Cyfoeth Naturiol Cymru
Natural Resources Wales

A review of the use of firearms on land managed by Natural Resources Wales

Paper 2
Synthesis of Evidence

1. Introduction

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

We are carrying out a formal review of our policy of the use of firearms and shooting activity on the land that we own and/or manage. This paper sets out a synthesis of the evidence gathered and assessed as part of that process. It describes the background, methodology and issues arising. Paper 3 describes how this evidence was then applied to the land managed by us providing context, conclusions and recommendations.

2. Background

NRW has several roles and remits where firearms are used in accordance with a variety of existing protocols, standards and guidance including as:

- a land manager - to limit the damage from pests to protect delivery of our land management objectives including the conservation of protected and priority species and habitats and productive capacity. We also consider proposals from third parties for activities on the land that we manage.
- an advisor - there are relevant circumstances involving the use of shooting where we are the provider of Statutory Nature Conservation Advice.
- a regulator - for relevant permit applications the apply to land in other ownership.

With the introduction of new legislation in Wales, we want to be sure that the use of firearms is undertaken for the right reasons, in the right circumstances and in the best way possible.

In addition, a number of interested parties have recently expressed concern over animal welfare issues connected to pheasant shooting on the land that we manage.

We are reviewing the use of firearms to include the consideration, viability and consequences of alternative approaches to firearms use.

Firearms are used for three broad purposes on the land owned and/or managed by NRW and this paper is a synthesis of the evidence as it relates to:

- Our use of firearms for managing wild species which impact on our objectives;
- Other people's use of firearms for managing wild species that impact on our neighbour's land management objectives; and,
- Our leasing of land for game shooting and other pursuits using firearms.

3. Methodology

The review is testing the use of firearms and shooting activity as it may relate to furthering the legal purpose of NRW[1], the Sustainable Management of Natural Resources (SMNR)[2] and contribution towards the Well-Being of Future Generations goals (the Well-Being Goals)[3].

In February 2017, NRW made a public Call for Evidence to inform the review. This was open for three months and 36 submissions were received. These varied from short statements of opinion to papers referencing peer reviewed journal papers. The Call for Evidence set out the criteria for qualifying evidence and explained that popular publications, anecdotal findings, opinions and ideas would not be accepted. Over 220 pieces of qualifying evidence were received. Together with evidence sourced by NRW and from our own records over 250 pieces of evidence were considered.

Members of the project team[4] assessed the submissions against the SMNR principles and the well-being goals as well as the confidence that could be allocated to the individual pieces of evidence based on the level of corroboration to which the evidence has been subjected.

This assessment was used to assess the balance of evidence for the issues that had been raised by NRW in relation to the impact of the use of firearms on the SMNR principles and well-being goals and draft conclusions from the evidence.

An expert panel[5], having reviewed the assessment of evidence and draft conclusions, met to discuss the evidence and develop this synthesis of the evidence upon which NRW will base its proposals for the policy on the use of firearms on land it manages.

Section 4: Key points arising from the evidence

4. Our use of firearms for managing wild species impacting on the achievement of NRW objectives

4.1 Background

Our objectives include conservation of species and habitats of local, regional, national and international importance (such as Sites of Special Scientific interest, Special Areas of Conservation, Areas of Outstanding Natural Beauty, Environment (Wales) Act schedule 7 species) and the management of invasive non-native species. Additionally, we minimise damage by pests that limit the ability of the land we manage to meet Welsh Government policy objectives and maintain its capacity for the people of Wales to derive a range of benefits. This includes the economic potential of quality timber products from our management of the Welsh Government Woodland Estate (WGWE).

Certain species can impact on the objectives of our management of the land. We manage wild deer (both native and non-native species) to reduce the impact they can have on achieving the objectives of Welsh Government's 2009 '*Woodlands for Wales Strategy*'[6]. The strategy seeks to increase woodland cover in Wales with more native broadleaf woodland, an increased diversity of woodlands to improve their resilience (for example to climate change, pests and diseases) and greater regeneration of woodlands both through planting and natural regeneration. Management of wild deer populations is carried out in accordance with Welsh Government's 2011 'Wild deer management in Wales' strategy[7]. Control is carried out by our highly trained staff applying best practice standards to ensure animal welfare.

We manage sites designated for their special nature conservation value and we are required to tackle factors that negatively affect the habitats and species for which the site

is designated. This can include control measures for unchecked native species and non-native species. Where no other method can effectively be employed to minimise these impacts, firearms are used, for example mink control on sites where water vole are present.

4.2 Economic impact

Nine pieces of evidence addressing this issue were considered. The level of confidence in this evidence was regarded as generally high. It included peer reviewed papers, government strategy, independent research reports, internal guidance and PhD theses.

4.2.1 Evidence

Evidence received indicates that certain mammals impact on the successful establishment of trees, both through restocking and natural regeneration and therefore management of the impacts of such species, whether native or non-native is necessary to deliver the purpose of NRW on the land which it manages.

In 2010 the CABI report *The Economic impacts of Invasive Non-Native Species on Great Britain*[8] revealed that the impacts of Invasive Non-Native Species to Wales cost £152,118,000; agricultural damage by non-native deer estimated at £41,339; and, total costs to agriculture of all deer in Wales to be estimated at £203,686. In forestry rabbits are estimated to cost £7,760,000 in Wales, deer £2,626,475 and grey squirrel £914,598.

Welsh Government's Strategy for Wild Deer Management in Wales (2011)[7] identifies the reasons why wild deer management is necessary in Wales:

> '... *although wild deer are not yet as numerous or widespread in Wales as in other parts of the UK, their impacts on agriculture, forestry and vulnerable habitats are becoming more obvious, as are collisions between deer and vehicles on the roads'*.

Deer management promoted under relevant WG policies, such as *Woodlands for Wales* (2009)[6] will have wide ranging benefits. The heritage and landscape values of deer should be recognised, but this needs to be balanced against our requirements for healthy and resilient ecosystems and the rural economy. There needs to be a strong focus on managing the negative impacts caused by deer when they become significant. We also need to take steps to control the spread of non-native deer species. Therefore, deer management will be encouraged where populations are assessed as having a significant impact on the value or cultural benefits of woodlands, agriculture, or on the wider environment and safety of the people of Wales.

4.2.2 Conclusion

The browsing, grazing and bark damage impacts of deer negatively impact the economic viability of forestry and agriculture. Without management, the potential economic benefit to Wales is reduced through lost agricultural output, increased stocking costs and reduced timber value.

4.4 Evidence-based policy for deer management

Twenty-two pieces of evidence addressing this issue were considered. The level of confidence in this evidence was regarded as generally high (16) with some additional, less rigorously demonstrated evidence (5 medium and 1 low confidence pieces). It included peer reviewed papers, government strategy, national standards, organisational reports, internal guidance and data and PhD theses.

4.4.1 Evidence

Sustainable deer management relies on sound scientific evidence, and it is important to continue to develop and challenge the evidence base so that deer management can improve and achieve its objectives. In support of this the Deer Initiative Partnership[9] regularly reviews developments in scientific research and their application to practical welfare-orientated deer management.

The Welsh Government's strategy for Wild deer management in Wales[7] states that deer are herbivores and when at high densities they can have significant negative impacts on forestry and woodland, priority habitats and protected sites. Significant localised impacts on agriculture have also been recorded. Therefore, if deer are not managed appropriately they may affect delivery of the outcomes of the WGs *Woodlands for Wales* (2009) Strategy, undermine our commitments to agriculture and rural development, and compromise our ability to achieve objectives regarding UK and international biodiversity.

Dubois et al (2017)[10] in their list of principles for decision-making in situations where there is human -wildlife conflict include Justification for Control - The need for wildlife control should be justified with evidence that substantial harm is being caused to people, property, livelihoods, ecosystems, and/or other animals.

4.4.2 Conclusion

Evidence to demonstrate the impacts of wild species should be used to determine if action is required and to monitor any management through an appropriate planning mechanism.

4.5 Impacts of deer populations on biodiversity

19 pieces of evidence addressing this issue were considered. The level of confidence in this evidence was regarded as generally high (15) with some additional, less rigorously demonstrated evidence (four medium confidence pieces). It included peer reviewed papers, government strategy, national standards, organisational reports, internal guidance and data and PhD thesis.

4.5.1 Evidence

There is evidence from research that demonstrates that deer populations, if left unmanaged, can have negative impacts on biodiversity through the results of grazing or browsing on habitats.

These adverse deer impacts include changes in seed dispersal, vegetation structure and composition, impacts on understorey and invertebrate and bird assemblages demonstrates the effect that unmanaged deer populations can have on biodiversity[11].

Recent declines in populations of woodland birds in Britain finds grazing and browsing pressure by deer modifies woodland habitat to the detriment of bird populations[12].

