

Sustainable Driven Grouse Shooting?

A Brief Summary Of The Evidence



A review of the evidence of the economic, environmental and social sustainability of driven grouse shooting. A guide for stakeholders and policy makers: Second edition

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Introduction

The first edition of the report *Sustainable Driven Grouse Shooting? A Summary of the Evidence* was published in July 2021. Since then, new research has been published and new political decisions have been taken. Therefore, the Regional Moorland Groups have commissioned Simon Denny to produce a second edition of the report.

Remit And Definition Of Sustainability

The remit of the second edition is the same as for the first, namely: to review the evidence on whether driven grouse shooting is sustainable. The definition of 'sustainable' is based on that produced by the International Union of Conservation of Nature (IUCN). This definition involves the assessment of three factors: economic, environmental and social. Consideration of all three of these factors introduces significant complexity into any discussion or decision

about the sustainability of driven grouse shooting, or alternative uses of moorland.

Target Audiences

Policy makers

- People directly involved in driven grouse shooting
- People with a vested interest in the activity
- Academics in related fields
- Other stakeholders and interest groups

Aim Of The Report

The report's aim is to present the current evidence-based knowledge relating to the three IUCN factors of sustainability (as above) of driven grouse shooting. The report is intended to enable policy makers, those involved in driven grouse shooting, and other stakeholders to consider all aspects of sustainability before making policy or management decisions about driven grouse shooting. It is also hoped that

the report will suggest new topics for research by academics. The aim of the report is not to defend, or otherwise, driven grouse shooting.

About The Author, Simon Denny

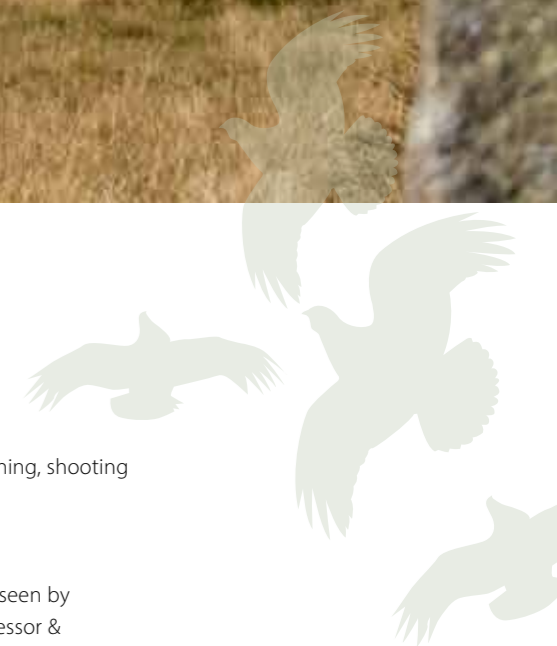
Professor Simon Denny BA, MA, PhD has experience in the military, business and education. In 2010, he was granted The Queen's Award for Enterprise Promotion. Since 2018 he has worked as an independent researcher and consultant, with clients including the Ministry of Defence, the Royal College of Nursing, the Motivational Preparation College for Training, CVQO, and the Uplands Partnership. He is a member of two county Wildlife Trusts, is a keen

birdwatcher, and enjoys gardening, fishing, shooting and watching cricket.

Independent Review

The production of the report was overseen by Professor James Crabbe, Emeritus Professor & Supernumerary Fellow at Wolfson College, Oxford University. He has no links to organisations either for or against driven grouse shooting and has therefore provided independent oversight to the completion of the report's second edition. In addition, the second edition of the report was peer reviewed by academics based in three UK universities.

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A Summary Of The Report And Its Findings

The 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 this report.

Driven grouse shooting is not a stand-alone activity; it exists as part of a complex system of what this report calls 'integrated moorland management', which results in environmental, economic, and social impacts. The critical questions are whether these impacts deliver benefits to society and the environment that are sustainable, and whether alternative uses of the UK's moorlands would deliver greater benefits.

Discussions about the future of driven grouse shooting have centred, almost exclusively, on whether it is environmentally sustainable. There is depressingly little attempt made by researchers to consider the economic or social sustainability of driven grouse shooting compared with alternative management regimes for moorland. Legislation and regulation almost completely ignore economic and social sustainability.

