "continue to use lead ammunition but will keep under review the efficacy of the available alternatives" (National Resources Wales, 2018a, p.7)

However, the Labour Welsh Environment Minister expressed a differing view based on an ethical opposition to shooting practices. The board of NRW reviewed the evidence in light of a request from the Environment Minister (National Resources Wales, 2018b). Ultimately, shooting over NRW land was banned as from March 2019 (Bodkin, 2018), which then led to calls by anti-shooting campaigners for shooting to be banned over land belonging to University of Wales Gregynog Hall campus near Newtown, Powys (Forgrave, 2019). Those who take part in driven game shooting have expressed concern that scientific evidence is being ignored with damaging economic, environmental and social consequences.

6.4.4 MOTIVATIONS FOR OPPOSITION

Research shows that whilst conflicts between those for and against shooting may appear at first to concern wildlife, they often make up part of wider debates surrounding land use, land ownership and natural resources' governance (Hodgson et al., 2018). Organisations that are opposed to all blood sports, such as Animal Aid and the League Against Cruel Sports are clear in their motivation for a ban of driven grouse shooting. However, it is sometimes unclear whether opposition to grouse moor management is a fundamental opposition to DGS or based on opposition to private ownership of large estates. Opposition to private estate ownership is particularly the case in Scotland, see Section 6.3.

6.4.5 CONCLUSION AND SUMMARY

Opposition to DGS can be on ethical grounds. Other opponents state that they are not opposed to all sports shooting, but believe that DGS is not sustainable and should be replaced with a less intensive alternative. There is a high level of conflict between those for and against shooting and, while conflicts that may appear at first to concern wildlife, in reality they are part of a wider debate concerning land use, land ownership and governance of natural resources (Hodgson et al., 2018).

The methods used by opponents are varied, organised and sometimes aggressive, utilising tools such as social media with expertise, which those who take part in DGS do not feel confident to use to dispel mistruths and inaccurate perceptions of their pastime (Latham-Green, 2020b). The use of selected evidence and misrepresentation of evidence, including in parliamentary debates, along with the failure of policy makers to accept the recommendations of independent review committees in relation to driven grouse shooting and other shooting regulation, exacerbates the feeling of helplessness and resentment among many people involved in shooting, and increases the conflict between those for and against DGS. This potentially increases the risk of gamekeeper abuse, which research has shown is an increasing problem, that can negatively impact the mental health and well-being of individual gamekeepers, their families and others within traditional upland, moorland communities where moor management for grouse shooting is practised.

In an attempt to provide a balanced picture, we have reviewed the reasons given by individuals and organisations opposed to DGS and summarized the relevant evidence. We present our initial summary in Table 6.3. We stress that, as this report is a living document, the evidence presented in the table will change as more science is carried out.

TABLE 6.3 SUMMARY OF OPPOSITION TO DRIVEN GAME SHOOTING AND THE RELEVANT EVIDENCE	
Opponents argument	What the evidence says
Driven grouse shooting is not economically viable and there are better alternative uses of moorland, such as Tourism and Forestry.	Alternative uses such as forestry and renewable energy require government subsidy to ensure profitability and those with the most viable economic opportunities have negative environmental and social impacts as detailed in Section 5.5. Conservation as an alternative would require subsidies both for environmental land management and in some cases either government funding, donations or a combination of both, to purchase the land from existing owners. Whilst tourism can provide economic returns, currently tourism exists within many upland areas where management for driven grouse shooting exists and high levels of income are generated over a relatively short time from between 12th August and 10th December, with the rest of the year already benefitting from tourism which is supported by the work of grouse estates in relation to access, track maintenance, biodiversity and landscapes as detailed in section 5.2. DGS is a form of tourism with economic benefit as explored in Section 5.2.
Walked-up Grouse Shooting is a better alternative	It is not economically viable for land to managed solely for walked up grouse shooting (Sotherton, Tapper and Smith, 2009) and therefore alternative uses for upland estates would most likely be sought, with resultant negative economic, environmental and social impacts through loss of the benefits from driven grouse shooting outlined in Sections 5.2-5.5. The arguments in favour of solely walked-up grouse shooting fail to take account of the intangible, cultural associations expressed by all of those involved, as no beaters and very few picker-up would be involved in walked up shooting (Denny and Latham-Green, 2020; Latham-Green, 2020).
Raptor Persecution	The shooting community opposes raptor persecution. Some species of raptor, such as white-tailed eagles and golden eagles, are thriving in the UK whilst others, such as the hen harrier, remain at risk (Stone et al., 1997; Baker et al., 2006; Musgrove et al., 2013; Woodward et al., 2020). Research suggests raptor persecution has been an issue (Murgatroyd et al., 2019). The conflict between those against DGS and the shooting community has been exacerbated by organisations on both sides of the raptor persecution debate interpreting the available data in a way that either supports their interests and agendas or damages the image of

	opposing groups (Hodgson et al., 2018). In England as part of a partnership approach the shooting community has been working with Natural England and others to ensure that hen harriers can increase to the maximum, sustainable population level across the UK in all suitable habitats, not just in their current breeding locations, through participation in the Joint Hen Harrier Action plan (DEFRA, 2016). Initial trials of the brood management programme have increased hen harrier breeding success in the UK (DEFRA and Natural England, 2020).
Predator control opposition	Grouse shooting estates are not alone in their use of predator control. The RSPB uses predator control to maintain its nature reserves as part of a range of conservation tools including fencing off set areas, to give at risk species such as hen harriers, curlews and lapwings the best chance of survival (Harper, 2018). County Wildlife Trusts, local authorities and the National Trust also use predator control. Opponents say that the levels of predator control on grouse moors are too high, but do not cite robust evidence for their case. To maintain a diverse range of species predator control is a useful conservation tool, particularly for ground nesting birds such as hen harriers, lapwing and curlew, that are highly susceptible to predation from species such as foxes, as detailed in Section 5.3.
Use of lead shot	The 2021 season is the last time most driven grouse will be shot with lead; with the only exceptions being those birds that are solely for the consumption of the Guns. By 2025, when the voluntary transition away from lead shot takes effect, these exceptions will be no more. Lead shot on grouse moors will cease to be an issue.
Peat damage	Rotational burning of heather or 'muirburn' is an emotive subject, for which incomplete or misleading evidence has been presented (GWCT, 2017, 2020a, 2021c, Heinemeyer and Ashby 2021). Managed muirburn carried out in the correct season by skilled land managers does not burn peat, but rather produces a cool burn which, if done correctly, can help reduce the risk of wildfires and manage vegetation to allow maximum biodiversity and production of grouse. Alternatives to burning for this purpose are currently under investigation but further research is needed as to whether these alternatives, such as cutting and mowing, can produce the same benefits as part of a developed ecosystem (see section 5.4.5 for more details).

Flood risk (including drainage)	Organisations against DGS have expressed concern over possible increased risk of flooding downstream from land managed for grouse shoots (University of Leeds, 2014). The situation is complex and management of moorland has the potential to provide ecosystem services that can be of benefit to society in relation to water but could also negatively impact these areas if managed incorrectly (as detailed in section 5.4 of this report). A report commissioned by the RSPB in 2012 found that evidence for flooding being negatively impacted by land management for game shooting purposes was inconclusive. It noted that drainage and land management can be found to have both positive and negative impacts on water flows and associated flood risk (Grant et al., 2012a). It concluded that it is "difficult to disentangle the multiple and interacting effects of grazing, burning, drainage and habitat restoration on water flows without conducting further research at multiple scales" (Grant *et al*., 2012a, p. 7). Opponents mistakenly argue that the land is drained for grouse to be raised (Heinemeyer and Ashby 2021). Research has shown that drainage of moorland negatively impacts the success of grouse, as the young grouse chicks can fall into drainage ditches and drying out moorland has been found to reduce the diversity and abundance of moorland insects, which are a key food source for grouse chicks (Coulson, Butterfield and Henderson, 1990). Drainage ditches are no longer dug on moorland to support grouse, their prevalence on moorland between 1950s and 1980s was encouraged by government policy and subsidy to improve areas such as hill farming and provide peat as fuel for burning (Holden, Chapman and Labadz, 2004; Werritty *et al*., 2015; GWCT, 2020a). Many grouse moor managers and other moorland landowners are now working to block up historical drains and re-wet moorland to support conservation (DEFRA, 2018, 2019; IUCN United Kingdom Peatland Programme, 2020).
Mountain Hare culling opposition	Watson and Wilson, (2018) suggested steep long-term mountain hare declines, particularly in areas managed as grouse moors. However, this study did not compare data that had been collected in a controlled way, at the same time of day, using the same method and or researchers and sometimes comparing areas up to 5km away from each other (GWCT, 2021b). The most recent research found that, on average, there are stable numbers of mountain hares in Scotland and they are up to 35 times more abundant on grouse moors managed for driven grouse shooting than anywhere else (Hesford et al 2019, 2020). Hesford et al

	found no relationship between culling of mountain hares and contraction in their range. They suggest that the rises in numbers of hares killed cited in earlier surveys was likely to reflect natural population cycles and that other factors such as changes in habitat and management may be responsible for the reductions (Hesford et al., 2019, 2020).

6.5 ALTERNATIVE USES

6.5.1 OVERVIEW

Upland regions are a nationally significant resource for people in the UK; most have landscape protection status (e.g. Area of Outstanding Natural Beauty), special conservation designations (e.g. SSSI, SPA and SAC), and separate local governance arrangements. These upland regions are mainly sparsely populated rural areas with Less Favoured Area status (DEFRA, 2011). The IUCN has stated that "the core of mainstream sustainability thinking has become the idea of three dimensions, environmental, social and economic sustainability" (Adams, 2006). It is suggested that these three dimensions need to be addressed by anyone wanting to change the status quo, so that any alternative land use is at least as beneficial as that currently in place. Many parts of upland areas of the UK have been managed to facilitate DGS for over a century. Sections 5.2-5.5 of this report have reviewed the current evidence for the economic, environmental and social impacts managing moorland to facilitate driven grouse shooting. However, not all moorland is managed as 'grouse moor', and there are a number of alternative land-uses that are practiced. These alternative uses need to be discussed and their impacts on economic, environmental and social sustainability examined.

A 2019 report for the Scottish government looking at uses for upland areas noted the following possible alternatives to traditional integrated moorland management:

- Agriculture, primarily in the form of livestock production
- Afforestation
- Renewable energy, primarily in the form of on-shore wind energy
- Rewilding
- Tourism
- Conservation/NGOs

Adapted from Thomson, McMorran and Glass (2018)

The main difficulty in considering alternative land uses is the complex nature of upland management. Staff employed in managing the land to facilitate grouse production may also be involved in other elements of a diversified, rural enterprise unrelated to grouse shooting (Grouse Moor Management Review Group, 2019). For example, sheep are often grazed on the heather moorland and used as 'tick mops' to reduce tick-born disease instance in grouse (Thomson, McMorran and Glass, 2018) and the maintenance of tracks by grouse moor estates is also beneficial and necessary for tourism to ensure public access (Denny and Latham-Green, 2020).

This section looks at these potential alternative uses of upland estates, in addition to reviewing walked-up grouse shooting, considering the advantages and disadvantages of each option.

It should be noted that for all of these alternative uses there would be negative consequences in terms of the social impacts, compared with those provided for individuals and communities from DGS. In the absence of DGS there would no longer be a seasonal, participatory activity linked to individual and community heritage and positive wellbeing outcomes.