On the management of impacts to the ecological condition of woodland Fuller and Gill state that,

> '*Without sufficient control, deer populations can rise to densities where damage to trees and changes in the structure and composition of the understorey vegetation are very likely and widespread impacts are to be expected on flora and fauna.*'[13]

A study by Ward (2005)[14] presents the first quantified estimate of national range expansion for all six species. There is no consolidated means in place for dealing with problems arising from the introduction of non-native species, e.g. Chinese water deer. To limit issues of economic damage to forest crops; animal welfare considerations associated with expanding species' ranges; and road traffic collision risks the study recommends that, *'... deer populations must be effectively managed to maintain this valuable component of our national biodiversity while limiting negative impacts on the economic and natural environment'*.

A PhD thesis by Symmons in 2010[15] cites impacts by deer browsing on woodlands managed for conservation and illustrates the value of small, short term exclosures and landscape level deer and impact evaluation methodology.

NRW's special sites database records necessary actions on designated sites (SSSI, SAC etc.) and identifies 16 designated sites covering 890 hectares that are negatively impacted by deer browsing or grazing.

4.5.2 Conclusion

Impacts of high deer populations in woodlands includes reductions in woodland flora diversity, loss of shrub layers resulting in reduced structural diversity and prevention of recruitment of tree regeneration to canopy layers. The resulting loss in habitat opportunities for insects and birds can further reduce the biodiversity of woodlands. Management of deer impacts is recommended where the impacts are unsustainable.

4.6 Impacts of other species on biodiversity

Six pieces of evidence address this issue with internal monitoring systems identifying the impacts on native biodiversity. The confidence ranged from low to high, with newspaper reports and peer reviewed journal papers and reports included.

4.6.1 Evidence

NRW's Special Sites Database identifies that feral goats are impacting on the features of some designated sites. Management of the level of grazing by these animals is carried out using firearms and on one site, where it is feasible due to this being a semi captive herd, via immuno-contraception. The objective of management is to manage the grazing impact to an acceptable level.

The non-native American Mink can have a detrimental impact on native species through a variety of interactions; predation, competition and as a vector of disease. Ground-nesting birds and small mammals are susceptible to predation. American mink will compete with native mustelids and there is potential for Aleutian disease to be transmitted from feral populations to native species[16].

4.6.2 Conclusion

Special sites, for example Sites of special scientific interest and Special areas of conservation, are designated for specific features which are rare or important a national or international level. Wild species which have a negative impact on those special features require management to maintain the features of the site in good condition[17].

4.7 Predator control for priority species

18 sources of evidence contribute to this issue. Most are peer reviewed journal papers along with internal reports and press articles. The confidence ranged from low to high with more sources at the high level.

4.7.1 Evidence

NRW's Special Sites Database shows that 26 sites totalling almost 9,000 hectares require predator control due to predation of species which are features of the site designations. This management action is supported by various studies into predation of birds.

A recent study of the Berwyn Special Protection Area concluded that,

> '*To restore breeding wader populations within the Berwyn, we recommend that 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*.'[18]

Ground nesting raptors such as hen harrier and merlin are vulnerable to nest predation by foxes[19]. Therefore, it is likely that predator control to increase breeding waders, in the absence of illegal persecution would also be beneficial to these breeding raptors.

Controlling predators is a potentially important management tool for conserving a range of threatened species. Considerable sums of public monies are currently spent on habitat improvement for conservation and some of these public funds should be used to underpin habitat works with predator removal[20].

Reynolds et al (2013)[21] demonstrated that reduction in the populations of non-native American mink allowed the successful reintroduction and persistence of native water vole. This was achieved by monitoring for presence of mink followed by live trapping and euthanizing. The Game and Wildlife Conservation Trust[22] developed the methodology of mink rafts, live trapping and dispatch usually by use of a firearm.

4.7.2 Conclusion

Priority species identified under legislation or local biodiversity plans can be vulnerable to predation by non-native and native predators. Evidence demonstrates that predator control is important where the impacts threaten the favourable condition of populations of priority species.

4.8 Management methods

Sixteen pieces of evidence were considered in assessing the options for management methods. These include peer reviewed papers, legislation, internal guidance and independent reports. The confidence in this evidence was generally high. The unverified independent expert advice was regarded as low but relevant.

4.8.1 Evidence

Culling using firearms is the standard method employed in Great Britain to manage deer populations. The welfare of the animals is governed by various pieces of legislation, notable are the Deer Act 1991 and the Statutory Instrument No 2183[23]. Deer welfare is addressed in best practice guides and deer stalking training.

Aebishcher et al (2014)[24] make recommendations for deer welfare in culling deer, these include a minimum bullet weight of 75 grains and found that stalkers with Deer Stalking Certificate 2 or Advanced deer stalking certificate had higher probability of hitting the target than those with DSC 1 or no qualification.

Dubois et al (2017)[25] set out seven principles as a framework for decision making in situations where there is a wildlife-human conflict with a species. These principles are;

- Modifying Human Practices – where human-wildlife conflicts exist can human practices be changed to avoid the conflict?
- Justification for Control - The need for wildlife control should be justified with evidence that substantial harm is being caused to people, property, livelihoods, ecosystems, and/or other animals.
- Clear and achievable outcome-based objectives - The desired outcome of a wildlife control action should be clear, achievable, monitored, and adapted based on lessons learned.
- Animal welfare - Control methods should predictably and effectively cause the least animal welfare harms to the least number of animals.
- Social acceptability - Decisions to control wildlife should be informed by the range of community values alongside scientific, technical, and practical information.
- Systematic planning - Decisions to control wildlife should be integrated into a program of long-term systematic management.
- Decision making by specifics rather than labels - Decisions to control wildlife should be based on the specifics of the situation, not negative labels applied to the target species.

4.8.2 Fertility control

Contraception of wild mammals at an individual level is possible but the success at a population level, particularly if the only method of population control, is not necessarily achievable. This is due to the effectiveness and costs of delivery of the contraception and population dynamics.

The present studies suggested that a substantial initial effort is generally required to reduce population growth if fertility control is the sole wildlife management method. However, several empirical and field studies have demonstrated that fertility control, particularly of isolated populations, can be successfully used to limit population growth and reduce human–wildlife conflicts[26].

Current fertility control is usually through an injectable single dose vaccine which is labour intensive and costly[27]. A review carried out for the Deer Initiative of contraception for deer management in the UK concluded that:

- Immunocontraception is effective in reducing fertility in deer to a considerable extent, but a reduction in fertility may not reduce population[28].
- Immunocontraception is very effective in deer. Both PZP and GnRH analogues reduce or abolish fertility in female deer with few side effects upon the treated animals.

- Long term infertility may be achieved with a single dose given to female deer. Even if given during pregnancy there is no effect upon the offspring and the treated females are likely to remain barren for up to five years.
- Studies to date appear to show few adverse effects upon social behaviour in gregarious deer species.
- Contraception will probably increase the longevity of vaccinated deer.
- There are species variations that may affect response in the different species of deer present in the UK.
- Because they are long-lived and suffer low predation/mortality rates deer are considered to be poor candidates for contraceptive control of whole populations.
- Where deer numbers are considered to be too high, contraception will not reduce numbers in the absence of other means of removal until older females die naturally, which may take many years.
- It will be necessary to contracept the majority of females in a given population over a period of 5-10 years before a reduction in the population will be achieved and even then, any reductions will only be modest.
- Efficient contraception requires the identification of individual female deer in a given population from year to year.
- Delivery has to be by injection, which may be delivered by hand from a syringe or by dart.
- Current dart systems are not able to deliver at distances at which wild deer can normally be approached in the UK.
- Current dart systems are subject to a significant rate of failure to deliver.
- Immunocontraception by darting or by injection may have a place in *limiting population growth* in enclosed or captive deer herds.
- The possible future developments of 'bio-bullets' may have a place in deer contraception, but no such system is close to production and would still require the long-term identification of individual deer.
- The possible future delivery of contraception by oral bait is unlikely to applicable to deer because of the adverse effects upon males. It is considered to be almost impossible to devise an oral bait delivery system that is specific to deer and specific to female deer.
- For wild deer populations 'Contraception is not a substitute for hunting'[29] .

In summary, theoretical models seem to show that deer are relatively poor candidates for population reduction by means of contraception. Delivery in all trials has been by hand injection or close darting, delivery from greater distance is unreliable and oral bait is not species specific.

Davis and Pech (2002)[24] concluded that immunocontraception is effective in reducing fertility in deer to a considerable extent, but a reduction in fertility may not reduce population, [30].

A vet and advisor to WG provides expert opinion advising against darting wild animals and that immunocontraception of wild animals would not be effective[31].