The contribution of this report is that it reviews evidence relevant to all three legs of the IUCN 'sustainability stool': economic, environmental and social.

Economic Sustainability

Few, if any, moorland estates or moor owners depend solely 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.

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 is not practised in isolation and its economic sustainability has to be considered as part of the complex mix that is integrated moorland management.

A 2020 study identified six different types (or 'orders') of economic impacts resulting from moorland managed for driven grouse shootingⁱ. 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 six orders of economic impact resulting from moorland where driven grouse shooting is practised are:

1. Employment and housing, etc, of full-time staff; expenditure of the people shooting grouse; employment of casual and part-time labour.
2. Engagement of contractors, both outdoors and indoors; expenditure with local shops and businesses by estate staff; engagement of professional services, eg. lawyers, accountants, etc.
3. Financial facilitation role of estates in enabling farmers to access agricultural subsidy schemes.
4. Maintenance of a landscape and vegetation attractive to tourists; enhancement of facilities for tourists, eg. hotels, inns and restaurants.
5. Reduction in cost of health risks to humans and farm animals through control of ticks and bracken.
6. Provision of ecosystem services, eg. reduction in wildfires, increase in peat formation, flood reduction, carbon sequestration.ⁱⁱ

These orders of impact become increasingly long-term in their effects and harder to measure as they descend from the first to the sixth.

To date there has been no attempt to define, let alone measure, the economic sustainability of the alternative uses of moorland using a similar holistic economic model. This absence of evidence is a glaring omission in any evidence-based discussion on the optimal ways in which moorland can be managed.

Environmental Sustainability: Biodiversity

Grouse moor management uses various tools to produce a big enough surplus of red grouse to enable shooting, ie. a 'shootable surplus'. The tools used include the legal control of generalist predators (eg. red foxes, stoats, and carrion crows), disease regulation (eg. the application of medicated grit) and vegetation control (eg. prescribed burning of heather). The red grouse is an upland species unique to the British Isles, which means grouse moors are restricted to the British uplands, mainly in England and Scotland.

Most areas where driven grouse shooting 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. Alternative uses proposed for UK moorlands would be very unlikely to maintain the current landscape and biodiversity and would inevitably result in very different effects, which are unknown in many cases.

Shooting estates account for 29% of upland Sites of Special Scientific Interest (SSSI), compared with an expected 16% if grouse moors were randomly

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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 driven grouse shooting. 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.ⁱⁱⁱ

During the 20th 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.

Predator control, the legal killing of feral cats, crows, foxes, stoats and weasels undertaken as part of grouse moor management to minimise predation of red grouse has been shown to benefit other ground-nesting birds^{2,3,4,5} and probably benefits mountain hares^{6,7,8}. The only place in the British Isles where mountain hares thrive at the uniquely high densities associated with the UK is on grouse moors. Predator control will suppress the local population of controlled species. However, the wider biodiversity impacts of predator control on the controlled species are poorly understood⁷.

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

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 (eg. the virus causing tick-borne encephalitis) 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.

Environmental Sustainability: Natural Capital And Ecosystems

The UK has no single formal definition of 'peat', 'deep peat' and 'peatland', with differing interest groups having differing definitions^{iv}.

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)^v. '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 often peat, including deep peat, on moorland, but not all moorland is peatland and some has hardly any or no peat. Heather will grow on mineral soil with just a few centimetres of an organic layer. It is important to note that 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 CO₂ 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^{vi}. Estimates put the amount of carbon stored in peat on grouse moors at between 66 and 205 million tonnes, which is between 11% and 35% of the total carbon stored all English peatlands. English grouse moors would thus emit between 1% and 5% of the net CO₂ emissions from England's peatlands per year. Therefore, English grouse moor CO₂ emissions are proportionally likely to be well below the proportion of carbon that they store, compared with other peatland uses.^{vii}

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, on natural capital and ecosystem services 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, because the problems in nature are mostly problems of the ecosystem rather than of soil, animals or plants^{viii}.



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.

Wildfires are a major source of CO₂ 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 CO₂ as a controlled/prescribed/managed burn of the same size. Wildfires occasionally result from lightning strikes, but the vast majority are due to either accidental^{ix} or deliberate actions, which tend to be in the spring or summer, often at weekends or on Bank Holidays.