6.5.2 AGRICULTURE, PRIMARILY IN THE FORM OF LIVESTOCK PRODUCTION

The Lake District is the only upland area in England that is not primarily managed for grouse shooting and where the predominant agricultural use is livestock farming, predominantly sheep (Denny and Latham-Green, 2020). In order to maximise returns, upland livestock farmers have traditionally used a variety of methods including the re-seeding of grasslands, use of pesticides and artificial fertilisers, increased use of machinery, enlargement and levelling of fields, drainage of land and the switch from hay to silage production to increase the available grass for grazing on upland areas, with consequential negative environmental impacts (Clark, Scanlon and Hart, 2019). A 2019 report found that, even using these methods, without subsidy no upland farms could maintain profitability when the focus is solely on increasing production, noting that if only naturally available grass was used (thereby minimising negative environmental impacts and maximising eco-system services) a combination of increased meat prices, better asset management and farm diversification would be necessary to enable profitability without subsidy (Clark, Scanlon and Hart, 2019). The authors of this report concluded that without changes to the status quo in upland, livestock farming areas there would be "fewer, larger farms in the uplands with little connection to place or community, that are dependent upon an intensive, high-input, nature-poor business model" (Clark, Scanlon and Hart, 2019, p.4).

Paid employment from livestock farming in the uplands is limited. Upland hill farming on the 'average' farm of 600 ewes and nine suckler cows can provide work for 1.3 full-time employees (FTE) per 668 hectares. It should be noted that most upland farmers supplement the work with unpaid labour from within the family, yet they still fail to make a profit without subsidy. On average 580 ha of land managed for sheep farming creates one FTE post (Thomson, McMorran and Glass, 2018). Sheep farming can provide an integral part of an integrated management system on a moorland habitat managed for grouse (Thomson, McMorran and Glass, 2018; Denny and Latham-Green, 2020), but as a stand-alone alternative, the evidence suggests that it is not currently economically (or socially) viable as an alternative to integrated moorland management, incorporating DGS.

6.5.3 AFFORESTATION

The afforestation of the UK consists of two types of forestry. Commercial plantations that usually consist of fast growing, often non-native species such as Sitka spruce; and mixed woodland expansion of a variety of native, slower growing species, which is most usually found in areas where conservation is prioritised over financial return. As much of the uplands are privately owned and therefore need to provide a reasonable

return on investment, commercial afforestation is considered here. Mixed, native woodland expansion is considered under Section 6.5.7.

If upland heather moorland areas are replaced with commercial forestry, there will be impacts on biodiversity. This is internationally important as the evidence suggests that 75% of the world's upland, heather moorland is found in the UK (Thompson *et al.*, 1995; GWCT, 2020d). Many of the species that thrive on heather moorland would be detrimentally affected or could even disappear if heather moorland habitat was lost, although there could be other species who may benefit.

Commercial forestry is usually comprised of fast-growing conifer species. The non-native Sitka spruce is the most widely used commercial forestry species, with the Forestry Commission reporting that Sitka spruce accounted for around one half (51%) of the UK conifer growing stock, followed by Scots pine (15%) and larch (10%) in 2020 (Forestry Commission, 2020). Densely packed coniferous plantations limit the light availability on the forest floor which negatively impacts a variety of species (Burton et al., 2018). Sitka spruce dominated closed canopy sites have very low numbers of ground flora and a lack of species diversity (Burton et al., 2018; Wallace, Good and Williams, 1992). Whilst diversity can be improved with lower stocking densities, allowing a greater amount of light through to the forest floor (Wallace and Good, 1995; Wallace, Good and Williams, 1992), reductions in density can negatively impact the yield or financial return for the commercial forestry enterprise.

Conifer plantations have been shown to negatively impact the presence and breeding performance of some bird species such as ravens and golden eagles, based on the densely planted, non-native conifer plantations of the 1970s (Burton *et al.*, 2018; Douglas *et al*., 2020). While more recent changes in design of plantations to include lower planting densities, riparian buffers, areas of broadleaf woodland and open space may not impact these species in the same way (Burton et al., 2018), these changes to planting density and additional planting requirements have costs that impact profit margins. Ground nesting birds in particular, such as the curlew and hen harrier, would be particularly impacted by the removal of heather moorland habitat in favour of conifer plantation, with hen harriers in particular favouring heather moorland for breeding (Potts, 1998; GWCT, 2019). A 1998 Scottish study noted that hen harrier breeding success is highest in heather moorland, which is declining in the uplands due to overgrazing and afforestation, noting hen harrier future success "may become increasingly dependent on moorland, where heather is maintained for grouse"(Redpath et al., 1998).[323]

Conifers have high water usage so can be useful in alleviating flooding, predominantly in the avoidance of flash flooding. Conversely, their high water demands can produce a negative effect on water yield during periods of dry weather (Burton et al., 2018). Forest canopies can also reduce run-off by up to 20%, but clear felling has the opposite impact, meaning that uncoordinated forestry practices can potentially exacerbate flooding (Allen and Chapman, 2001). There is evidence to suggest that coniferous plantations can have an

[323] For more details of how grouse moor management and hen harrier success in the UK can be combined please see Section 6.1.10.

acidification effect on soils and freshwater due to their effectiveness at scavenging acid pollutants (Burton et al., 2018; Rees and Ribbens, 1995; Allen and Chapman, 2001).

In terms of carbon sequestration and climate change, afforestation can be a useful tool on open habitats and croplands (Alonso, I., Weston, K., Gregg, R. and Morecroft, 2012), with coniferous species like Sitka spruce recommended for their fast growth and high carbon uptake (Cannell, 1999). However, it is important that the afforestation does not take place on areas of peatland, as peat-based soil may dry out, releasing large amounts of carbon, especially in the early years of plantations (Alonso *et al* 2012). Friggens *et al.* (2020) showed that even planting native tree species (*Betula pubescens* and *Pinus sylvestris*) onto heather moorland in Scotland did not lead to an increase in net ecosystem carbon stock either 12 or 39 years after planting. Rather they found that plots with trees had great soil respiration and lower carbon levels than control plots that were heather-dominant. They hypothesize that tree planting dramatically alters underground mycorrhizal fungi communities, leading to a net loss of carbon.

The length of time between planting and clear felling is also important as the longer trees are standing, the more carbon they can capture. The final destination of the timber is also a factor to consider when comparing forests to other carbon sequestration tools, such as renewable energy use from wind and solar farms. If the timber is used for wood burning then carbon is released and although not adding to net emissions, payback times until the carbon is reabsorbed can be long (Crane, 2020).

The influence on climate of afforestation is wider than just the carbon cycle. Other factors such as albedo[324], evapotranspiration[325] and aerodynamic surface roughness length[326] can mean that the net effect of forest plantation can be negative (Crane, 2020; Burrascano et al., 2016). However ,at UK latitudes the evidence for whether the overall climate effect is positive or negative are contradictory (Montenegro et al., 2009).

In England afforestation in the form of new woodland creation currently attracts government subsidy of £1.28 per tree, up to a maximum of £6,800 per hectare, under the Woodland Creation Grant within the Countryside Stewardship Scheme, but in order to claim the subsidy there are considerable maintenance, record keeping, verification and reporting requirements (UK Government, 2021). In addition, the subsidy cannot be claimed:

- if tree planting could damage areas of ecological, archaeological or historic interest
- to plant woodland for producing Christmas trees or biomass
- for restocking woodlands following a conditional felling licence (except where this has been issued for tree health reasons)

[324] Albedo relates to the ability of land to reflect or absorb heat. Light surfaces, like open snowy areas, reflect heat having a cooling effect whereas dark areas, like densely planted coniferous forests absorb heat more easily having a warming effect

[325] Evapotranspiration is the process by which water is transferred from the land to the atmosphere by evaporation from the soil and other surfaces and by transpiration from plants

[326] "Aerodynamic roughness length is usually defined as the height where the wind velocity is equal to zero. It is an important aerodynamic parameter and reveals the exchange between the atmosphere and land surfaces." (Zhang et al., 2017)

It is difficult to ascertain the profitability of forestry alone without subsidy. A 2016 study found that without subsidy, exchanging upland sheep farming for forestry would not be economically viable (Hardaker, 2018). However, a 2014 comparison between the viability of hill farming and forestry estimated that for 20,000 ha in Eskdalemuir the surplus before grants would be £149 per ha. It should be noted that this comparison was produced for Confor, the industry body that promotes forestry and wood (Bell, 2014). In spite of various Forestry Commission grant schemes over the past decades to encourage woodland expansion, the target planting levels have not been met, with reasons for this failure including social barriers, lack of information and bureaucratic application processes (Burton et al., 2018). In terms of employment forestry can provide continuous employment in management and deer control, with a larger labour force needed at harvesting and felling times (Confor, 2018). It has been estimated that for each 422 ha one FTE post is created (Thomson, McMorran and Glass, 2018).

In terms of public response, there has been some opposition in Ireland to large scale afforestation, expressing fears that large scale Sitka spruce plantations are creating 'ecological dead zones' and destroying the habitats of birds such as curlew and hen harriers in order to meet carbon sequestration targets (Colwell, 2018).

The evidence suggests that commercial afforestation can provide some employment (Thomson, McMorran and Glass, 2018), be financially profitable (Bell, 2014), but most likely only with the support of government subsidy (Hardaker, 2018), and on balance it cannot offset CO2 emissions. However, it also has the potential to hamper biodiversity conservation (Burrascano et al., 2016), especially if other important habitats are lost to make way for plantations. Afforestation on or near peatlands does not just negatively impact biodiversity on the forested site itself, but also on neighbouring open peatland adjacent to planting sites (Crane, 2020). Environmentally, it is important that landscapes on peat soils are not replaced with forestry, as the carbon released from peat is greater than the benefit gained from the plantation of forests (Cannell, Cruickshank and Mobbs, 1996; Alonso *et al* 2012).

6.5.4 RENEWABLE ENERGY, PRIMARILY IN THE FORM OF ON-SHORE WIND ENERGY

The IUCN has recognised that while renewable energy can reduce carbon emissions it can also negatively impact biodiversity and any negative impacts need to be mitigated (IUCN, 2021; Bennun et al., 2021).

Latest available data shows that the UK currently has 8,669 onshore wind turbines across 2,582 onshore operation projects with an operational capacity of 13.7 GW (RenewableUK, 2021). Upland areas can make ideal sites for onshore wind turbines, as they are exposed locations free from obstacles, such as buildings and trees that can potentially interfere with turbine performance. Turbines need be located in areas with adequate wind speeds and not all UK areas are suitable. Particularly suitable wind speeds are found in Scotland, Northern Ireland and Wales (Grantham Research Institute on Climate Change and the Environment (GRICCE), 2020). According to GRICCE, as at December 2019 119 sites had been granted planning permission for onshore wind turbines and a further 12 were under construction with the majority (approximately 60%) of approved sites located in Scotland. Some of these approved applications relate to a single turbine,

although the largest is set to have 103 turbines, producing 370 MW of electricity by 2024.[327] Scotland is the location for 12 out of the 14 largest sites with a planned installed capacity of more than 50 MW and majority (56%) of the 32 sites currently under construction are also located in Scotland (GRICCE, 2020).