NRW's Wildlife Management Framework[32] promotes the use of other management techniques as well as firearms to minimise the impacts of wildlife, including measures in strategic, long term forest design and tactical site management.

4.8.4 Forest design /exclosures

Options to minimise impacts of wild species on management objectives can include designing management to protect the species or habitats. This can include fencing out, excluding grazing/browsing animals such as deer or protecting individual trees. Other options are to design management to favour species that are less vulnerable to the impacts, e.g. tree species choice for planting schemes.

Issues related to these options are that fencing can lead to the grazing pressures being redirected to other areas rather than reducing the pressure. Changing the management options is not likely to be appropriate to protect priority species and may not meet the management objectives for species protection, productive capacity or maintenance on native habitats.

4.8.5 Effects of not managing grazing and browsing animals

Studies of rewilding projects such as those in the Netherlands[33] found that woody plants were limited by the presence of unmanaged large herbivores and woodland was converted to grassland. This was a study of farmed, wild and reintroduced species in a contained nature reserve of 5,600ha. The high numbers of herbivores meant that food supply became a limiting factor of all herbivore populations. Weak animals are culled using firearms. In some years, the food supply limitations gave rise to high winter mortality rates and raised animal welfare concerns.

Any contained system on land managed by NRW would likely be considerably smaller and suitable patches not well connected thus limiting the ability for herbivores to move to forage. In an open system, the herbivores would move to seek food once an area's food supply became limited. This has implications for species, including those impacting on an owner's objectives, to move from one landholding to another, damaging crops and therefore livelihood.

4.8.6 Conclusion

Before management actions are implemented a process of evidence based decision making should take place. Consideration of the need for action, consideration of the options for management and formulation of a feasible plan with clear objectives and monitoring.

Consideration of alternatives to lethal control should be considered and combinations of actions may be needed to successfully achieve successful reduction of impacts.

Contraception may be a viable option in some limited circumstances but in unenclosed populations is unlikely to be successful as a single technique and has ongoing commitments. It also has potential issues regarding welfare and use of meat in human food chain.

Management using firearms is currently seen as the most effective method of managing impacts of certain wild species.

4.9 Protecting deer welfare

Three pieces of evidence were considered regarding this issue. Confidence was medium overall.

4.9.1 Evidence

Stakeholders have underlined the need to ensure high standards of welfare for wild deer, in particular the use of trained and competent people in deer management and the application of best practice.

Best Practice Guidance has been developed via the Deer Initiative Partnership[34] to help ensure that informed deer stalkers and managers are able to operate to the best standards of safety, food hygiene and deer welfare.

Deer welfare is threatened by deer–vehicle collisions (DVCs) which can also create a public safety hazard. It is also threatened by illegal activities such as poaching. Where deer populations reach higher densities, there is an increased risk of adverse impacts on deer health.

4.9.2 Conclusion

Welfare of deer can be at risk where there are high deer populations resulting in insufficient food source, increased risk of disease and interaction with humans resulting in deer vehicle collisions or poaching. Management of deer through well trained operatives following best practice minimises these risks.

4.10 Lead ammunition

There is a large amount of evidence available regarding the use of lead ammunition. In relation to its use in managing large mammals fourteen pieces of evidence were regarded as directly relevant. The level of confidence in these was assigned as medium to high; the evidence consists of journal papers, symposium proceedings and internal papers.

4.10.1 Evidence

There is evidence of contamination of meat such as venison from lead ammunition and the Lead Ammunition Group report (2015)[35] states that:

> *'Consumption of venison from deer killed using lead bullets is likely to cause lower levels of ingestion of ammunition-derived lead than the consumption of gamebirds killed with shot, but this will vary according to the cuts and amounts of meat consumed and the rigour with which shot-damaged meat is identified and discarded'.*

NRW 2016 Information Note on Lead[36], states that NRW currently uses lead and non-lead ammunition on the WGWE. Trials using alternatives to lead ammunition have not identified a satisfactory substitute for lead ammunition in the management of large mammals. This is due to the characteristics of alternative materials giving lower levels of bullet expansion leading to an increased likelihood of merely wounding animals and therefore raising concerns of animal welfare. Wounding to other animals in the proximity to the target animal was also an issue if projectiles exit the target animal. Therefore, NRW continues to use lead ammunition but monitors developments in ammunition design.

4.10.2 Conclusion

The effects of lead consumption are well documented. The levels of lead consumption by humans from game meat is dependent upon the type of ammunition used and the skill of the operator handling the carcass in removing damaged meat before it enters the food chain.

Animal welfare concerns from NRW experts with regards to ammunition type in managing large mammals currently determines the use of lead ammunition by NRW operatives. The level of training required by NRW enacting management and handling of carcasses before meat enters human food chain will minimise the level of lead in venison from the NRW estate.

4.11 Achieving the Sustainable Management of Natural Resources

Management of wild species impacting on NRW's objective of delivering SMNR meets the SMNR principles through delivering adaptive management at the appropriate scale. It is best delivered through collaborative management and can deliver multiple benefits. Following the principles recommended by Dubois et al[21], it should be evidence based and have appropriate timescales of implementation. It builds resilience of the ecosystem. The evidence analysis identified 71 pieces of evidence that contribute to assessment of SMNR principles.

Managing the impacts of wild species on the delivery of NRW management objectives is necessary to deliver sustainable management of natural resources. Where species affect the resilience of ecosystems through browsing, grazing or predation of native species management is required to reduce those impacts to a level where the benefits from the resources can be maintained. These may be nature conservation, production of timber, sequestration of carbon or other goods or services. The principals of ethical wildlife control provide a framework for identifying the need for control, planning and delivering management.

The management of these impacts contribute to preventing significant damage to ecosystems, in planning action the spatial scale, benefits and intrinsic value of natural resources and consequences of action are considered. Objective setting takes account of the resilience of ecosystems and available evidence. Implementation requires management the appropriate spatial scale, collaboration with others and should be adaptable to change in response to monitoring.

4.12 Contribution to the Well-being of Future Generations goals

The management of impacts from wild species addresses the resilient Wales well-being goal in maintaining biodiversity and functioning ecosystems to support resilience. Additionally, it contributes to a prosperous Wales where the benefits of healthy ecosystems deliver economic benefits, through delivery of provisioning services. 62 sources contained evidence that contributes to the well-being goals. Evidence related to lead ammunition implied a negative impact on health; this is dependent on ingestion of contaminated meat.

4.13 Summary

Management of species that conflict with a strategic and site based objectives (defined as 'pest' species) is recognised as necessary to achieving the objectives of NRW in land

management for SMNR. Impacts on the resilience of woodlands and the conservation of species across various habitats need to be managed using a variety of methods including lethal control. Dubois et al[25] recommend that the need for lethal control be assessed before implementation and the ongoing need is reviewed.

5. Other people's use of firearms for managing wild species that impact our neighbour's land management objectives

5.1 Background

NRW currently issues permissions for neighbouring land owners or groups representing their interests, to enter NRW managed land to manage. This is primarily the control of foxes to prevent damage to livestock. This is usually carried out using dogs to flush out foxes to waiting guns.

We will only consider issuing licences where a neighbouring landowner is suffering actual losses or is at risk of suffering losses arising from predation by foxes or other wild mammals that are coming from the NRW estate. Before issuing a licence, the prospective licence holder will need to provide documentary evidence from the neighbouring landowner that there is such a risk.

Evidence received recommends that lethal control is used only after other methods to reduce the damage have been attempted/ considered[25].

5.2 Impact on livestock

13 pieces of evidence were considered relevant to this issue. The confidence ranged from low to high including several published papers giving an overall confidence of medium – high.

5.2.1 Evidence

Farmers and representatives of land management groups / membership organisations identify predation of lambs by foxes as an important factor in the livelihoods of Welsh sheep farmers.

Financial analysis, based on relationships between lamb losses, fox density and the costs of fox control, suggests that it is only worthwhile for farmers to carry out additional control actions where regional fox densities are high[37].

One study found that based on perceived estimates of predation, foxes cost sheep producers across Britain approximately £9.4 million in 1999[38]. In 1998 the Ministry of Agriculture, Fisheries and Food estimated that sheep producers in the UK lose up to four million lambs each year, at an annual cost to the industry of £120 million. Deaths due to misadventure and all predators combined accounted for just five percent of these losses; the other losses were due to a variety of management problems[39].