The evidence base for controlled burning 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 emissions, flooding, and water quality.^x 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^{9,10}. 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 under-studied or unproven peatland management options, for example mowing or cutting of heather; or no management leading to tree

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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.^{xi} The move towards cutting of heather and associated vegetation as a prescribed alternative to controlled burning is taking place without sufficient scientific study to compare the risk and benefits of each treatment. For peatlands, less is known about the impacts of cutting (some likely to be negative) than the impacts of burning^{9,10}.

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 controlled burning is short-lived and small-scale. Large carbon emissions data cited are largely based on lowland arable peatlands. There is no overall emissions inventory for net greenhouse gas data from managed grouse moors.^{xii}

The claim that rewetted bogs will become fire resilient (a claim often made) seems not to be based on any applicable evidence and ignores the fact that many peatlands might not offer the necessary water balance to achieve the needed

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94% of England's peatland emissions come from lowland peat

English grouse moors emit between **1% & 5%** of the net CO₂ emissions from England's peatlands per year





wetness, especially considering climate change (as indicated by model scenarios)¹¹, topographic impacts and seasonal drought conditions¹². Wetter areas, as observed in forests, might actually increase biomass and fuel production and thus increase fire severity¹³. However, although wetter areas should support more Sphagnum moss, which is likely to enhance resilience to fires, this might equally increase heather growth in all but the wettest areas and the outcome will depend on the site conditions, especially the wetness potential. There are important known unknowns which need to be considered in relation to site-specific vegetation composition, fuel load build-up, limitations for rewetting, and long-term resilience to wildfire of heather-dominated moorlands. In addition, the potential impacts of pyro-convection¹⁴ resulting from moisture-releasing latent heat and leading to enhanced convection need to be much better understood.

When contextualised against wildfire risk, the current published science does not show that controlled burning is detrimental to carbon capture on managed heather peatlands¹⁵. On the contrary, there is a lot of peat-core evidence, modelling studies and newly-emerging science to suggest that biochar produced by controlled burning is an effective – and thus potentially valuable – means of locking up carbon in peatland soils^{16,17,18}. Charcoal has also been linked to reducing the microbial action associated with decay¹⁹, and the release of greenhouse gases like methane from peatland²⁰. These biochar effects may also be more effective at capturing carbon compared with cutting vegetation^{9,10} and compared with unmanaged litter decomposition¹⁶. Notably, recent debates about the role of charcoal in peatland carbon accumulation are not about the quality of the science, but have been based on unfounded accusations about how the science is interpreted, inappropriate use of terminology and misleading model scenarios about drainage^{21,12,22}. Moreover, unmanaged, ageing heather on blanket bogs seems to dry out the peat, stimulating decomposition and is likely to reduce the net carbon uptake, whereas alternative heather cutting seems to increase sedge cover with likely increased methane emissions¹⁰. However, although an increased Sphagnum moss cover might buffer against these effects²³, we lack understanding about where this is possible and how all these findings relate to heather-dominated shallow peat soils.

Social Sustainability

Driven grouse shooting 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 people who shoot^{xiii}, but also others involved in the shoot day including beaters (who encourage the grouse to fly), pickers-up (who collect the shot birds), drivers, flankers (who encourage the grouse to go over those shooting), caterers, supporters, etc. This extensive 'cast list' facilitates contact between individuals from different backgrounds and maximises the potential for social impacts.

Integrated moorland management, including driven grouse shooting, delivers positive impacts on the social and working lives of both active participants in driven grouse shooting, and those who use the moorlands for exercise and cultural activities. The World Health Organisation (WHO) Health Economic Assessment Tool (HEAT) tool^{xiv} can provide an estimate of the societal value of reduced mortality from physical activity of regular walking for a person aged 45 and over. Using this tool, the societal value of acting as a beater on a grouse shoot twice a week can be calculated as up to £1,966^{xv} per year. The societal value for a person aged 44 and under could be up to £211^{xvi} per year. Although 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 that of red grouse, has been found to have a statistically significant impact on participants' mental health and well-being^{xvii} compared with the national average^{24,1}. The overall costs of poor mental health in the UK have been estimated at £105 billion per year²⁵. Maintaining well-being can be valued at approximately £10,560 per person, per year^{xviii 26,27}. This is a key finding that highlights a positive and measurable social impact that should be noted by policy makers and others.