The UK government has committed to reach net zero carbon emissions by 2050 (Walker, Mason and Carrington, 2019) and onshore wind will play a role in the achievement of this target (UK Government, 2020b). Although offshore wind energy has previously been the key focus, in March 2020 the government announced subsidies would be available for onshore wind farm projects, for the first time since 2015 (UK Government, 2020a). The subsidies will take the form of government contracts that guarantee a price for the energy the wind farms will create after they have been built, reducing investment risk (Hitchings-Hales, 2020), for which businesses will be able to compete at an auction late in 2021 (Ambrose, 2020). It has been argued that the lack of subsidy for onshore wind farms meant investors were being asked to take high risks with capital, gambling on future energy prices, making investment in onshore wind unattractive, and thereby negatively impacting the UK Government's goal of increasing energy production from renewables (Grubb, 2015). Subsidies influence the amount of jobs available from wind farm developments, with over 2,000 Scottish jobs being lost in the four years from 2016 - 2019 when subsidies were cut (Burns, 2019). A 2019 report noted that onshore wind, including direct and indirect employment accounted for 5,800 FTE, but direct employment had fallen from 3,600 (in 2016) to 2,300 in 2019 (STUC, 2019). The authors noted the majority of decreases were in the manufacturing and construction industries relating to the building of turbines, with factors influencing the reduction including the cut in government subsidies for onshore wind farm installations including feeder-in tariff reductions (STUC, 2019). This would suggest that direct employment from wind farms does not remain high in the long term, as the majority of roles relate to the building and installation of the turbines themselves. A 2012 report considering economic impact of onshore wind regionally/nationally (based on a 25 year lifespan) noted that of the 4,509 total direct & supply chain jobs created at the time via onshore wind, just 782 or 17% related to the 'operations and maintenance phase', with the remainder relating to development and construction (BiGGAR Economics, 2012).

Onshore wind energy has both positive and negative environmental impacts. The use of renewable energy contributes towards the UK's 2050 carbon neutral target, potentially reducing overall CO2 emissions. However, this is dependent upon the sites used for two reasons. Firstly, wind speed, with areas of Scotland, Northern Ireland and Wales having the optimum wind speed, recognising that the areas chosen to house turbines need to be free of obstacles such as buildings and trees that can interfere with turbine performance (GRICCE, 2020). Secondly, and most importantly when considering as an alternative to grouse moor management, the type of land habitat they are built upon. Following extensive research, scientists believe that the building of wind farms on peatlands should be avoided (Smith, Nayak and Smith, 2014, 2012). This is because layers of accumulated peat that represent a large stock of soil carbon are lost when peatlands are drained to construct wind farms. Early research suggested that wind farms sited on peatlands can reduce net carbon emissions if strictly managed for maximum retention of carbon, but a 2014 study showed that,

[327] This facility is located at Lang Kames in the Shetland Islands

due to projected changes in the proportion of fossil fuels used to generate electricity, even with careful management of construction, by 2040 building wind farms on most undegraded peat sites will not reduce overall carbon emissions (Smith, Nayak and Smith, 2014). Therefore "future policy should avoid constructing wind farms on undegraded peatlands unless drainage of peat is minimal and the volume excavated in foundations can be significantly reduced compared to energy output" (Smith, Nayak and Smith, 2014). The Scottish Government has created a calculator to assess the suitability of building wind farms on peatlands (The Scottish Government, 2018).

There can also be negative impacts from wind turbines on birds and bats. There is a risk from collision for both bats and birds, with bird species using artificial (such as farmland and urban areas) and grassland habitats having a significantly higher collision rates than species using other habitats (Thaxter et al., 2017). Raptors , many of which are slow to reproduce and have at risk populations, are the most vulnerable birds (Thaxter et al., 2017). It has been concluded that "building fewer, large turbines may actually reduce the risk of collision for birds for a given amount of energy generated, although turbines with a capacity over 1.25MW were associated with higher collision rates for bats" (British Trust for Ornithology (BTO), 2017, para.4). Wind turbines can interrupt the migratory pathways of some species, particularly soaring birds (Marques et al., 2020). A 2020 study found that functional habitat may also be lost, as soaring birds change their flight trajectories to avoid wind turbines, which could "lead to functional habitat loss, as suitable soaring areas in the proximity of wind turbines will likely be underused" (Marques *et al.*, 2020).

There are concerns about the impact of wind farm socially, the visible presence of onshore wind farms is not universally accepted (Toke, 2005; Harper et al., 2019). Since 2015 all wind turbine applications, including commercial wind farms, have had to go through local planning processes and government guidance states that "applications should not be approved unless the proposed site has been identified as suitable for wind energy development in a Local or Neighbourhood Plan" (GRICCE, 2020). The suspension of subsidies for onshore wind farms came as a result of a 2015 election pledge by the Conservative government. A 2019 study found that the closer an area is to urban centres the less likely planning is to be granted for a wind farm. The likelihood of neighbourhood support for onshore wind farms is reduced if the population has a higher than mean average age (Harper et al., 2019), which is the case in the upland communities in England (Denny and Latham-Green, 2020) or the population has higher than average education levels (probably due to the ability to organise campaigns opposing developments) (Harper et al., 2019). When local people agree to wind farms onshore, there have been short-term benefits to local residents in the form of community grant schemes that can fund community organisations and projects and investment in local infrastructure such as access roads. New wind farm construction also creates potential for wildlife and habitat management, with wind farm developers contributing to ecological projects which can help to enhance the local area and support further employment, and sometimes visitor centres, which can be tourist attractions for an area (BiGGAR Economics, 2012).

Concerns have been expressed around decommissioned wind turbine blades, with news stories highlighting the existence of large burial sites for turbines (BBC, 2020c). Research suggests that the best option is refurbishment, resale and reuse, thereby extending the lifespan of the turbines albeit with reduced

efficiency. However, removal, refurbishment and relocation of wind turbines has been recognised as a challenge due to transport difficulties. Wind turbine blades are challenging to recycle with limited uses for any processed material recovered, an increasingly pertinent issue as in Europe alone, as at 2016, 50,000 tons per year of wind turbine blade material was predicted to reach the end of its life by 2022 (Beauson and Brøndsted, 2016).

The sparsely populated, remote, exposed nature of Scottish Islands, such as the Shetlands, means they are ideal for onshore wind, as the geographic characteristics of the habitat and wind speeds are ideal (GRICCE, 2020) and access can be difficult to explore other options. However, most of the upland areas of England in particular do not have the most optimum wind speeds (GRICCE, 2020) with many areas located on peatland. The building of wind farms on areas of comprised of undegraded peat habitat is advised against by scientists, as this would most likely result in increased carbon emissions (Smith, Nayak and Smith, 2014, 2012). The evidence also suggests government subsidies are required to encourage large-scale onshore wind developments (Grubb, 2015) and that high levels of employment both direct and indirect are not long-lasting, predominantly related to the supply and installation of turbines, with only an estimated 17% of FTE direct and indirect jobs created being sustained during the operations and maintenance phase of a wind farm's 25 year life span (STUC, 2019; BiGGAR Economics, 2012). Environmentally, bats and bird species, particularly raptors,, can be negatively impacted through collisions with turbines (Thaxter et al., 2017) and reductions in the amount of functional habitat through interruption of migratory pathways (Marques et al., 2020). Socially, wind farms are not universally accepted and planning regulations in England in particular require local neighbourhood support, which can prove a barrier to investment in the planning process by prospective wind energy companies, with the likelihood of planning being approved being further from urban areas and in areas where there are higher than average mean age population with higher than average qualifications (Harper et al., 2019). It has been suggested therefore that the majority of future onshore wind projects agreed will most likely be in Scotland, as is currently the case (Hitchings-Hales, 2020).

6.5.5 REWILDING

It is difficult to find a universally accepted definition of rewilding in the literature. Within the EU, rewilding has been framed by the EU Habitats directive (European Commission, 2021), adopted in 1992, then reviewed and still found to be fit for purpose by the European Commission in 2015 (European Union, 2015). Originally used to describe the creation of 'wildlife corridors' in core wilderness areas of North America, the use of the term 'rewilding' has now expanded to cover a wide range of ecological restoration and human-nature relationships (Hall, 2019). A 2017 study considering practices and discourse of rewilding in Scotland's wild places identified four overlapping and interacting framings of rewilding being 'wild nature', 'wild places', 'wild experience' and 'wildness'. The study also recognised the importance of cultural, social and historical factors if access to wild places in Scotland was to be restricted, given the history of the 'Highland clearances' and indigenous links to land via traditional landscape practices of cultural significance in Scotland (Deary and Warren, 2017). Many individuals view driven game shooting as a form of intangible cultural heritage, as identified by UNESCO (United Nations Educational Scientific and Cultural Organization (UNESCO), 2018;

Denny and Latham-Green, 2020; Latham-Green, 2020) as explored in Section 5.5. Whilst there has been a drive to identify 'Wild Land Areas' by Scottish Natural Heritage', there is no formal policy basis for rewilding in Scotland (Deary and Warren, 2017). This study also highlighted that there is no agreement on what environmental areas should and should not reinstated, how this should be done and how far back to past environments future management should be guided. (Deary and Warren, 2017). Improving the provision of ecosystem services is often cited as a justification for rewilding (Brown et al., 2018; Cerqueira et al., 2015b; Cramer, Hobbs and Standish, 2008; Olwig, 2016) but it is not clear how ecosystem services would be impacted by rewilding practices.

The organisation Rewilding Britain defines rewilding as

> "The large-scale restoration of ecosystems to the point where nature is allowed to take care of itself."
> (Rewilding Britain, 2020, para.1)

According to Rewilding Britain, this can include sustainable agriculture, forestry and fishing, with Rewilding Britain's vision being that of the 5% of the UK that should be rewilded[328], and 25% should be made up of sustainable agriculture, forestry and fishing. The organisation does not make clear how rewilding will be funded. (Rewilding Britain, 2021b). It has been noted that 'wild meat' can be a food source that can be produced as a result of rewilding (Hall, 2019) and it could be argued that grouse meat falls within this category, with the complex system of grouse moor management outlined in the research (Denny and Latham-Green, 2020) constituting a sustainable form of agriculture.

Ever since the stone age, people have impacted and influenced the natural landscape, with increasing influence from the 15th century onwards when global travel and settlement increased (Mooney and Dennis, 2016). Archaeological research has revealed evidence of millennia of anthropogenic transformations that have created novel ecosystems around the world (Boivin et al., 2016). As population sizes increase, there is an impact on natural systems and what was once normal, such as the habitation of the UK by wolves for example, had a much lower impact on humans thousands of years ago, when populations were smaller and there was more land available, than now when populations are larger and people live in closer proximity to historically 'wilder' areas. Rewilding literature and publications place a high focus on environmental impacts, particularly returning abandoned agricultural land to a more natural state (Navarro and Pereira, 2015). True wilderness no longer exists in Britain. However, it has been suggested the wildest areas of land within the UK can be identified using Geographical Information Systems "based on human perceptions of wilderness qualities" (Carver, Evans and Fritz, 2002, p.25). To ensure a sustainable future, it is important that any decision to change land management from an integrated practice such as grouse moor management or to introduce new species such as wolves (Navarro and Pereira, 2015), for example, is made with careful

[328] A 2021 UN Environment Programme report makes the key point that simply creating a protected area is insufficient to prevent species decline. The director of the UN Environment Programme's World Conservation Monitoring Centre pointed out that protected areas need to be effectively managed and equitably governed if they are to realise their many benefits. See https://news.sky.com/story/creating-global-protected-areas-insufficient-to-prevent-species-decline-un-report-warns-12310893

consideration given to the economic and social consequences of such changes, as well as environmental consequences (Adams, 2006).