In 2000 the Burns Inquiry found that,

> *'Other means of fox control, in particular shooting, seem capable of killing at least as many foxes as are killed by hunting, except in mid-Wales and some other upland areas. In mid-Wales, methods involving dogs are currently effective in maintaining the population below carrying capacity and cost very little. In the event of a ban (of hunting with dogs), shooting would be the most viable alternative but even this*

would be difficult because of the terrain. Much would depend, in upland areas, on whether it was still permissible to use dogs to flush foxes to guns.'[40]

In addition, the Burns Review stated that,

'In upland areas, where the fox population causes more damage to sheep-rearing and game management interests, and where there is a greater perceived need for control, fewer alternatives are available to the use of dogs, either to flush out to guns or for digging-out'.[41]

In 2013 the Federation of Welsh Farming Packs (FWFP) carried out a poll of 651 sheep farmers in markets throughout Wales[42]. Table 1 shows the responses including that 90% of respondents said that they had experienced financial loss from fox predation since 2005.

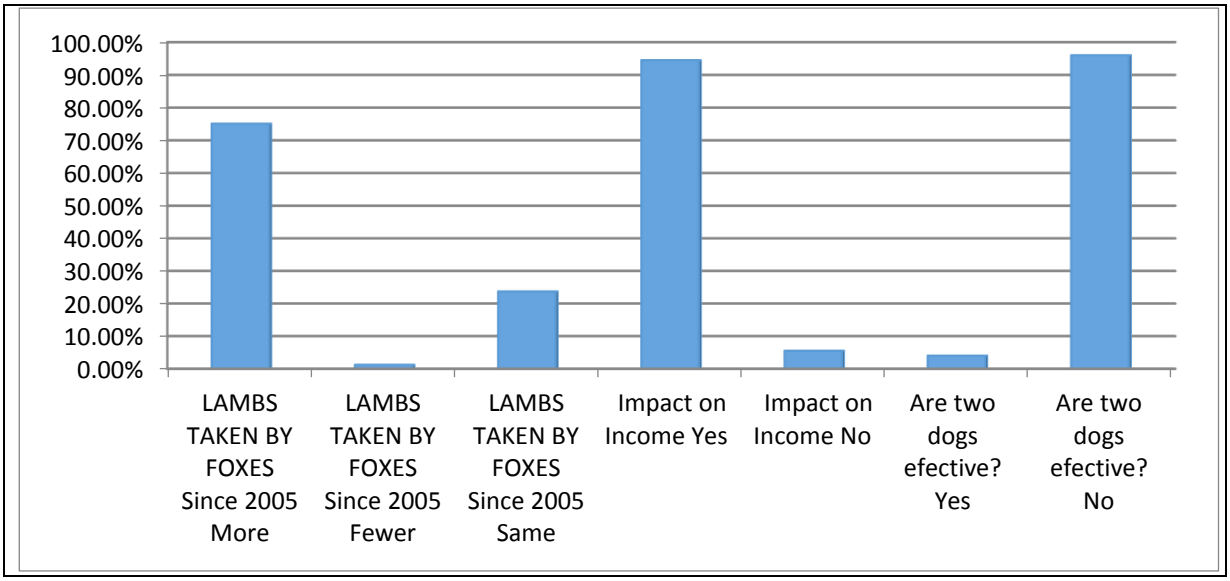

Table 1: Percentage of farmers surveyed who had experienced lamb losses through fox predation between 2005 and 2013, from FWFP submission to review[38] ('sic')

The FWFP survey found that the effectiveness of flushing to guns has been reduced with the implementation of the Hunting Act (2004), causing significant additional losses to livestock farmers and that no farmers want to lose the ability to use dogs to flush to guns on 322,000 acres of afforested land in Wales. They indicate that this would lead to even greater financial losses.[43]

It is stated that current fox control activity keeps predation below 2% of lambs born.

Countryside Alliance cited a local case of a Welsh farmer losing '... *a minimum of 27 lambs to fox predation in just under a three-week period'*.[44]

5.2.2 Conclusion

Studies in the UK suggest that the percentage of lambs lost to predation by foxes is low, less than 3%. Confidence in the available studies is limited by the difficulties in finding a situation where fox management is not undertaken to act as a control site. This is due to fox control being widely carried out. There are areas recognised as suffering higher levels

of fox predation and localised examples of high levels of predation impacting on farming income and therefore on the rural economy.

5.3 Impact on wild birds

Fifteen sources provided of evidence for this issue with a higher number of peer reviewed papers. The overall confidence was regarded as high.

5.3.1 Evidence

In the State of Nature Report (2013)[45] regarding uplands it is stated,

> *'Forestry can affect the hydrology of surrounding habitats and support generalist predators that venture on the moors to hunt.'*[46]

Fox control in forestry may be performed to protect nearby livestock, however reducing fox populations can also have important conservation benefits, both for species in the woodland itself, such as woodcock and snipe, as well as those in adjacent habitats.

Ground-nesting birds can be particularly vulnerable to predation, and many are in decline in Wales as well as across the UK. Where forestry opens on to moorland, a suite of ground-nesting birds such as curlew and golden plover may benefit from reduced predation pressure[47]. On grassland that adjoins woodland, breeding lapwing or snipe may benefit from fox control performed in the neighbouring forestry block.

Predation has been identified as a major cause of reduced breeding success for many ground-nesting birds. A large European study examined nesting success and predation for five species: Eurasian oystercatcher, northern lapwing, black-tailed godwit, Eurasian curlew, and common redshank. This showed that, for all five species, nest predation has increased by approximately 40% in the last four decades, and that reproductive output is currently too low to sustain their populations. For curlew nests observed between 1996 and 2006, 65% were predated, and over 70% failed to fledge a chick[48].

Curlew have recently been identified as the most pressing bird conservation priority in the UK[49], and predation is an important factor for this species[50]. One study in Northern Ireland found 74-86% of nest failures, and 74% of chick mortality, were due to predation. The predators responsible varied between sites, but were predominantly foxes and crows[51].

At appropriate sites, predator control can improve nesting success for breeding curlew and other ground-nesting birds. This is recognised in an RSPB paper, which demonstrates the importance of game-keeping on moorland for curlew[52]. This is supported by Fletcher et al, 2010 who found a three-fold increase in breeding success of lapwing, golden plover, curlew, red grouse and meadow pipit when predator control is carried out[53].

5.3.2 Conclusion

Predation by foxes and other species can limit breeding success of priority species populations, notably ground nesting bird species. Predator control is an effective tool in managing predation of these species.

5.4 Alternatives

Seven pieces of evidence addressed alternatives to the current use of firearms. The level of confidence was high.

5.4.1 Evidence

There are three main alternatives to allowing Hunting Act 2004 ‘exempt hunting’ with dogs to manage fox predation; these are lamping and marksman, snaring followed by dispatch and contraception.

A study by Rochlitz (2010)[54] found that snares do not operate humanely. They can be indiscriminate and trap non-target animals.
A 2012 report[55] to Defra found that some snare designs, when well manufactured and appropriately used, can meet the Agreement on International Humane Trapping Standards. The Welsh Government Code of Best practice on the use of snares in fox control, 2015[56] provides advice on their use, seeking to deliver higher animal welfare standards, increased efficiency in terms of fox control and ensure that fewer non-target species are caught. The use of snares would still require the use of a firearm to dispatch the animals caught and as such are not an alternative to allowing ‘exempt hunting’ with two dogs to flush foxes to guns.
NRW does not currently permit the use of snares on land it manages.

Use of a firearm at night with a spotlight is less effective in areas of dense vegetation, such as forestry[57]. A Forestry Commission Technical publication[58] supports this view advising that the most effective time to us a spotlight being in winter when visibility through vegetation is improved. The method still requires the use of a firearm; therefore, whilst it is an alternative to hunting with dogs it if not an alternative to using firearms.

Contraception has two main delivery mechanisms: a) the use of a dart requiring a firearm and has the risk of not injecting properly, and b) cage trapping and injection which is expensive and may not be effective. The use of contraception is not successful in reducing a population rather it can be used to maintain a population level after other methods have been used to reduce it. Programmes over a long timescale have been shown to reduce the population but in short term impacts remain[59].

While immunocontraception in foxes may be feasible it would require levels of sterility of between 65% and 80%.

A submission to this review by Thomas et al (2017) identifies that, ‘... *the use of firearms for the purposes of pest control represents an important tool for protecting and maintaining ecosystem resilience*.’[60]

5.4.2 Conclusion

Commonly used alternatives to permitting exempt hunting on forest land still require the use of firearms, snares and shooting with the use of a spotlight. Other alternatives such as poisoning are not legal. Contraception of large mammals is difficult and not likely to be effective without long term commitment and resource.

5.5 Achieving the Sustainable Management of Natural Resources

The effects of predators on the sustainable management of natural resources is to reduce the success of vulnerable priority species therefore impacting on the resilience of those species and ecosystems. The economic impacts are disputed with National studies, for instance, finding a low level of impact of foxes on lamb survival yet documented local effects being significant. There is potential therefore for impacts to the rural economy in localities. Mid Wales is recognised as having a higher level of impact from foxes.