Communities in areas where driven grouse shooting 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. Driven grouse shooting activities are part of the intangible cultural heritage of many people and communities.

The social impacts of driven grouse shooting 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.

The Arguments Of Opponents Of Driven Grouse Shooting And Sustainability

Opposition to driven grouse shooting can be on ethical grounds. Other opponents state that they are not opposed to all sports shooting, but believe that driven grouse shooting is not sustainable and should be replaced with a less intensive alternative. Although 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' governance²⁸. 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 driven grouse shooting or based on opposition to private ownership of large estates.

Opposition to driven grouse shooting can be summarised under eight headings. These headings do not include an ethical opposition to the killing of any animal, a belief that even if not shared must be acknowledged and respected (in the same way that the belief that it is legitimate to kill some animals in

certain circumstances should also be acknowledged and respected). The eight arguments employed against driven grouse shooting are:

1. Driven grouse shooting 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 to driven grouse shooting.
3. Driven grouse shooting involves the illegal killing of birds of prey (raptors).
4. Opposition to predator control.
5. Use of lead shot.
6. Heather burning results in damage to peat, thus releasing carbon.
7. Moorland management for driven grouse shooting involves draining the moors, resulting in an increased risk of flood.
8. Driven grouse shooting involves the killing of mountain hares.





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If the arguments deployed by those opposed to driven grouse shooting are considered against the current research-based evidence, it is concluded that they are not supported. The eight arguments against driven grouse shooting are individually contradicted by the evidence available. Moreover, these arguments collectively fail to consider the definition of sustainability used by the IUCN, and this report. Opponents of driven grouse shooting take little or no account of the economic or social impacts of driven grouse shooting which, as this report has shown, are significantly positive to the mainly remote locations in which driven grouse shooting is practised. It is important that those opposed to driven grouse shooting understand the holistic nature of 'sustainability' before advocating for the practice to be banned.

Interest group bias on both sides of the debate has also influenced the available research base for driven grouse shooting, 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, such as the Grouse Moor Management Review Group (GMMRG)^{29,30,31,32}. Many people involved in shooting believe that its positive impacts are not understood. There is increased conflict between those for and

against driven grouse shooting (and other forms of shooting).

The criminal damage³³ 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 co-operation are common. Multiple stakeholder working is sustainable, provided that people act in accordance with the law.

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 driven grouse shooting do not feel confident to use to dispel mistruths and inaccurate perceptions of their pastime²⁴. 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 driven grouse shooting.

The Sustainability Of Alternatives To Driven Grouse Shooting

Commonly cited alternative uses of moorlands include livestock grazing, commercial forestry, renewable energy, rewilding, tourism, and

conservation. These alternative uses are normally advocated as part of a 'mixture' with other alternative uses. Studies that comprehensively measure and attempt to value the economic, environmental and social impacts of the commonly cited alternative uses of moorland do not seem to exist. In the absence of such studies, there is no evidence that banning driven grouse shooting and moving to an alternative use of the landscape would deliver the range of sustainability benefits that current practices provide. The alternative uses proposed for 'grouse moors' are likely to result in a reduction of positive impacts, with negative implications for the sustainability of communities.

There is a need to recognise that, as the IUCN points out, the three elements of the sustainability stool cannot and should not be viewed in isolation.

The Key Points About Sustainability

Driven grouse shooting 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. An increasing number of landowners are installing energy plants, with hydro-electric plants being seen as the least damaging to the environment. As described in the section on economic impacts within the report, driven grouse shooting drives high-end tourism, and facilitates tourism from non-shooting people throughout the year. Nearly all landowners engage in moorland management practices that are classed

as 'conservation' and others that can be classified, by some at least, as 'rewilding'. Driven grouse shooting is not an 'either/or' activity, it is part of a holistic mix. Those people who advocate the wholesale adoption of alternative uses of moorland are ignoring the current situation, and nearly all of the evidence for sustainability.

Integrated moorland management involves multiple stakeholders and should be outcomes-focused.³⁴ 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.