Rewilding Britain gives a wide range of examples of 'rewilding' as follows:
"Examples of rewilding include:

- Protecting, expanding and connecting ancient woodlands to enable a diverse range of wildlife to establish and disperse, and increasing carbon storage
- Reducing high populations of grazing animals to help trees and other vegetation grow
- Removing fishing pressure and creating proper marine protection to stop dredging and bottom trawling so that sea life can recover and flourish
- Restoring wetlands and introducing beavers to boost biodiversity, store carbon and help flood prevention
- Bringing back missing species to plug crucial gaps in the ecosystem, and re-forge key relationships between species (for example, between predators and prey and scavengers)
- Restoring key marine ecosystems such as kelp forest, seagrass and oyster beds to boost biodiversity, suck in carbon and get natural processes working
- Removing dams so that fish can move freely and the forces of erosions and deposition are allowed to re-establish themselves
- Reconnecting rivers with floodplains, restoring their natural course to slow the flow, easing flooding and creating habitats for fish and other aquatic and wetland wildlife
- Connecting up habitats and providing wildlife bridges so wildlife can move and disperse naturally, helping them adapt to climate change and build resilience.
- Setting aside large areas for nature so that nature can truly evolve on its own terms, maximising biodiversity, carbon storage and essential eco benefits
- Creating a wildlife-friendly garden and helping wildlife move through it to help nature on a smaller scale"

(Rewilding Britain, 2021a, para.3)

Whilst many of the above examples are not relevant to this report, other examples already make up part of the management of land for driven grouse shooting, as outlined in Table 6.4.

TABLE 6.4 HOW GROUSE MOOR MANAGEMENT CAN ASSIST IN REWILDING

Rewilding example	How grouse moor management assists in this area
Reducing high populations of grazing animals to help trees and	Integrated moorland management does not depend on intensive livestock production Sheep and cattle production is used as part of a managed moorland system as a means of both habitat and disease control (see section 5.2) (Denny and Latham-Green, 2020).

other vegetation grow	
Bringing back missing species to plug crucial gaps in the ecosystem, and re-forge key relationships between species (for example, between predators and prey and scavengers)	Grouse moor management can help maintain a biodiverse range of species and help species that were previously in danger recover. A 2014 study, which considered the impact of grouse moor management on other upland birds in the UK, found that DGS supported up to 10-times more Golden Plover, five-times more Northern Lapwing and twice as many Eurasian Curlew than moors managed for walked-up shooting, which in turn supported more waders than moors with no grouse interest. On blocks where predators were controlled, Red Grouse, Golden Plover, Curlew and Lapwing were two to five-times more numerous (Baines et al., 2014). Predator control has benefitted species of songbirds and in particular ground nesting birds such as curlews and lapwings (Baines et al., 2014). The Hen Harrier Action plan has the grouse shooting community working with other partners help improve the conservation status of the hen harrier in England. The plan includes the trial of a brood management programme as detailed in Section 6.1 (DEFRA, 2016). In 2020 Natural England recorded the best year for hen harrier breeding in England since 2002, with 60 chicks fledged from 19 nests across Northumberland, Yorkshire Dales, Cumbria and Lancashire in early summer 2020 (Department of Environment Food and Rural Affairs (DEFRA) and Natural England, 2020). The example of Berwyn in Wales indicates what can result from the cessation of integrated moorland management: • Between 1983-5 and 2002, lapwing were lost from the Berwyn survey areas, golden plover declined from 10 birds to one, and curlew declined by 79% despite its conservation designations. • Carrion crow numbers increased six-fold and raven four-fold, with the number of occupied 1-km2 grid squares doubling and trebling respectively. • Buzzard numbers increased two-fold in abundance and the number of occupied grid squares increased four-fold. Peregrines also increased seven-fold in abundance. Hen harriers declined by half. There were no significant changes detected in the abundance of the other SPA designated raptors, merlin and red kite. • Meadow pipits and whinchat doubled in numbers, and stonechat increased ten-fold between surveys. However, ring ouzel declined by 78% and tree pipit by 50%. • Between the upland breeding bird surveys, red grouse numbers declined by 54% and the occupied range of 1-km2 grid squares fell by 38%. • Grouse count data on four moors collected since 1995 showed that grouse numbers have remained at low levels on three of the moors, with adult summer densities at Llanarmon declining from 15 grouse km-2 in 1995 to 3 grouse km-2 in 2009. Summer densities ranging from 21 grouse km-2 at Llanarmon to 6 grouse km-2 at Vyrnwy. • For black grouse, numbers declined by 78% between the upland breeding bird surveys and occupied 1-km2 grid squares fell by 28%.

	(Warren and Baines, 2012) It was recommended that to restore breeding wader populations within the Berwyn SPA, "predator control is incorporated as a general tool within agri-environment schemes, particularly where habitat enhancements through heather burning and appropriate grazing are being practised" (Warren and Baines, 2012, p.3)
Setting aside large areas for nature (partial)	Apart from during the grouse shooting season, although these moorlands are environmentally managed, they are predominantly left for nature with no shooting parties and just access from bird watchers, walkers and other tourists. If moorland was not managed, wild fire risk will increase, as explored in Section 5.4. The purple heather, a key tourist attraction, would be replaced by taller, woody growth and shrub. Controlled burning (and cutting where the terrain permits it) can help reduce the risk of wildfires, as reviewed in section 5.4.5.
Restoring wetlands	In past years land drainage was encouraged by government subsidy to increase agricultural output from hill farming and provide peat fuel for burning. It is not a part of moor management required to raise grouse. The great majority of drainage that took place on managed moors in the past was as a result of government policy at the time (Denny and Latham-Green, 2020). In recent years, changes in environmental priorities mean there has been a move to block up of drains and rewet moorland, supported financially by various countryside stewardship schemes, with which the majority of grouse moor managers/owners managing the land to achieve the required environmental goals (Denny and Latham-Green, 2020). Whilst subsidies are received, the initial outlay comes from the estate, utilising estate expertise and equipment. This environmental work is part of the complex web of grouse moor management, coordinated by the estate utilising their staff and expertise. Without the presence of DGS estates and staff this work would need to be funded fully (whether that be by government subsidy and conservation organisation member funds or other means) and coordinated/ completed by other bodies.

There are some similarities between the ways some landowners and tenants practice integrated moorland management and the new guiding principles for rewilding, articulated by Carver *et al.* (2021). These principles include that rewilding requires local engagement and support. By contrast, rewilding projects that local communities perceive to be imposed on them from outside a region, and which fail to take account of local interests, can cause resentment and resistance meaning they are likely to fail (Lorimer et al., 2015; Pellis, 2019; Hall, 2019). Upland communities where moorland is managed for grouse include residents who believe that participation in DGS is important to their community (Denny and Latham-Green, 2020), with individuals who took part in driven game shooting of all types in any role expressing a strong link to rural identity and sometimes intangible cultural heritage (Latham-Green, 2020). Any changes to the current practices in these areas would need to consider the views of local communities carefully before discontinuing a practice that many feel is integral to their identity, and which has a positive impact on their health and well-being (Haslam *et al.*, 2009; Latham-Green, 2020). Rewilding involves utilising a range of different land

management techniques to minimise negative environmental impacts and maximise positive impacts. However, it does this to the detriment of economic and social impacts which are given lower priority. We suggest that many of the activities associated with rewilding are already part of an integrated approach to the management of moorland for DGS. These activities are funded through a combination of estate funds and sometimes subsidies related to agriculture and conservation. These activities utilise the expertise and equipment of the land-owners and their experienced staff, including gamekeepers. If some views of rewilding were to prevail and replace DGS there would be negative economic consequences, in terms of direct and indirect income from shooting both for estates, local communities and the wider local and national economy, as well as social consequences for those no longer able to take part in DGS including, in particular, all those employed on a casual basis such as beaters and pickers-up.

6.5.6 TOURISM

Tourism is often provided as an economic justification for rewilding (Hall, 2015, 2019). However, there is a lack of specific studies of rewilding and tourism (Hall, 2019). Tourism is currently supported by grouse moor management through the maintenance of a mainly accessible and diverse mosaic-type landscape that is attractive to millions of visitors a year.

Visitors to the uplands who take part in DGS are, of course, 'high value' tourists who visit at the end of the main tourist season and into the 'shoulder' season of the autumn months. They will often stay in local hotels that are of a high standard, eat in restaurants, buy sporting attire and equipment from local businesses and spend additional monies during their stay in the area, as explored in Section 5.2. In order to encourage tourists to an area the appropriate infrastructure, facilities and attractions are needed. Open heather moorland, with its purple foliage, and the associated biodiversity is already a key attraction. The North Yorkshire Moors for example, hosts the Moors National Park Centre, which offers a range of ways to enjoy the moors free of charge. It is located in a former shooting lodge on the banks of the River Esk. The centre provides information about the National Park's villages, historic attractions, and tranquil moors and dales including moorland stories, heritage and wildlife displays, general visitor information, a gift shop, local crafts, ale and food and a country café with garden seating. There are grounds where people can picnic and other highlighted, outdoor attractions such as riverside sculpture trail, indoor climbing wall, outdoor adventure playground, the story-telling chair in Crow Wood and a woodland trail to the bird hide. There is also an art gallery (Welcome to Yorkshire, 2019). This is funded by the National Parks Authority. These tourist enterprises co-exist with the grouse moor management. The moors are managed using the methods described in Section 5.3 and 5.4 to maintain a patchwork of different sizes of heather (GWCT, 2019), which results in the purple heather landscape many people travel to the moors to visit, as publicised by the National Parks (North Yorkshire Moors National Park, 2021). If this management was to stop, the purple heather would be lost, and the biodiversity would change. The maintenance of access pathways would need to be funded from alternative sources or would gradually degrade.

It is interesting to note that the only upland area in the UK that does not rely on management of land for grouse moors is the Lake District. This area is heavily reliant on tourism with a less diverse range of employment opportunities, compared to those areas managed as grouse moors, and has the highest proportion of second homes of all of the National Parks, as was noted in a 2020 comparative study (Denny and Latham-Green, 2020). The study found that communities in areas where integrated moorland management is practiced, both those in National Parks and those outside them, have weathered the coronavirus storm more robustly than those in moorland and upland communities in areas where there is a very high reliance on tourism (Denny and Latham-Green, 2020).

To replace one kind of tourism with another takes time. The amount of money spent by any alternative tourists that could be encouraged to an area cannot be quantified in advance. The amount of money currently spent by those coming to shoot grouse is discussed in Section 5.2 and this would cease if no shooting took place.

To summarise, moorland management for DGS exists as part of a complex web of activities that supports tourism in the form of biodiversity enhancement (See Sections 5.3 and 5.4), track maintenance and landscape shaping. Shooting only takes place between 12th August and 10th December each year, but throughout the whole year the land managed by estates for driven grouse shooting, and the resultant benefits of this in terms of landscape, access and biodiversity is available free of charge for non-shooting tourists in the uplands.

6.5.7 CONSERVATION/NGOS

The current system for moorland management means that conservation work resulting in positive ecosystems impacts for people and a wide range of animal species, as detailed in Section 5.3, is carried out using the expertise and resources of moorland estates, supplemented in some case by government subsidies. If DGS was to cease, moorland owners would have to generate income from different uses of their land. As we have indicated, the current evidence is that alternative uses of moorland are not likely to be as economically, environmentally, and socially sustainable as integrated moorland management.

6.5.8 CONCLUSION AND EVIDENCE SUMMARY

This section has detailed a number of alternative methods of managing upland, moorland habitat. Table 6.5 summarises each use and its potential advantages and disadvantages, highlighting the relevant key evidence citations. The table also refers to walked-up shooting for completeness, often suggested by opponents as a potential alternative.