The SMNR principles of evidence, scale and adaptive management are important in determining if and how action should be undertaken. The exempt hunting of mammals under the Hunting Act 2004 requires that the activity is undertaken 'for the purpose of preventing or reducing serious damage which the wild mammal would otherwise cause'; this supports the activity as preventative action under the SMNR principles.

5.6 Contribution to the Well-being of Future Generations goals

The evidence provided to this review links the control of wild species impacting on land managers' objectives to the goals of prosperity with loss of agricultural production, resilience of rural economy, cohesive communities and health of those living and working in rural areas. There is evidence that predators impact upon the resilience of ecosystems if they are affecting vulnerable species.

5.7 Summary

Whilst there are conflicting pieces of evidence concerning the impact of foxes on lambs in the UK, there are few examples of evidence where fox control is not carried out so making a direct comparison to a control area is difficult. There is a recognition that in upland Wales there is a potential higher level of impact and examples of localised instances of significant loss.

There is evidence that predation is a factor in the success of upland breeding birds and where this is identified predator control is recommended to improve breeding success of these species.

Currently available management techniques for controlling foxes require the use of firearms as a quick and effective method of dispatch.

6. Our leasing of land for game shooting and other pursuits using firearms

6.1 Background

We consider applications by third parties to carry out activities on the land we manage. Currently NRW leases four areas of forest land (on the Welsh Government Woodland Estate [WGWE]) to third parties for the purpose of game shooting (a total of 440ha of land). All shooting activity must be managed to best practice standards with an agreed management plan including public safety measures. None of the leases inhibit public access or our own interests in managing the land, e.g. timber production. NRW allows lease holders to keep pheasants in pens at agreed locations within their lease areas. Management of birds in pens must follow the WG *Code of Practice for the Rearing of Gamebirds for Sporting Purposes* (2010)[61].

There are additional areas of land, for example foreshores, owned or managed by us where there is an expectation associated with the deeds or lease agreements that we will lease the shooting rights. The leases require a management plan. These areas are within the scope of the review.

Eight sites are let with a total area of 4881 ha. The rights are exercised on all eight sites, however shooting it not permitted on approximately 1120 ha of this area.

There are significant areas of the WGWE which are leasehold where the landlord has retained various rights and this can include shooting rights. We cannot restrict the holders of these rights from exercising them. Therefore, these areas are outside the scope if this review.

There are over 100 areas where the shooting rights are retained. Many of these rights are not exercised currently.

6.2 Farmed birds, rearing, holding pens and release

Seven pieces of evidence where considered. The confidence ranged from medium to high.

6.2.1 Evidence

In 2008 the Farm Animal Welfare Council (FAWC) published its opinion on the welfare of farmed game birds which included the holding of birds in release pens[62]. This highlighted management techniques which are appropriate for the welfare of farmed birds and those which should not be carried out. Matheson et al (2015)[63] studied the behavioural needs of pheasants in caged environments.

The WG Code of Practice[61] (2010) addresses the concerns raised by the FAWC opinion and those highlighted in the later study by Matheson. It includes good practice on, amongst other issues, inspection and husbandry, food and water, housing and penning, disease treatment and preparation for release.

6.2.2 Conclusion

The evidence indicates that the rearing and release in pens of gamebirds can, if not well managed, impact on the welfare of the birds. The WG Code of Practice provides a statement of best practice to address the issue.

6.3 Evidence of risk to biodiversity

Thirty-eight pieces of evidence were considered with a confidence level of high.
There are various studies into the impacts of pheasant release on habitat and specific genera. Studies such as those reviewed by Bicknell et al (2010)[64] consider the impacts, positive and negative, and the benefits of management techniques in promoting those benefits or reducing negative impacts.

6.3.1 Presence of gamebirds

Habitat management, supplemental food and predator control increase numbers of some bird groups and some small mammals. Direct impacts of gamebirds include:

- Gamebirds, mostly pheasants, modify woodland ground flora within release pens, through browsing and soil enrichment.
- Pheasants at high densities can modify hedgerow and hedge bank floral structure, and this may have knock-on effects for hedge nesting birds.
- Pheasants reduce the biomass of overwintering ground-active invertebrates and caterpillars that are important food resources for breeding birds.
- Breeding gamebirds may compete with native birds for invertebrate resources.

6.3.2 Gamebird release and holding pens

Impacts of gamebird release in the UK include where gamebirds on moorland fringe habitat threaten rare and endangered bryophyte communities, and may impact on red grouse and other fragile moorland bird species.

Draycott et al (2008)[65] concluded that the impacts of pheasant releasing on vegetation structure and bird communities in woodlands are benign or positive. This study demonstrates that some aspects of woodland management for pheasants, including reducing the extent of canopy cover can encourage growth of understorey vegetation which helps create favourable conditions for some woodland bird species.

Draycott et al (2012)[66] concluded that the structural characteristics of hedgerows on sites with pheasant releasing do not differ from hedgerows on farms where there is no pheasant releasing undertaken.

Neumann et al (2015) found detrimental impacts on some invertebrate communities in woodland where pheasants were released,

> '*No major differences in invertebrate abundance, or Carabidae or Staphylinidae richness, were found in spring at either the pen scale or the wood scale. However, pheasant release pens resulted in significant changes in the species composition of Carabidae, with shifts towards species typical of arable fields and grassland. Carabid species active in spring and those that are very large (N17.0 mm) declined at pheasant release densities higher than 1000 birds/ha.'*[67]

They suggest that detrimental effects on specialist woodland invertebrates would be minimized if releasing was conducted at the recommended density of 700 birds per hectare or less.

A James Hutton Institute review determined that in the UK high densities of game birds impact the ground flora in release pens stating,

> '*Furthermore, released birds may cause soil enrichment, and may affect hedge structure and species richness, and woodland ground flora, for example by browsing protected species such as bluebells. Changes in hedge structure might impact on birds including yellowhammer which nest in the lower portion of hedgerows, and could subsequently reduce productivity. Furthermore, released pheasants which subsequently breed may act as competition for invertebrate food resources for other breeding birds. This may become more important in the future as game organisations work to increase game bird breeding numbers*[68]*.'*

Robertson et al (1988)[69] found that woodland management for pheasants can benefit many of the declining butterfly species associated with sunny, open woods.

Oliver Rackham (2006)[70] found that pheasant release sites support a higher percentage of annuals and perennials preferring higher soil fertility, while woodland ground flora is adapted to lower soil fertility. This conclusion suggests that the ground flora appropriate to the woodland could be reduced in the presence of released pheasants.

The James Hutton Institute, Aberdeen conclude:

> '*Rear, releases and restocking tend to increase the harvestable population of target game species, but not necessarily the breeding populations. There are exceptions*

when restocking is accompanied by other management actions. On the other hand, releases may have important negative effects, through the loss of genetic diversity and the introduction of diseases and parasites. Yet there is limited information about the extent and significance of these processes in the wild. The main way in which releases are likely to affect non-game species seems to be through potential habitat modification where release densities are high, such as in the lowlands of the UK[71]*.'*

6.3.3 Research gaps from Bicknell et al (2010)

The 2010 review on the '*Impacts of non-native gamebird release in the UK'* identified two recommendations for future research:

a) *'Rear and release of game birds for shooting is wide spread and popular in some areas of continental Europe and particularly in the UK. While there is evidence that associated habitat management may be beneficial to non-target species there is evidence that released birds can have a negative effect on other species and habitats, the biodiversity impacts of rear and release at a landscape level remains poorly understood and represents a priority area for future research.'*[72]

And that,

b) *'While habitat management associated with rear and release of game birds can have clear benefits on non-target species and habitats it is unclear if these habitat improvements are more common in shooting areas than in non-shooting areas. Assessing the range and distribution of habitat management actions such as beetle banks and field headlands between shooting and non-shooting areas would be informative in assessing the wider biodiversity benefit of habitat management for rear and release of game birds.'*[73]

6.3.4 Impacts on predators and predation dynamics

The review undertaken by Bicknell et al (2010) set out three main impacts:

- Predator abundance may be increased by excess prey abundance in the form of gamebirds. Predators such as foxes and corvids may become more ubiquitous, and protected predators, such as raptors may also benefit.
- At the end of the shooting season gamebirds may be reduced to such an extent that predators sustained at elevated numbers due to abundant overwinter prey, may switch to other prey types. This period of low gamebird abundance coincides with the nesting season for most bird species, and over-abundant predators may have detrimental effects on nesting birds.
- Some gamekeepers persecute protected predators such as birds of prey, particularly buzzards and goshawks, which are perceived as threats to gamebirds.[74]

In a study looking at the biodiversity impacts of game bird hunting in Europe and North America, Mustin et al (2011) state of predator control that,

'Direct predator control is a widespread practice in Europe, and prey densities usually respond to such control. Widespread and common intensive predator control appears to be primarily associated with driven shooting of rear and released game birds, and red grouse management in England and Scotland. The efficacy of predator control programmes is likely to vary according to population and ecological variables. To maximise efficiency, predator control has to be carried out in

combination with habitat manipulation, and/or has to be very intensive, culling all potential predators, over large areas, and particularly in years or conditions when the impact of predation is likely to be greatest. This, along with lack of public acceptance, is in part why predator control is not common in North America. The effect of predator control on prey species other than game birds is little studied. Both positive and negative effects may be expected, and the relative importance of both would depend on the type and extent of control exerted. No studies up to now have shown negative effects of predator control on other species, but available information for positive effects is inconclusive. The (illegal) control of predators of conservation importance has important detrimental effects on some species in some areas.' [75]

6.3.5 Code of Good Practice

WG *Code of Practice for the Rearing of Gamebirds for Sporting Purposes* (2010)[61] advises that shoots should avoid releasing more than 1000 birds per hectare of pen and no more than 700 birds per hectare of pen in ancient semi-natural woodland. Additionally, it states that a management plan should be prepared to ensure positive environmental benefit from their activities. Managers should endeavour to deliver an overall measurable improvement to habitat and wildlife on their shoots and avoid releasing birds into sensitive habitats or locations.