Conclusions

The second edition of Sustainable Driven Grouse Shooting? A Summary of the Evidence confirms the three important overall conclusions reached by the first edition:

- That any decision by policy makers about the sustainability of driven grouse shooting should be informed by a clear understanding of all the evidence and, importantly, its omissions and limitations;
- That integrated moorland management regimes practised by landowners and tenants should be informed by robust evidence, and changes made where necessary;
- That those opposed to driven grouse shooting, and those advocating alternative uses for grouse moors, should base their arguments on applicable evidence (for which more research is undoubtedly needed).

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.





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Recommendations

The second edition of Sustainable Driven Grouse Shooting? A Summary of the Evidence makes seven recommendations:

- Any decision about banning driven grouse shooting and alternative uses of moorland currently used for driven grouse shooting should use the Six-Order Economic model to identify the economic impacts and sustainability of these other options. Those who 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.
- 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.
- Landowners and tenants practising integrated moorland management should invest more resource into recording the levels of biodiversity on their land and develop and implement plans to enrich it.
- Landowners and tenants should invest resources to work with scientists to establish and, implement and monitor 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 who wants to demonstrate that the way in which they use their land is sustainable, and to be rewarded for increasing natural capital.
- 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 driven grouse shooting.
- 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 driven grouse shooting.
- Those involved in driven grouse shooting, those with a stake in the way moorlands are used, and those opposed to driven grouse shooting should engage with each other to develop positive dialogue and mutual understanding and a shared broad vision for the uplands.^{xxi}

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Notes

- ⁱ The Regional Moorland Groups have taken over the role of commissioning the report from the Uplands Partnership, who commissioned the first edition.
- ⁱⁱ The economic impacts of points 4 and 6 could, in theory, be extended to include research and monitoring of landscape and ecosystem projects that are funded by research organisations. However, given the difficulty of defining the impact of funding academic research, this edition of the report will not consider it.
- ⁱⁱⁱ GWCT, The Moorland Balance <https://www.gwct.org.uk/media/1153026/Moorland-Balance-2-1-.pdf>
- ^{iv} <https://www.iucn.org/>
- ^v <http://publications.naturalengland.org.uk/publication/5419124441481216>
- ^{vi} <https://www.gwct.org.uk/policy/briefings/carbon-storage-on-grouse-moors/>
- ^{vii} <https://www.gwct.org.uk/policy/briefings/carbon-storage-on-grouse-moors/>
- ^{viii} Watt, 1947
- ^{ix} 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>
- ^x 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).
- ^{xi} *ibid*
- ^{xii} *ibid*
- ^{xiii} People who shoot are often referred to as ‘Guns’.
- ^{xiv} World Health Organisation (WHO), 2019
- ^{xv} 2021 figure, converted from 2,270 Eur to GBP at a rate of 0.8666 on 09.04.2021 (Bank of England, 2021)
- ^{xvi} 2021 figure, converted from EUR to GBP at a rate of 0.8666 09.04.2021 (Bank of England, 2021)
- ^{xvii} Measured using the nationally recognised short Warwick-Edinburgh mental well-being score (SWEMWBS)
- ^{xviii} The figure of £10,560 may seem high, but it is a reasonable indicative figure when we consider that The Social Value Bank developed by HACT and Fujiwara shows that being in good health may be worth £20,141 per year, stopping smoking around £4,000 per year and overcoming depression problems even £36,766 per year. Doing regular physical exercise can be valued between £3,500 and £4,200 per year depending on the level of the activity, see <https://www.socialvaluebank.com/how-it-works>
- ^{xix} In 2021 a single moor in the North of England had over 60 legal predator traps destroyed by people opposed to grouse shooting.
- ^{xx} See, for example, <https://publications.naturalengland.org.uk/file/4780137623322624> and <https://www.moorsforthefuture.org.uk/our-resources/file-preview?id=87568>
- ^{xxi} The ‘Why Moorlands Matter’ summit held on 25th to 30th May 2023 on a grouse moor near Lancaster is a good example of this recommendation in action. See, <https://www.countrylife.co.uk/comment-opinion/opinion-continuing-feuds-instead-of-seeking-compromise-is-irresponsible-as-we-argue-british-wildlife-collapses-256920>



Denny S.J. (2023) Sustainable Driven Grouse Shooting? A review of the evidence of the economic, environmental and social sustainability of driven grouse shooting. A guide for stakeholders and policy makers. Available at: www.regionalmoorlandgroups.com