TABLE 6.5 ALTERNATIVE USES EVIDENCE SUMMARY

Use	Summary Details	Key References	
ALL	The suggested alternative uses of alternative agriculture, forestry, renewable energy, rewilding, conservation and tourism fail to take account of the loss of local employment for gamekeepers, beaters, pickers-up and others along with the community, cultural and heritage aspects of participation in DGS, as well as the wider economic and social benefits of DGS to the local community. Gamekeepers and their families have been shown to be integrated in local communities. Gamekeeper jobs would lbe lost, negatively impacting on individuals (who would also lose housing in many cases) and the local community, especially If younger families move away from rural areas to find work.	Denny, S. and Latham-Green, T. (2020) *What Impacts does Integrated Moorland Management, including Grouse Shooting, have on Moorland Communities ? A Comparative Study*. Latham-Green T. Understanding the Social Impact of Participation in Driven Game Shooting in the UK. 2020. Latham-Green T. Executive Summary of a PhD Thesis: "Understanding the social impact of participation in Driven Game Shooting in the UK." McMorran, R. (2009) 'Red grouse and the Tomintoul and Strathdon Communities', *Group*. McMorran, R., Bryce, R. and Glass, J. (2015) *Grouse shooting, moorland management and local communities. Community Perceptions and Socio-Economic Impacts of Moorland Management and Grouse Shooting in the Monadhliath and Angus Glens. Commissioned Report.* Thomson, S., McMorran, R. and Glass, J. (2018) *Socio-economic and biodiversity impacts of driven grouse moors in Scotland. Part 1. Socio-economic impacts of driven grouse moors in Scotland*.	
Use	**Advantages**	**Disadvantages**	**Key References**
Alternative Agriculture	Livestock farming can be profitable, but only as part of a range of farm diversification as detailed in section 6.5.2. (It should be noted sheep farming already forms part of the existing, upland moor management for grouse in some areas).	Intensive sheep farming has negative environmental impacts and cannot be profitable on its own even with subsidies (Clark, Scanlon and Hart, 2019) Reduced social benefits as detailed in section 5.5 for existing DGS participants.	Clark, C., Scanlon, B. and Hart, K. (2019) *Less is more: Improving profitability and the natural environment in hill and other marginal farming systems*. Denny, S. and Latham-Green, T. (2020) *What Impacts does Integrated Moorland Management, including Grouse Shooting, have on Moorland Communities ? A Comparative Study*. Thomson, S., McMorran, R. and Glass, J. (2018) *Socio-economic and biodiversity impacts of driven grouse moors in Scotland. Part 1. Socio-*

		Ignores the cultural and heritage aspects of participation in DGS. Loss of employment opportunities for beaters, pickers-up and others. Gamekeepers and their families have been shown to be integrated in local communities (Denny and Latham-Green, 2020). Gamekeeper jobs would likely be lost, negatively impacting on individuals (who would also lose housing in many cases) and the local community, especially If younger families move away from rural areas to find work.	*economic impacts of driven grouse moors in Scotland*.
Commercial Afforestation	Can provide a high level of income to landowners through a mix of government subsidies and timber production. Provides some employment. Can potentially help achieve the UKs net zero carbon target, as afforestation can be a useful tool on open habitats and croplands (Alonso, I., Weston, K., Gregg, R. and Morecroft, 2012), but not when located in upland areas consisting of peat, as peat-based soil may dry out, releasing large amounts of carbon, especially in the early	Coniferous forestry plantations may not be economically viable without subsidy and have negative environmental impacts on a range of species as including hen harriers and curlew as detailed in section 6.5.3. Loss of employment opportunities for beaters, pickers-up and others. Gamekeepers and their families have been shown to be integrated in local communities (Denny and Latham-Green, 2020). Gamekeeper jobs would be lost, negatively impacting on individuals (who would also lose housing in many cases) and the local	Allen, A. and Chapman, D. (2001) 'Impacts of afforestation on groundwater resources and quality', *Hydrogeology Journal*. Springer, 9(4), pp. 390–400. doi: 10.1007/s100400100148. Alonso, I., Weston, K., Gregg, R. and Morecroft, M. (2012) 'Carbon storage by habitat: Review of the evidence of the impacts of management decisions and condition of carbon stores and sources.', *Natural England Research Reports, Number NERR04*, 17(10), pp. 55–59. Available at: http://publications.naturalengland.org.uk/publication/1412347. Bell, J. (2014) *Eskdalemuir A comparison of forestry and hill farming; productivity and economic impact*. Burrascano, S. *et al.* (2016) 'Current European policies are unlikely to jointly foster carbon sequestration and protect biodiversity',

	years of plantations (Alonso, I., Weston, K., Gregg, R. and Morecroft, 2012). There are other factors in play that may influence carbon sequestration benefits including albedo[329], evapotranspiration[330] and aerodynamic surface roughness length[331], as noted in section 6.5.3. It should be noted that if the timber is used for wood burning then carbon is released and although not adding to net emissions, payback times until the carbon is reabsorbed can be long (Crane, 2020). Conifers can be useful in alleviating flooding, predominantly in the avoidance of flash flooding rather that large flood events, however conversely this can produce a	community, especially If younger families move away from rural areas to find work. Coniferous forestry plantations should not be planted on deep peat as the damage to the peat results in a negative impact on carbon emissions due to the peat drying out, releasing large amounts of carbon. The influence on climate of afforestation is wider than just the carbon cycle as other factors such as albedo[332], evapotranspiration[333] and aerodynamic surface roughness length[334] can mean that the net effect of forest plantation can be negative (Crane, 2020; Burrascano et al., 2016). At UK latitudes the evidence for whether	*Biological Conservation*. Elsevier Ltd, pp. 370–376. doi: 10.1016/j.biocon.2016.08.005. Burton, V. *et al.* (2018) 'Reviewing the evidence base for the effects of woodland expansion on biodiversity and ecosystem services in the United Kingdom', *Forest Ecology and Management*. Elsevier B.V., pp. 366–379. doi: 10.1016/j.foreco.2018.08.003. Cannell, M. (1999) 'Growing trees to sequester carbon in the UK: answers to some common questions', *Forestry*. Oxford University Press, 72(3), pp. 237–247. doi: 10.1093/forestry/72.3.237. Cannell, M. G. R., Cruickshank, M. M. and Mobbs, D. C. (1996) 'Carbon storage and sequestration in the forests of Northern Ireland', *Forestry*, 69(2). Available at: https://academic.oup.com/forestry/article/69/2/155/638420 (Accessed: 7 January 2021). Confor (2018) 'Forestry and local economy'. Available at: https://www.confor.org.uk/media/246920/westwater-larriston-

[329] Albedo relates to the ability of land to reflect or absorb heat. Light surfaces, like open snowy areas, reflect heat having a cooling effect whereas dark areas, like densely planted coniferous forests absorb heat more easily having a warming effect

[330] Evapotranspiration is the process by which water is transferred from the land to the atmosphere by evaporation from the soil and other surfaces and by transpiration from plants

[331] "Aerodynamic roughness length is usually defined as the height where the wind velocity is equal to zero. It is an important aerodynamic parameter and reveals the exchange between the atmosphere and land surfaces." (Zhang et al., 2017)

[332] Albedo relates to the ability of land to reflect or absorb heat. Light surfaces, like open snowy areas, reflect heat having a cooling effect whereas dark areas, like densely planted coniferous forests absorb heat more easily having a warming effect

[333] Evapotranspiration is the process by which water is transferred from the land to the atmosphere by evaporation from the soil and other surfaces and by transpiration from plants

[334] "Aerodynamic roughness length is usually defined as the height where the wind velocity is equal to zero. It is an important aerodynamic parameter and reveals the exchange between the atmosphere and land surfaces." (Zhang et al., 2017)

	negative effect on water yield during periods of dry weather (Burton et al., 2018).	the overall climate effect is positive or negative are contradictory (Montenegro et al., 2009). Coniferous plantations can have an acidification effect on soils and freshwater due to their effectiveness at scavenging acid pollutants (Burton et al., 2018; Rees and Ribbens, 1995; Allen and Chapman, 2001). Reduced social benefits as detailed in Section 5.5 for existing DGS participants. Ignores the cultural and heritage aspects of participation in DGS. There has been negative public response in Ireland to large scale afforestation due to destruction of certain habitats and negative impacts on species such as curlew and hen harrier (Colwell, 2018). If plantations are too densely planted they can negatively impact presence and breeding performance of some bird species such as ravens and golden eagles, but lower planting densities, riparian buffers, areas of broadleaf woodland and open space included in plantation design may not impact these species in the same way.	forestry-and-local-economy-feb-2018.pdf (Accessed: 6 January 2021). Crane, E. (2020) *Woodlands for climate and nature: A review of woodland planting and management approaches in the UK for climate change mitigation and biodiversity conservation. Report to the RSPB.* Forestry Commission (2020) *Forestry Statistics 2020*. Game and Wildlife Conservation Trust (GWCT) (2019) *The Moorland Balance: The Science Behind Grouse Shooting and Moorland Management*. Second. Fordingbridge: Game and Wildlife Conservation Trading Ltd. Game and Wildlife Conservation Trust (GWCT) (2020) *How much upland heather moorland is in the UK? - Game and Wildlife Conservation Trust*. Available at: https://www.gwct.org.uk/blogs/uplands-blog/2020/april/how-much-upland-heather-moorland-is-in-the-uk/ (Accessed: 6 January 2021). Hardaker, A. (2018) 'Is forestry really more profitable than upland farming? A historic and present day farm level economic comparison of upland sheep farming and forestry in the UK', *Land Use Policy*. Elsevier Ltd, 71, pp. 98–120. doi: 10.1016/j.landusepol.2017.11.032. Montenegro, A. *et al.* (2009) 'The net carbon drawdown of small scale afforestation from satellite observations', *Global and Planetary Change*. Elsevier, 69(4), pp. 195–204. doi: 10.1016/j.gloplacha.2009.08.005. Potts, G. R. (1998) 'Global dispersion of nesting Hen Harriers Circus cyaneus; Implications for grouse moors in the U.K.', *Ibis*. Blackwell