6.3.6 Wildfowling

Wildfowling takes place over estuaries and wetlands but does not involve the rearing or release of birds.

As the quarry consists of wild birds there is a necessity to provide good habitat to maintain a population which can withstand birds being taken on a sustainable basis. As a result, wildfowling associations usually help manage the area where the activity takes place, through leases or ownership. The Wildfowling Code of Good Practice[76] recognises the importance of conservation and recommends that management plans are used.

The Joint Working Group for Wildfowling and Conservation on Tidal Land set up by The Crown Estate has as one of its primary purposes,

'... *the monitoring of the operation of these leases to ensure that wildfowling is carried out in a sustainable manner and is compliant with the requirements of the EU Habitats and Birds Directives and any other relevant wildlife conservation legislation in accordance with guidelines from the Government Conservation Agencies'*.[77]

An example of conservation in practice is the voluntary moratorium on shooting Greenland White-Fronted Geese and the involvement of wildfowling practitioners in monitoring the populations.

6.3.7 Conclusion

There are evidenced impacts on biodiversity from the presence of pheasant pens and release with benefits for some groups of species and disadvantages for others. The evidence does not suggest a clear conclusion on the impacts, however it is clear that active woodland management and adherence to the recommendations of less than 700 birds per hectare of pen are necessary to ensure there is not an overall negative impact on biodiversity.

Stocking densities in pens along with planned and regular habitat management actions are key in determining if the presence of pheasants in a woodland have a detrimental, benign or positive effect on the biodiversity of the woodland. Many of the actions used to benefit pheasants in a woodland such as thinning, encouragement of ground and shrub layers, edge management and ride management are those that good woodland management practice[78] recommends for the biodiversity and resilience of any woodland.

Wildfowling requires that the number of birds taken is not at an unsustainable level. Annual reports of numbers and species taken help to monitor this aspect and management plans are recommended to contribute to the sustainability of populations. There are examples of voluntary restrictions to sustain species population.

6.4 Use of lead shot

17 pieces of evidence were considered including significant amount of information in the Lead Ammunition Group report. The level of confidence was regarded as high.

6.4.1 Wildlife, human health and environment

A significant part of the evidence submitted related to the use of lead ammunition. These related mostly to impacts upon wildlife, human health and environment.

The Review by Bicknell et al (2010) state that,

- Birds of prey and other animals suffer lead poisoning following the consumption of gamebirds that are shot but not collected.
- Spent lead shot on game estates is ingested by some birds, leading to poisoning at sufficient concentrations.
- Lead shot in the environment may escalate the food chain from soil invertebrates to small mammals to predators.[79]

Butler (2005)[80] studying lead exposure in ring-necked pheasants found high lead levels in game birds but was not conclusive on the effect to the birds; there was no reduction in body weight.

A review by Fisher et al (2006)[81] on lead poisoning from ammunition sources in terrestrial birds found unnecessary mortality in wildlife from ingesting lead ammunition.

In a risk assessment, specific to upland game birds and raptors, Kendall (1996) stated that,

> '*Although this ecological risk assessment does not clearly define a significant risk of lead shot exposure to upland game birds, this issue merits continued scrutiny to protect our upland game bird and raptor resources.'* [82]

A global update of lead poisoning in terrestrial birds from ammunition sources by Pain et al (2009) found that lead poisoning in birds affects various species although evidence from the UK is limited[83]. The study of lead contamination and associated disease in captive and reintroduced Red Kites, *Milvus milvus* in England by Pain et al (2007) found evidence of lead in Red Kites[84].

6.4.2 Defra Lead Ammunition Group report (2015)

In 2010 the UK Government, Defra and Food Standards Agency set up the Lead Ammunition Group (LAG). Key stakeholders and experts were brought together to identify risks, explore possible solutions to address those risks and to advise the UK Government Departments accordingly. The LAG published its '*Conclusions of risk assessment on risks to human health from consumption of game meat shot with lead ammunition'* as follows:

- The consumption of meat from wild game animals killed using lead ammunition poses risks to some high-level consumers of wild game.
- The risks are very low for the general population who consume wild game infrequently.
- The number of high-level consumers subjected to elevated risk cannot be estimated precisely, but approximate calculations indicate that the number is likely to be tens of thousands in UK.
- Potential adverse effects on the health of high-level consumers include reduced intelligence and cognitive function of children, increased risk of spontaneous abortion in pregnant women and cardiovascular effects and chronic kidney disease in adults.
- It is to be noted that the human health risk assessment is based mainly on calculations using measured levels of contamination with ammunition-derived lead and absolute bioavailability estimates of lead from gamebirds killed using lead shot.
- Consumption of venison from deer killed using lead bullets is likely to cause lower levels of ingestion of ammunition-derived lead than the consumption of gamebirds killed with shot, but this will vary according to the cuts and amounts of meat consumed and the rigour with which shot-damaged meat is identified and discarded.

In addition, the LAG also published its '*Conclusions of risk assessment on risks to human health from livestock exposed to ingestion of ammunition lead'* as follows:

- Continuous or repeated use of the same areas for discharging large quantities of lead ammunition, such as clay pigeon shooting grounds and perhaps some long-established game shoots (and the target areas of rifle ranges) are likely to give rise to levels of lead deposition that may adversely affect the health of livestock grazing or foraging the areas of pellet fallout and the immediate vicinity.
- Whether or not similar levels of lead shot discharge and deposition occur in the context of game shooting will be a function of the intensity and longevity of the shooting activity in a locality.
- Poultry, including chickens, ducks, partridges and pheasants *Phasianus colchicus* appear to be especially at risk from feeding or foraging in such areas.
- Harvesting silage or haylage from such areas may have toxic effects in livestock fed on the conserved forage.
- Although the risk assessment found no evidence of onward transfer of toxic levels of lead to humans from ruminants or pigs under such circumstances, such potential transfer is plausible and the risk is therefore to be assessed as very low but not negligible.
- When poultry, including chickens, pheasants and ducks, forage over land that is repeatedly or continuously used for shooting and where deposition of lead is high, there is primary evidence of transmission from source to the end stages of one of the potential

pathways (eggs) and strong circumstantial evidence for a second pathway (poultry meat).

- The risk to human health from poultry ranging over these areas is therefore considered to be present but low.

The LAG published its 'Conclusions of risk assessments on risks to wildlife from lead ammunition' stating of the risk of '*Wildlife exposure to lead from ammunition*' that '*... there are five possible pathways by which ammunition lead can reach susceptible tissues in animals'* summarised as follows:

- Direct ingestion of spent lead ammunition (mainly shotgun pellets) from the environment. Evidence for many species of wildfowl, and some other water birds and gamebirds in the UK and overseas. A range of other species of wildlife may be exposed by such direct ingestion, although few relevant studies have been undertaken and published in the UK.
- Indirect ingestion by predators/scavengers of spent lead ammunition in the bodies of their prey. Evidence exists for some raptor species in the UK and overseas.
- Movement of spent ammunition lead via plants into their consumers. Evidence that a range of ground-foraging passerines and pigeons (*Columbidae*), as well as other forms of wildlife, including small mammals, reptiles and amphibians in areas of high shot-fall (such as clay pigeon grounds), may be exposed but that there are few studies from the UK.
- Movement of spent ammunition lead by ingestion of soil or soil organisms/invertebrates into their consumers. There is evidence that a range of ground-foraging passerines and pigeons (*Columbidae*), as well as other forms of wildlife, including small mammals, reptiles and amphibians in areas of high shot-fall (such as clay pigeon grounds), may be exposed but that there are few studies from the UK. A possible pathway is identified for Woodcock, *Scolopax rusticola*, which is subject to confirmation in the UK.
- Movement of spent ammunition lead from embedded shot/bullets into body tissues/organs.

The LAG conclude that,

> *'The overall risk impact for the general exposure of wildlife (i.e. all wildlife species in all places) to lead from ammunition falls between "low" and "medium" and the risk rating is therefore to be calculated as "medium" to "high"'.*[85]

And the Group concluded that,

> *'On the basis of the evidence and recognising the distinction between first wildfowl, terrestrial gamebirds, raptors and scavengers, and secondly other wildlife, the likelihood of the risk arising for "other wildlife" is likely to be "very low" except in areas of intensive shooting. For the former group, although the potential exists for some populations, the research has not been undertaken and no impact rating can therefore be calculated.'*[86]

In response to the LAG report Defra concluded that,

> *'In both instances – human health and wildlife – the report did not show that the impacts of lead ammunition were significant enough to justify changing current*

policy; we therefore do not accept your recommendation to ban the use of lead ammunition."[87]

The use of lead ammunition was banned on foreshores, certain SSSIs and for the shooting of all ducks, geese, coot and moorhen in September 2002 with introduction of regulations by the National Assembly for Wales. The Welsh Government position is that they support the current restrictions on the use of lead shot and there are no current plans to extend or alter those restrictions[88].

6.4.3 Conclusion

The evidence indicates that there are risks to wildlife from spent lead shot including the consumption of gamebirds that are shot but not recovered, ingestion of spent shot by birds and escalation through the food chain of lead ingested by soil invertebrates and small mammals. There is a risk to health of those consuming a high level of game shot with lead ammunition and from livestock grazing on areas where high levels of shot are discharged.

This review recognises the risks of continued release of lead into the environment and the conclusion of some authors that there are areas that warrant further research. The UK Government has explored this issue specifically through the Lead Ammunition Group and concluded that the impacts are not sufficient to justify changing policy. Use of lead shot is banned in sensitive habitats and this should continue to be enforced in those circumstances. WG are not planning to extend or alter current restrictions.

6.5 Disease

6.5.1 Evidence

18 evidence sources were considered with a confidence range of medium to high.

Birds in rear and release pheasant management may be a vector of disease to wild birds. Potential diseases and parasites include *Salmonella pullorium*, avian influenza, Newcastle disease, various endoparasites and Lyme disease. Other bird species can carry these diseases and parasites. The increased densities of birds in pens may make them more susceptible to transmission however the scale of risk is not clear from studies.

The Review by Bicknell et al (2010) states that,

'Studies that demonstrate or even imply the transfer of parasites from non-native gamebirds to native wildlife are few, mainly due to the difficulties associated with establishing the direction of infection of a shared parasite. Likewise, the effects on wildlife of hosting various parasites have not been extensively quantified, except where significant outbreaks have occurred, though even in these cases the source of the outbreak is rarely well understood. The most detailed studies show that pheasants appear to act as a reservoir of Heterakis gallinarum which they pass on, directly or indirectly to grey partridges that are not resistant to the parasite. Pheasants are also prolific transmitters of the bacteria responsible for Lyme disease, which infects passerines and humans via a tick vector."[89]

Public Health Wales' [90]information on Lyme disease suggests that the prevalence of Lyme disease in ticks is low and the total number of cases recorded in Welsh residents, although rising in recent years (2009 – 2016), is still low at less than 50 in 2016. Pheasants are not the only host for the ticks which can transmit the bacteria *Borrelia burgdorferi*.

Dr Robert Smith (Clinical Scientist), Public Health Wales, states that,

> *'The main feeding hosts for larval and nymphal ticks are small mammals such as field mice and voles and birds, including blackbirds and pheasants. These hosts may also be reservoirs of B. burgdorferi and the tick feeding patterns ensure the organisms' continuing cycle between generations of reservoir and vector hosts. Humans are incidental hosts for tick feeding. Fortunately, only a minority of ticks carry borreliae (10-20% in Hampshire-Dorset, much lower elsewhere) and borrelial transmission usually occurs late in the feed, between 48 and 72 hrs; it is less likely to occur within the first 24hrs of attachment.'*[91]

	2016	2015	2014	2013	2012	2011	2010	2009
UK acquired	42	20	15	15	9	5	8	6
*Rate/100,000 (UK acquired) **	1.37	0.65	0.48	0.48	0.29	0.16	0.26	0.19
Overseas acquired	4	3	4	3	3	4	1	4
*Total***	46	23	19	18	12	9	9	10

*ONS 2012 population
** Source: Lyme Reference Service (RIPL)

Table 2: Cases of *Lyme borreliosis* in Wales 2009-2016, Public Health Wales[92].

Medications are available to treat reared birds including in release pens and from feeders. This treatment will also benefit wild birds using feeders. The WG Code of Practice (2010)[61] states that preventative medication should not be carried out without veterinary advice. This suggests that clarification is needed on using medication in feed.

The review of impacts of game bird release in the UK by Bicknell et al (2010) concluded that,

'*The source of many parasites are not well understood, and in many cases studies have not comprehensively tested the parasite link between gamebirds and other wildlife, making the evidence presented here largely anecdotal or isolated.'*[93]

And gave three key points that,

- No known studies have investigated population impacts of disease on birds in the UK.
- It vitally important to understand whether red-legged partridges released on the moorland fringe habitat may influence disease and/or parasites of red and black grouse, and the fragile wader species in this habitat.
- A very useful study would test a few sedentary wildlife species for multiple parasites on game estates compared with control estates.

6.5.2 Conclusion

Disease transmission is a risk to both introduced birds and native species, however the evidence is not conclusive. Medication for disease management will reduce the risk as will recommendations for stocking densities.

6.6 Economy

Five pieces of evidence where considered. The level of confidence attributed to them was medium to low.

6.6.1 Evidence

Two reviews dominate the available evidence on economic valuation of shooting / hunting: firstly, a report commissioned by UK Shooting and Countryside organisations delineating the benefits of shooting (PACEC 2014[94]) and secondly a review commissioned by *The League Against Cruel Sports* (Cormack and Rotherham 2014[95]) of the 2014 and earlier 2006 PACEC reports. Neither reports provided analysis nor information pertinent to the sustainable management of natural resources. The PACEC report did not value the provisioning services provided by the game that was shot, and did not attempt to identify comprehensively the relevant use and non-use values involved, preferring to concentrate upon short-term demand and employment considerations. Cormack and Rotherham focussed upon the lack of independent verification and the sources of bias within the two PACEC reports. The narrow short-term focus was not directly challenged, but the authors did highlight displacement and dead weight loss issues to support their contention that the benefits identified were overstated. However, since these benefits are not comparable to the contemporary understanding and assessment of the sustainable management of natural resources it is not possible make a definitive statement.

The 2014 PACEC report states that shooting in Wales supports 2,400 Full Time Equivalents and adds £75M to the Gross Value Added (GVA)[94]. Assessment of this report by Cormack and Rotherham in 2014 states that:

> *'… the general status of the two reports was they were large, impressive, and generally robust but with significant weaknesses or flaws in some areas.'*[96]

Cormack and Rotherham question the size of the contribution of shooting to the UK GVA, suggesting that between £267M and £746.4M is more accurate than the £2billion reported by PACEC.

One shoot manager whose shooting area includes land leased from NRW submitted records of the payments into the local economy in the past 12 months[97]. This includes employing seven full time staff and 23 part-time staff, rent, contractors, supporting businesses such as garages, retail businesses, hotels and insurances services. The total is just under £500,000. Additionally, the submission cited that ten hotels benefit from visiting clients of the shoot. Shooting clients also donated £7,500 to local charities.

One public house owner is quoted as saying that without the income generated by shooting activities his rural business would not survive[98].

The way in which tourists perceive the countryside has an impact on rural tourism[99]. However, it seems that how this perception is affected by different land uses is unknown.

Restriction of access to areas of the countryside as a result of shooting activities may provide a negative perception. Contributors to the call for evidence recognised that there is a current lack of objective evidence for the effect of shooting on tourists' perceptions of the countryside as a whole[100].

6.6.1 Conclusion

The evidence available indicates that there is economic benefit to Wales through shooting activities. The published reports include all shooting activities and it is not possible to relate this to the third-party shooting activity permitted on NRW land. Anecdotal comments again are not attributable to the remit of this review. The records provided relating to the leased areas give an indication of direct influence of the activity on the local economy showing a positive contribution.