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Renewable Energy – Wind Farms	Can provide an income to landowners/investors through government subsidies in the form of guaranteed rates for electricity produced (Hitchings-Hales, 2020) and provide some employment, of which 17% is during the operational phase of the wind farm's life (BiGGAR Economics, 2012). Can potentially help achieve the UKs net zero carbon target, but not in most upland areas consisting of peat, due to projected changes in the proportion of fossil fuels used to generate electricity, even with careful management of construction, by 2040 building wind farms on most undegraded peat sites will not reduce overall carbon emissions (Smith, Nayak and Smith, 2014). If local people agree to wind farms onshore, there can be benefits to local residents in the form of community grant schemes, potential	Onshore wind farms have negative environmental impacts, particularly for certain bird species (including some raptors) and bats (Thaxter et al., 2017; Marques et al., 2020). Government subsidy is required to make onshore wind viable for investors, the evidence indicates that jobs were lost when subsidies ceased (STUC, 2019; Burns, 2019). Loss of employment opportunities for beaters, pickers-up and others. Gamekeepers and their families have been shown to be integrated in local communities (Denny and Latham-Green, 2020). Gamekeeper jobs would likely be lost, negatively impacting on individuals (who would also lose housing in many cases) and the local community, especially If younger families move away from rural areas to find work.	BiGGAR Economics (2012) 'Onshore Wind: Direct & Wider Economic Impacts', *RenewableUK and the Department of Energy and Climate Change (DECC)*, (May), pp. 1–100. Available at: https://www.gov.uk/government/publications/onshore-wind-direct-and-wider-economic-impacts. British Trust for Ornithology (BTO) (2017) *Wind farms and biodiversity: are they on a collision course?* Available at: https://www.bto.org/about-bto/press-releases/wind-farms-and-biodiversity-are-they-collision-course. Burns, H. (2019) 'More than 2,000 jobs lost at Scotland's wind farms since subsidies axed, new statistics show - Business Insider', *The Insider*, 1 February. Available at: https://www.insider.co.uk/news/wind-farms-scotland-jobs-subsidies-13937943 (Accessed: 15 January 2021). Denny, S. and Latham-Green, T. (2020) *What Impacts does Integrated Moorland Management, including Grouse Shooting, have on Moorland Communities ? A Comparative Study*. Grantham Research Institute on Climate Change and the Environment (2020) *How important is onshore wind energy to the UK? - Grantham Research Institute on climate change and the environment*, *London*

	for wildlife and habitat management or visitor centres to be part funded by developers, which can help to enhance the local area and perhaps support further employment (BiGGAR Economics, 2012). Could increase the UK's energy security, through provision of UK based energy generation.	The majority of employment occurs in the construction and commissioning stage of the wind farm's life rather than during the operational life of the wind farm, which accounts for just 17% of total employment created (BiGGAR Economics, 2012). Onshore wind farms should not be built on deep peat as the damage to the peat can result in a negative impact on carbon emissions (Smith, Nayak and Smith, 2012, 2014). Reduced social benefits as detailed in Section 5.5 for existing DGS participants. Ignores the cultural and heritage aspects of participation in DGS. Socially (and visually) wind farms are not always accepted by communities (Toke, 2005; Harper et al., 2019). Planning can be a lengthy and costly process (Windemer, 2020), particularly in England where in order to gain planning approval, neighbourhood support for any project is required (GRICCE, 2020). Concerns have been expressed around decommissioned wind turbine blades, with news stories highlighting the existence of large burial sites for turbines (BBC, 2020c). Wind turbine blades are challenging to recycle with limited uses for any processed material	*School of Economics*. Available at: https://www.lse.ac.uk/granthaminstitute/explainers/how-important-is-onshore-wind-power-to-the-uk/ (Accessed: 15 January 2021). Grubb, M. (2015) 'Energy policy in a spin', *New Scientist*. Elsevier BV, 227(3028), pp. 24–25. doi: 10.1016/s0262-4079(15)30695-3. Harper, M. *et al.* (2019) 'Onshore wind and the likelihood of planning acceptance: Learning from a Great Britain context', *Energy Policy*. Elsevier Ltd, 128, pp. 954–966. doi: 10.1016/j.enpol.2019.01.002. Marques, A. T. *et al.* (2020) 'Wind turbines cause functional habitat loss for migratory soaring birds', *Journal of Animal Ecology*. Edited by A. Bijleveld. Blackwell Publishing Ltd, 89(1), pp. 93–103. doi: 10.1111/1365-2656.12961. Smith, J., Nayak, D. R. and Smith, P. (2012) 'Avoid constructing wind farms on peat', *Nature*, 489(7414), p. 33. doi: 10.1038/489033a. Smith, J., Nayak, D. R. and Smith, P. (2014) 'Wind farms on undegraded peatlands are unlikely to reduce future carbon emissions', *Energy Policy*. Elsevier, 66, pp. 585–591. doi: 10.1016/j.enpol.2013.10.066. STUC (2019) 'Broken Promises and Offshored Jobs'. Thaxter, C. B. *et al.* (2017) 'Bird and bat species' global vulnerability to collision mortality at wind farms revealed through a trait-based assessment', *Proceedings of the Royal Society B: Biological Sciences*. Royal Society Publishing, 284(1862), p. 20170829. doi: 10.1098/rspb.2017.0829. Toke, D. (2005) 'Explaining wind power planning outcomes: Some findings from a study in England and Wales', *Energy Policy*. Elsevier,

		recovered, an increasingly pertinent issue as in Europe alone, as at 2016, 50,000 tons per year of wind turbine blade material was predicted to reach the end of its life by 2022 (Beauson and Brøndsted, 2016).	33(12), pp. 1527–1539. doi: 10.1016/j.enpol.2004.01.009. BBC (2020) *What happens to all the old wind turbines?* - BBC News. Available at: https://www.bbc.co.uk/news/business-51325101 (Accessed: 30 April 2021). Beauson, J. and Brøndsted, P. (2016) 'Wind turbine blades: An end of life perspective', in MARE-WINT: *New Materials and Reliability in Offshore Wind Turbine Technology*. Springer International Publishing, pp. 421–432. doi: 10.1007/978-3-319-39095-6_23.
Rewilding	The lack of a specific definition for rewilding means that it is difficult to assess advantages and disadvantages. The use of the term rewilding has now expanded to cover a wide range of ecological restoration and human-nature relationships (Hall, 2019) usually to improve the provision of ecosystem services (Brown et al., 2018; Cerqueira et al., 2015b; Cramer, Hobbs and Standish, 2008; Olwig, 2016). Ecosystem restoration can be beneficial (as shown in Sections 5.3 and 5.4 relating to the work currently being carried out by grouse moor managers) but removing all intervention by humans and leaving ecosystems to develop alone would mean losses of some species and gains of others.	There is no agreement on what environmental areas should and should not be reinstated through rewilding, how this should be done and how far back to past environments future management should be guided. If management of upland, moorland areas for driven grouse shooting ceased, many activities that contribute to ecosystem restoration as detailed in Section 5.3 and 5.4, would either be lost or would need to be funded from alternative sources, such as government subsidies. There would be impacts on other species such as ground nesting birds if there were reduced moor management including predator control. This could result in losses of at risk species to the benefit of some species that are not currently at	Adams, W. M. (2006) *The Future of Sustainability: Re-thinking Environment and Development in the Twenty-first Century*. Available at: http://www.vda.de/en/service/jahresbericht/aut (Accessed: 11 December 2020). Baines, D. *et al.* (2014) 'Grouse moor management: effects on other upland birds in the UK', in Buchanan, G., Thompson, D., Chamberlain, D. & Pearce-Higgins, J. (eds) (ed.) *Ecology and Conservation of Birds in Upland and Alpine Habitats: 1*. Peterborough: British Ornithologists' Union. Available at: http://www.bou.org.uk/bouproc-net/uplands/baines-et-al.pdf (Accessed: 19 December 2017). Boivin, N. L. *et al.* (2016) 'Ecological consequences of human niche construction: Examining long-term anthropogenic shaping of global species distributions', *Proceedings of the National Academy of Sciences*. National Academy of Sciences, 113(23), pp. 6388–6396. doi: 10.1073/pnas.1525200113. Brown, A. G. *et al.* (2018) 'Natural vs anthropogenic streams in Europe: History, ecology and implications for restoration, river-

	It is difficult to say which species would benefit from rewilding and which would be negatively impacted. It would likely depend on the level and type of human intervention. As an example, after moor management was ceased at Berwyn Protection Area (SPA) there were decreases in curlew, lapwing, golden plover, hen harrier, black grouse and red grouse but increases in carrion crow, buzzards, meadow pipits, whinchats, peregrines and ravens (Warren and Baines, 2012). Rewilding could open new tourist opportunities but, it should be noted that, while tourism is often suggested as a potential income stream for rewilding, research shows that there is a lack of specific studies of rewilding and tourism (Hall, 2019).	risk, as examined in Section 6.5.5. For example, after moor management was ceased at Berwyn Protection Area (SPA) there were decreases in curlew, lapwing, golden plover, hen harrier, black grouse and red grouse but increases in carrion crow, buzzards, meadow pipits, whinchats, peregrines and ravens (Warren and Baines, 2012). Reduced social benefits for existing DGS participants detailed in Section 5.5. Ignores the cultural and heritage aspects of participation in DGS. Loss of employment opportunities for beaters, pickers-up and others. Gamekeepers and their families have been shown to be integrated in local communities (Denny and Latham-Green, 2020). Some gamekeeper jobs would likely be lost, negatively impacting on individuals (who would also lose housing in many cases) and the local community, especially If younger families move away from rural areas to find work. Rewilding projects that local communities perceive to be imposed on them from outside a region which fail to take account of local interests can cause resentment and resistance meaning they are likely to fail (Lorimer et al., 2015; Pellis, 2019; Hall, 2019). The research	rewilding and riverine ecosystem services', *Earth-Science Reviews*. Elsevier B.V., pp. 185–205. doi: 10.1016/j.earscirev.2018.02.001. Carver, S., Convery, I., Hawkins, S., Beyers, R., Eagle, A., Kun, Z., Van Maanen, E., Cao, Y., Fisher, M., Edwards, S.R., Nelson, C., Gann, G.D., Shurter, S., Aguilar, K., Andrade, A., Ripple, W.J., Davis, J., Sinclair, A., Bekoff, M., Noss, R., Foreman, D., Pettersson, H., Root-Bernstein, M., Svenning, J., Taylor, P., Wynne-Jones, S., Featherstone, A.W., Fløjgaard, C., Stanley-Price, M., Navarro, L.M., Aykroyd, T., Parfitt, A. and Soulé, M., 2021. Guiding principles for rewilding. *Conservation Biology*. [online] Available at: https://conbio.onlinelibrary.wiley.com/doi/full/10.1111/cobi.13730 > [Accessed 28 Jun. 2021]. Carver, S., Evans, A. J. and Fritz, S. (2002) 'Wilderness attribute mapping in the United Kingdom', *International Journal of Wilderness*, 8(1), pp. 24–29. Available at: http://eprints.whiterose.ac.uk/934/https://eprints.whiterose.ac.uk/ (Accessed: 22 January 2021). Cerqueira, Y. *et al.* (2015) 'Ecosystem services: The opportunities of rewilding in Europe', in *Rewilding European Landscapes*. Springer International Publishing, pp. 47–64. doi: 10.1007/978-3-319-12039-3_3. Cramer, V. A., Hobbs, R. J. and Standish, R. J. (2008) 'What's new about old fields? Land abandonment and ecosystem assembly', *Trends in Ecology and Evolution*. Elsevier Current Trends, pp. 104–112. doi: 10.1016/j.tree.2007.10.005. Deary, H. and Warren, C. R. (2017) 'Divergent visions of wildness and naturalness in a storied landscape: Practices and discourses of rewilding in Scotland's wild places', *Journal of Rural Studies*. Elsevier

		suggests that a large proportion of upland residents are supportive of management of upland moorland for grouse shooting and many feel participation in driven grouse shooting is part of their rural identity and/or tangible cultural heritage (Latham-Green, 2020b; Denny and Latham-Green, 2020) therefore, it could be difficult to gain community acceptance of rewilding schemes in such areas which could lead to their failure. Social and cultural perspectives are important to consider. A 2017 study considering practices and discourse of rewilding in Scotland's wild places identified four overlapping and interacting framings of rewilding being 'wild nature', 'wild places', 'wild experience' and 'wildness', also recognising the important element of cultural, social and historical factors with potentially restricting access to wild places in Scotland in light of the historic 'Highland clearances' and indigenous links to land via traditional landscape practices of cultural significance in Scotland. Previous research has identified many individuals view driven game shooting as a form of intangible cultural heritage, as identified by UNESCO. Whilst there has been a drive to identify 'Wild Land Areas' by Scottish Natural Heritage', there is no formal policy basis for rewilding in Scotland.	Ltd, 54, pp. 211–222. doi: 10.1016/j.jrurstud.2017.06.019. DEFRA (2016) *Joint Action Plan to increase the English Hen Harrier population*. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/491818/hen-harrier-action-plan-england-2016.pdf (Accessed: 11 December 2020). Denny, S. and Latham-Green, T. (2020) *What Impacts does Integrated Moorland Management, including Grouse Shooting, have on Moorland Communities ? A Comparative Study*. Department of Environment Food and Rural Affairs (DEFRA) and Natural England (2020) *A record-breaking year for hen harrier breeding - GOV.UK*. Available at: https://www.gov.uk/government/news/a-record-breaking-year-for-hen-harrier-breeding (Accessed: 16 December 2020). European Commission (2021) *The Habitats Directive - Environment - European Commission*. Available at: https://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm (Accessed: 22 January 2021). European Union (2015) *Joint paper on the Action for Biodiversity in the EU and the Fitness Check of the Birds and Habitats Directives*. Game and Wildlife Conservation Trust (GWCT) (2019) *The Moorland Balance: The Science Behind Grouse Shooting and Moorland Management*. Second. Fordingbridge: Game and Wildlife Conservation Trading Ltd. Hall, C. M. (2019) 'Tourism and rewilding: an introduction – definition, issues and review', *Journal of Ecotourism*. Routledge, 18(4), pp. 297–308. doi: 10.1080/14724049.2019.1689988.

			Harper, M. (2018) *The conservationist's dilemma: an update on the science, policy and practice of the impact of predators on wild birds (5), RSPB Website: Martin Harper's blog*. Available at: https://community.rspb.org.uk/ourwork/b/martinharper/posts/the-conservationist-39-s-dilemma-an-update-on-the-science-policy-and-practice-of-the-impact-of-predators-on-wild-birds-5 (Accessed: 18 January 2021). Haslam, S. A. *et al.* (2009) 'Social Identity, Health and Well-Being: An Emerging Agenda for Applied Psychology', *Applied Psychology*, 58(1), pp. 1–23. doi: 10.1111/j.1464-0597.2008.00379.x. Latham-Green, T. (2020) *Understanding the Social Impact of Participation in Driven Game Shooting in the UK*. University of Northampton. Latham-Green T. Executive Summary of a PhD Thesis: "Understanding the social impact of participation in Driven Game Shooting in the UK." *Res Gate*. 2020;(September):1-22. https://www.researchgate.net/publication/344191124_Executive_Summary_of_a_PhD_Thesis_'Understanding_the_social_impact_of_participation_in_Driven_Game_Shooting_in_the_UK'?_sg=7kyVxYHRMDywx-yuP-sKgtYc4aQk_gd1WSoKdB5doWo7EHYx55A05R_6Rcr-dbt3p04GU1U7cszHgcgNF. Lorimer, J. *et al.* (2015) 'Rewilding: Science, Practice, and Politics', *Annual Review of Environment and Resources*. Annual Reviews Inc., pp. 39–62. doi: 10.1146/annurev-environ-102014-021406. Mooney, C. and Dennis, B. (2016) *Scientists say that 'nature,' untouched by humans, is now almost entirely gone - The Washington Post*, *Washington Post*. Available at: https://www.washingtonpost.com/news/energy-

environment/wp/2016/06/06/theres-basically-no-landscape-on-earth-that-hasnt-been-altered-by-humans-scientists-say/ (Accessed: 7 January 2021).

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Olwig, K. R. (2016) 'Virtual enclosure, ecosystem services, landscape's character and the "rewilding" of the commons: the "Lake District" case', *Landscape Research*. Routledge, 41(2), pp. 253–264. doi: 10.1080/01426397.2015.1135320.

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Rewilding Britain (2020) *Defining rewilding*. Available at: https://www.rewildingbritain.org.uk/explore-rewilding/what-is-rewilding/defining-rewilding (Accessed: 6 January 2021).

Rewilding Britain (2021a) *Examples of rewilding | Rewilding Britain*. Available at: https://www.rewildingbritain.org.uk/explore-rewilding/what-is-rewilding/examples-of-rewilding (Accessed: 6 January 2021).

Rewilding Britain (2021b) *What is rewilding? | Rewilding Britain*. Available at: https://www.rewildingbritain.org.uk/explore-rewilding/what-is-rewilding (Accessed: 6 January 2021).

Warren, P. and Baines, D. (2012) 'Changes in upland bird numbers and distribution in the Berwyn Special Protection Area , North Wales between 1983 and 2012', *Birds In Wales*, (11), pp. 32–42. Available at:

			http://www.moorlandassociation.org/wp-content/uploads/2015/03/Berwyn-Report.pdf.
Tourism	Potential opportunities to create new tourist attractions in upland areas, subject to agreement of landowners and/or purchase of land by communities. Rewilding has been suggested as a potential source of tourism, however research shows that there is a lack of specific studies of rewilding and tourism (Hall, 2019).	Tourism currently exists in upland moorland areas managed for driven grouse shooting in the form of both shooting tourism and wider tourists visiting the moors for birdwatching, walking and general recreation. The current benefits afforded to tourism such as track maintenance and land management resulting in the form of landscape currently seen and the range of bird species may be lost if grouse moor owners no longer fund and complete conservation activities. It is likely that government subsidies and/or charities would need to fund these activities fully for them to continue. Heavy reliance on tourism in an area can lead a less diverse range of employment industries, reducing resilience against the impact of extreme events such as the Covid 19 pandemic. It can also lead to an increase in second homes compared to other upland areas in England (Denny and Latham-Green, 2020). Reduced social benefits as detailed in Section 5.5 for existing DGS participants. Ignores the	Denny, S. and Latham-Green, T. (2020) *What Impacts does Integrated Moorland Management, including Grouse Shooting, have on Moorland Communities ? A Comparative Study*. Game and Wildlife Conservation Trust (GWCT) (2019) *The Moorland Balance: The Science Behind Grouse Shooting and Moorland Management*. Second. Fordingbridge: Game and Wildlife Conservation Trading Ltd. Hall, C. M. (2015) 'Tourism and biological exchange and invasions: a missing dimension in sustainable tourism?', *Tourism Recreation Research*. Taylor and Francis Ltd., 40(1), pp. 81–94. doi: 10.1080/02508281.2015.1005943. Hall, C. M. (2019) 'Tourism and rewilding: an introduction – definition, issues and review', *Journal of Ecotourism*. Routledge, 18(4), pp. 297–308. doi: 10.1080/14724049.2019.1689988. North Yorkshire Moors National Park (2021) *All about heather*. Available at: https://www.northyorkmoors.org.uk/discover/moorland/all-about-heather (Accessed: 22 January 2021). Welcome to Yorkshire (2019) *The Moors National Park Centre*. Available at: https://www.yorkshire.com/view/attractions/danby/the-moors-national-park-centre-125775.

		cultural and heritage aspects of participation in DGS. Gamekeepers and their families have been shown to be integrated in local communities (Denny and Latham-Green, 2020). Some gamekeeper jobs would likely be lost, negatively impacting on individuals (who would also lose housing in many cases) and the local community, especially If younger families move away from rural areas to find work. Loss of employment opportunities for beaters, pickers-up and others.	
Conservation	If landowners agree to convert to conservation management solely funded by the taxpayer or communities/individuals are able to buy land from current landowners, some gamekeepers could potentially be employed by conservation organisations to manage the heather moorland for the benefit of a diverse range of species. Whilst there is a large body of evidence for the effects of conifer plantations it has been recognised that evidence gaps need to be filled in relation to native woodland afforestation (Burton et al., 2018). Partial afforestation using mixed, broad leaf woodland could, in theory, be managed for conservation but deep peat areas should not	Has to be funded either by charitable donation and/or government subsidy, including monies to purchase land if required. While carbon capture is often cited as a reason to plant trees, location of planting is key. Friggens *et al.* (2020) showed that even planting native tree species (*Betula pubescens* and *Pinus sylvestris)* onto heather moorland in Scotland did not lead to an increase in net ecosystem carbon stock either 12 or 39 years after planting. Rather they found that plots with trees had great soil respiration and lower carbon levels than control plots that were heather-dominant. They hypothesize that tree planting dramatically	British Association for Shooting and Conservation (BASC) (2021) *Minister 'appalled' by widespread gamekeeper abuse - Politics.co.uk*, *www.politics.co.uk*. Available at: https://www.politics.co.uk/opinion-former/2021/01/13/minister-appalled-by-widespread-gamekeeper-abuse/ (Accessed: 1 February 2021). Burton, V. *et al.* (2018) 'Reviewing the evidence base for the effects of woodland expansion on biodiversity and ecosystem services in the United Kingdom', *Forest Ecology and Management*. Elsevier B.V., pp. 366–379. doi: 10.1016/j.foreco.2018.08.003. Cross, M. (2021) 'Abuse of gamekeepers - it happens on a daily basis', *Shooting UK*, 18 January. Available at: https://www.shootinguk.co.uk/features/abuse-of-gamekeepers-118486 (Accessed: 25 January 2021). Friggens, N. L. et al. (2020) 'Tree planting in organic soils does not result in net carbon sequestration on decadal timescales', *Global Change Biology*. Blackwell Publishing Ltd, 26(9), pp. 5178–5188. doi:

	be afforested, with a preference for restoration (Payne and Jessop, 2018). In addition, it is unclear whether native woodland planting results in carbon sequestration and storage that is equal to or greater than the carbon released when the trees are planted (Burton et al., 2018). A middle way that has been suggested when restoring uplands previously planted with conifers is 'Peatland Edge Woodland Creation' consisting of low density planting of native species combined with re-wetting of the peat surface however the benefits of this option are disputed (Payne and Jessop, 2018). The management of land for conservation can provide opportunities for volunteering and local recreation.	alters underground mycorrhizal fungi communities, leading to a net loss of carbon. Gamekeepers and their families have been shown to be integrated in local communities (Denny and Latham-Green, 2020). Some gamekeeper jobs would likely be lost, negatively impacting on individuals (who would also lose housing in many cases) and the local community, especially If younger families move away from rural areas to find work. Loss of income from high spending shooting visitors from UK and overseas (see Section5.2) both directly to shoots and to wider community (e.g. suppliers, hoteliers, restaurants etc.). Reduced social benefits as detailed in Section 5.5 for existing DGS participants. Ignores the cultural and heritage aspects of participation in DGS. Loss of employment opportunities for beaters, pickers-up and others. Conflict between those for and against shooting (Latham-Green, 2020b) and the harassment of gamekeepers (Mundell, 2020; Thomson *et al.*, 2020; BASC, 2021b; Cross, 2021) may have an impact on those with the requisite expertise to effectively manage land to maintain and	10.1111/gcb.15229. Payne, R. and Jessop, W. (2018) *Natural capital trade-offs in afforested peatlands: Evidence synthesis and needs for the future of peatland forestry and forest-to-bog restoration. Valuing Nature Natural Capital Synthesis Report VNP10 Full Report.* Thomson, S. *et al.* (2020) *Summary Report - The socioeconomic and biodiversity impacts of driven grouse moors and the employment rights of gamekeepers*. UK Government (2021) *Countryside Stewardship Scheme - TE4: Supply and plant tree - GOV.UK*. Available at: https://www.gov.uk/countryside-stewardship-grants/supply-and-plant-tree-te4 (Accessed: 6 January 2021).

		improve biodiversity being reluctant to do so if certain individuals and/or groups are involved. This means expertise could be lost.	
Walked-up grouse shooting	Reduced intensity of land management, but not an absence of management (note, could have positive and negative impacts, especially on certain species, depending on level of management).	Management of heather moorland is expensive and not economically viable with walked-up shooting only (Sotherton, Tapper and Smith, 2009), meaning subsidies would be needed for it to continue to produce the biodiversity benefits such as increased hen harrier numbers. The economic benefits of high value tourist visitors would be lost or severely reduced, both to shoots themselves and the wider community. Gamekeepers and their families have been shown to be integrated in local communities (Denny and Latham-Green, 2020). Some gamekeeper jobs would be lost, negatively impacting on individuals (who would also lose housing in many cases) and the local community, especially If younger families move away from rural areas to find work. Alternative uses for moorland may be considered by landowners such as renewable energy or forestry which have their own positive and negative economic, environmental and social impacts.	Sotherton, N., Tapper, S. and Smith, A. (2009) 'Hen harriers and red grouse: economic aspects of red grouse shooting and the implications for moorland conservation', *Journal of Applied Ecology*. John Wiley & Sons, Ltd, 46(5), pp. 955–960. doi: 10.1111/j.1365-2664.2009.01688.x. Denny, S. and Latham-Green, T. (2020) *What Impacts does Integrated Moorland Management, including Grouse Shooting, have on Moorland Communities ? A Comparative Study*.

		Reduced social benefits for existing DGS participants as detailed in Section 5.5. Ignores the cultural and heritage aspects of participation in DGS for the beaters and the majority of pickers-up who are not involved in walked up shooting, narrowing the spectrum of social participation to include only those that can afford to shoot. Loss of employment opportunities for beaters, pickers-up and others.	

7 CONCLUSIONS

7.1 ECONOMIC IMPACTS

Any statements regarding the sustainability of DGS must take into account the full range of economic benefits that result to people, businesses and communities as a result of integrated moorland management. The impacts of integrated moorland management, which includes DGS, on the agriculture sector through financial facilitation; on tourism through the creation of a unique, accessible, and attractive landscape; on human and animal health through exercise and tick and bracken control; and on carbon sequestration and flood control through moorland management and restoration practices are immense. Moreover, their long-term financial impact is clearly important not only for local communities, but for the wider UK population.

If landowners and tenants were fully rewarded for the direct and indirect economic benefits that integrated moorland management, including driven grouse shooting, generates[335] there would be no question about the economic viability of this form of land management.

In the absence of a holistic reward system for all economic impacts, integrated moorland management (including DGS) will continue to depend on a complex, holistic, model of economic management and, in some cases, on landowners and tenants being prepared to invest their money without expectation of a return.

Detailed studies of the economic impacts of moving away from current management practices to re-purpose grouse moors for alternative uses have not been carried out. It is unlikely that the alternative uses that are proposed by some groups for the moorlands would deliver the same positive economic impacts, at least for a number of generations. DGS is an important part of a mosaic of income-generating activities that sustain upland communities and deliver important benefits to the wider UK population.

7.2 BIODIVERSITY: ECOLOGICAL AND ENVIRONMENTAL IMPACTS

DGS management results in an increasingly rare assemblage of plants, animals and invertebrates being supported and enhanced to the benefit of the UK and Europe. This assemblage is different from alternative habitats and typically provides a net gain in diversity and abundance over similar but unmanaged moorland. Some species so not do so well in moorland managed for activities including DGS, but this is true of all choices made in ecosystem management. Compared with upland areas where grouse shooting does not take place, the biodiversity of 'grouse moors' seems to be at least as rich, if not richer.

If people, both the public and governments, value heather moorland landscapes, then they will need to be actively managed to be maintained. The current model of integrated moorland management, that includes as part of the economic and social mix DGS, is a sustainable approach to maintaining such landscapes. It is not clear what other management regimes would deliver the same result.

There are environmental threats to the sustainability of the current integrated moorland management model. Rising temperatures, rainfall and habitat change typical of lower intensity management means the

[335] Calculating the overall economic impacts is, of course, not possible at the present time.

increasing numbers of ticks, and the increasing number of dangerous diseases they transmit could pose a significant problem for humans and other animals that venture onto the moors. In addition, there is always the risk of existing grouse disease control measures becoming ineffective, or new diseases emerging for which treatment is not available. Finally, if environmental changes lead to increased populations of heather beetle, then the sustainability of the heather-clad moorland, and the grouse, will be seriously compromised. Of course, all alternative uses of moorland face future threats.

The biodiversity impacts of integrated moorland management, including DGS are sustainable and should be maintained. Some landowners could do more to improve biodiversity on their land. However, the long-term sustainability of the model is threatened by rising temperatures and disease.

7.3 NATURAL CAPITAL AND ECOSYSTEMS

The natural capital concept and the ecosystem services model are important (especially in a period of climate change), but the data about how differing moorland management regimes impact on climate change, water quality and flood risk, and wildfire mitigation is simply not robust.

It is not possible to say with any assurance that integrated moorland management, including the practices associated with grouse shooting, is more or less sustainable in terms of the ecosystem services (carbon emission and sequestration, water quality, flood mitigation and as noted above biodiversity) it provides than alternative uses of moorland.

New, multi-site, long-term research projects would help assess the impacts on ecosystem services provision resulting from differing moorland management regimes. However, such projects are expensive and slow to deliver. In the interim structured data gathering by moorland managers (citizen science) and adaptive trial management would be invaluable in adding to the evidence base.

Nearly all ‘grouse moors’ have multiple functions. The landscape on which driven DGS takes place is utilized for a range of income-generating activities including livestock production, alternative energy production, and forestry, as well as tourism and leisure. Although some landowners control all these activities themselves, many have to collaborate and coordinate with multiple stakeholders, including graziers and farmers. Moreover, DGS takes place on both owned and leased land. Gathering valid and reliable evidence about the ecological sustainability of ‘grouse moors’ will involve studying DGS as a part of the complex and holistic mix that is integrated moorland management, not as an isolated phenomenon.

Upland landowners are able to deliver public goods, which are the basis for receiving support from the ELM scheme. The challenge they face is to work with scientists to establish and implement practicable and effective systems that measurably deliver ecosystem benefits in a very complex and integrated ecosystem. It is a challenge that needs to be met by all landowner who want to demonstrate that the way in which they use their land is sustainable, and who would like to be rewarded for increasing natural capital.

7.4 SOCIAL IMPACTS

Driven shooting, unlike walked-up shooting, involves a wide range of individuals from a variety of backgrounds, not just guns, but also beaters, pickers up, drivers, flankers, caterers, supporters and others, facilitating contact between individuals from different class backgrounds and maximising the potential for social impacts. Moorland management regimes that facilitate DGS enable people to take part in activities, both as part of DGS and separate to it, that result in positive impacts on their social and work lives and their physical and mental health and well-being. It is possible to calculate the indicative values of some of these activities to individuals, and to groups of people, and these values are often significant. Individuals, communities, and the state benefit from many of the social impacts of DGS. As we note in the introduction to this document, sustainability has three dimensions; economic, environmental, and social. The evidence from the existing literature is that in terms of social impacts, DGS should be seen as sustainable. Alternative uses of moorland will deliver different social impacts, but these have not yet been fully identified. Any decisions about the implementation of these alternative uses must take into account the potential loss, or gain, in social impact.

We believe that our conclusions, detailed above, are supported by the currently available evidence. However, we are conscious of the danger of legislation being driven by public (non-evidence based) perceptions of issues such as animal welfare, muirburn, rewilding etc. It is important that policy makers are presented with evidence, in a form that they find useful. This report will help in the production of this useful evidence.

7.5 ALTERNATIVES

A number of alternative uses have been considered in this report but there is insufficient evidence in the research base at present to assess the full impact of exchanging the current moorland management system for any of the, often suggested, alternatives. Any changes would have economic and ecological impacts. The social impact of stopping DGS would be particularly high, even if all other forms of grouse shooting were to be allowed, as the range of individuals involved in DGS is far wider, involving individual from all social backgrounds, compared to many other forms of shooting.

7.6 OPPONENTS

Opposition to driven grouse shooting can be on ethical grounds by individuals who are against all shooting of live quarry, as is the case for organisations such as the League Against Cruel Sports, Animal Aid and the RSPCA. Other opponents state that they are not opposed to all game shooting but believe that DGS is not sustainable and should be replaced with a less intensive alternative. There is a high level of conflict between those for and against shooting. Conflicts that may appear at first to concern wildlife are in reality often part of a wider debate concerning land use, land ownership and governance of natural resources (Hodgson et al., 2018).

Many studies of both numbers of raptors and factors affecting them, including illegal killing, are at best five years old, sometimes over 10. Given the contention that is associated with raptors and grouse moor we would like to see more ecological and attitudinal information collected more regularly.

The methods used by opponents are varied, organised and sometimes aggressive. Some opponents utilise tools such as social media with expertise. Many people that participant in DGS do not feel confident in their ability to use media, including social media, to dispel mistruths and inaccurate perceptions of their activities (Latham-Green, 2020a; b). The use of selected evidence and misrepresentation of evidence, including in parliamentary debates, along with the failure of policy makers to accept the recommendations of independent review committees in relation to DGS and other shooting regulation, exacerbates the feeling of helplessness and resentment amongst many involved in DGS. Abuse of, and attacks on, gamekeepers and their families are increasing. Gamekeepers are increasingly reporting negative mental health and well-being.

8 RECOMMENDATIONS

The work we have done to produce this report has led us to three important overall conclusions:

- that any decision by policy makers about the sustainability of DGS should be informed by a clear understanding of all the evidence,
- that integrated moorland management regimes practiced by landowners and tenants should be informed by evidence, and changes made where necessary,
- that those opposed to DGS, and those advocating alternative uses for grouse moors, should base their arguments on evidence.

The crucial point about evidence is that it should cover the IUCN's three 'pillars' of sustainability; economic, environmental and social. Considering one or two of these pillars alone is not acceptable, they are an integrated, holistic structure, a three-legged stool. Bad policy, poor management, and illogical opposition will result from ignoring one or more of the legs of the stool, and economic, environmental and social sustainability will be diminished.

Based on this logic, we make the following recommendations:

A. Any decision about an alternative use of moorland currently used for DGS should use the Six-Order Economic model in order to identify the economic impacts and sustainability of these other options. Those that propose alternative uses of the UK's moorlands should demonstrate that the economic impacts of their preferred options deliver outcomes that are at least as valuable as those delivered by integrated moorland management, and that are sustainable.

B. The maintenance of a mosaic of moorland vegetation as a result of grouse moor management delivers a uniquely diverse habitat and biodiversity. Those advocating alternative uses for grouse moors should demonstrate that their chosen option(s) deliver the same or higher levels of biodiversity.

C. Landowners and tenants practicing integrated moorland management should invest more resource into recording the levels of biodiversity on their land and develop and implement plans to enrich it.

D. Landowners and tenants should invest resources to work with scientists to establish and implement practicable and effective systems that measurably, value and enhance the services delivered by their very complex and integrated ecosystems. This challenge needs to be met by any moorland owner that wants to demonstrate that the ways in which they use their land is sustainable, and to be rewarded for increasing natural capital.

E. Those advocating alternative uses for grouse moors should invest resource in identifying and valuing the ecosystems services delivered by their chosen option(s) and demonstrate that they will deliver the same or higher values than integrated moorland management, including DGS.

F. Alternative uses of moorland will deliver different social impacts, but these have not yet been fully identified. Any decisions about the implementation of these alternative uses must take into account the potential loss, or gain, in social impact when compared with the significant social impacts arising from DGS.

G. Those involved in DGS, those with a stake in the way moorlands are used, and those opposed to DGS should engage with each other to develop positive dialogue and mutual understanding.

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