6.7 Evidence for cohesive communities and Well-being

Thirteen sources of evidence were considered with a confidence level of low to high

6.7.1 Social activity

Whilst academic research into hunting has grown since the Burns Inquiry in 2000 and the Hunting Act in 2004, this does not seem to have extended to a robust examination into the social benefits of hunting. Potential social benefits can be broadly categorised as social and community capital; mental and physical well-being; learning and skills and economic activity. Indirectly induced benefits to human wellbeing can be derived from landscape, from simply being out of doors and feelings of connectedness in a larger group of people, for example.

Prior to 2004 hunting with hounds had garnered some interest among social geographers and sociologists but our searches have found limited substantial, and substantiated, evidence to draw definitive conclusions regarding the effects, whether positive, negative or neutral, on the social and economic well-being of people and their communities.

Cox et al's (1994)[101] research indicates that within the hunting community a high level of social interaction outside of the hunt itself exists. Results indicate 48% of the hunting community in the research area participated (including organising and clearing up) in social events relating to or benefitting the hunting activity (e.g. fund raising; Hunt Ball). This high percentage of involvement indicates the potentially significant generation of social capital for those individuals involved. Also, recognised by Cox *et al* (1994) is the fact that the hunting community is one of a complex nature with affiliation to 'co-habitants' of that community of interest forming an important aspect of everyday life. This is echoed in statements in the Burns Inquiry Report[102] which can be summarised as indicting that the social activities organised by the hunts form an important feature of the social life of those communities in which hunting is actively pursued.

However, in Milbourne's (2003)[103] research commissioned for the Burns Inquiry, whilst hunting's role was recognised it was not found to be the main source of social activity. This was found, within the research communities, to be the pub and church. This research sought to examine:

> *'… what involvement or contact individuals in different hunt localities have with hunting and its associated social activities; secondly, to explore what impact hunting and these activities have on their lives; and thirdly, to examine attitudes towards hunting and related activities'*.[104]

Hillyard (2007)[105] usefully provides a critique of academic texts that seek to examine the social benefits of hunting, including that of Milbourne (2003) and Cox *et al* (1994). She finds that despite – or because of - utilising traditional social research methodologies, both academic results are limited and indicate further research is required.

The more recent PACEC report (2014:v)[94] provides a survey generated assessment of the social benefits respondents reported as a result of participating in hunting:

> '*In over 97% of cases, shooting participants agree or strongly agree that shooting contributes to their well-being. 93% agree or strongly agree that that shooting sites are healthy and attractive. 87% agree or strongly agree that shooting contributes to the social fabric of the local area, and 81% agree or strongly agree that it contributes to local employment and skills.'*

6.7.2 Well-being

The role of hunting activities and clubs in the social fabric of rural communities was discussed in several submissions to this review. These include shoots that have been in existence for 175 years, involvement of local participants in beating as well as shooting, and involvement in community events. The health benefits to those taking part in shooting related activities as well as the benefits of lean game as a food were discussed.

There appears to be no evidence pertaining to the health and well-being benefits derived from hunting (including diet), whether through the physical activity involved or the social interaction. There was no evidence of a proxy suitable for use.

The 2014 PACEC report[106] further identifies sizeable economic and employment benefits from hunting which contribute to Wales' rural economy and land management skill sets.

There appears to be no more recent data to contradict the 2014 PACEC report and the potential for bias within the survey sample owing to the cohort used should be noted. Additionally, despite acknowledging the difficulty of calculating the economic impact of hunting to the economy, rural or otherwise, Ward (1999) [107] concludes that the arguments used in favour of economic benefit have overstated the case. It follows that this may also be the case for inferences of well-being benefits.

Restrictions caused by shooting activities on access to the Welsh Government Woodland Estate for recreation and education purposes has been cited as being negative and potentially impacting on social benefits of other site users. Other opinion states that management activities by shoots keep paths open and carry out basic stewardship activity such as litter picking and reporting fly tipping which helps keep the woodland appealing for visitors. Both viewpoints are anecdotal and unsubstantiated.

Research into the impacts of shooting on social well-being appears limited, with the 2014 PACEC report providing survey generated assessment of the benefits individuals experience on the social aspects of the activity:

> *'In over 97% of cases, shooting participants agree or strongly agree that shooting contributes to their well-being. 93% agree or strongly agree that that shooting sites are healthy and attractive. 87% agree or strongly agree that shooting contributes to the social fabric of the local area, and 81% agree or strongly agree that it contributes to local employment and skills.'*[108]

6.7.4 The contribution of hunting to social and cultural life

The Burns Inquiry report (2000) identifies hunting as an intricate and complex social activity intrinsically linked to rural life. However, in research commissioned for the Inquiry whilst hunting's role was recognised it was not found to be the main source of social activity:

> *'As is perhaps already clear from this discussion, hunting's contribution to social and cultural life was not the main factor underlining support for hunting. Nevertheless, it is clear that organised hunting plays an important role in the social life of these communities. Nearly a third of respondents had attended at least one social event organised by the hunt in the last 12 months, with the figure reaching just over half in the Devon and Somerset study area. But hunting's importance is less significant - even in the Devon and Somerset study area - than that of the local pub or church. In the West Cumbria, Powys and Leicestershire study areas pub-organised activities had been attended by more than twice as many respondents as those organised by the hunt, the same being true for church events in the first two areas. The importance of pub-organised events was accentuated if one measures frequency of attendance. A third of respondents said they had attended pub-organised events at least once a month, compared with half that number in the case of church and hunt events. More generally, it was clear that there was a wide range of other activities taking place, organised by different groups, and other individual pursuits such as walking, gardening and going out for the evening. It is plain, therefore, that any claim, even in respect of strongly rural areas where support for hunting is high, that hunting is the main source of social activity is exaggerated. In other rural communities, particularly larger villages and market towns, it is likely to be even less significant.'*[109]

> *'The finding that hunt-based social activities were not the main reason why hunting was perceived as important at a community level tended to be borne out in follow-up interviews. Only a fifth of interviewees thought that these activities represented the hub of the local community. Nearly half thought that any community function was confined to particular groups such as farmers and hunt participants. About a third thought that these activities contributed either little or nothing to the local community.'*[110]

Whilst this related to the issue of hunting with dogs it demonstrates the complexity in assessing the contribution of such activities to the cohesiveness and well-being of the communities affected. The evidence available does not provide a definitive view on the role of shooting and social benefits or negative impacts.

6.7.4 Landscape

The role of shooting in shaping the landscape is recognised, albeit in a limited way, in the evidence. In Wales, for example, The Forgotten Landscapes Partnership recognises the relevance of management for shooting in shaping the landscape and providing habitat to support species:

'*The reduction in interest in maintaining the commons in a condition fit for grazing and to support important wildlife is leading to a reduction in the skills base amongst the commoners and other commons users such as the Blorenge Shooting Syndicate. For several hundred years these moors have been used for grouse shooting and managed*

accordingly, but alongside the decline in farming interest grouse moor management has also diminished.'[111]

6.7.5 Conclusion

These few reports demonstrate the complexity in assessing the contribution of such activities to the cohesiveness and well-being of the communities affected. The conflicting views, and the lack of other evidence, do not allow us to draw objective conclusions on the contribution of hunting to building social capital or on social interaction contributing to overall wellbeing.

Hillyard's review (2007)[105] concludes that a lack of research is more of a concern than the quality or bias of research conducted by the pro and anti-hunting lobbies themselves, with researchers responding to the issues raised within the Burns Inquiry rather than defining their own research agenda. Whilst any bias owing to the nature of the research commissioners and /or participants should not be an issue there is little evidence that this potential has been accounted for in the reporting or results of reports.

6.8 Achieving the Sustainable Management of Natural Resources

The activities related to third party shooting, mainly pheasant shoots and wildfowling, have the potential to impact upon the sustainable management of natural resources. Impacts of increased bird numbers in woodlands can affect native species and habitats through competition, predation and enrichment. The management associated with pheasant releasing can have positive effects for biodiversity. Application of SMNR principles can balance impacts through adapting management to reduce negative impacts and encourage positive effects, taking preventative measures to reduce risk of disease and using evidence to inform decisions. Wildfowling necessitates managing adaptively, for example monitoring species numbers and adjusting the number of birds taken in response to this evidence or ceasing to take certain species.
The overall balance of benefits versus negative impacts is not conclusive. Impacts on sensitive or higher value habitats is greater than upon sites with lower value biodiversity.

6.9 Contribution to the Well-being of Future Generations goals

Third party shooting is linked to several of the well-being goals. There are benefits to the prosperity of Wales associated with shooting activities, although the extent of these is disputed. The evidence provided demonstrates positive direct benefits to the local economy in the vicinity of shooting leases. The overall benefit may be reduced due to the negative perception of some visitors; it is however not possible to calculate a tangible figure to this effect. There is a global responsibility to consider the populations of migratory birds when engaging in shooting activities involving wild birds. The agreed moratorium on shooting Greenland White-Fronted Geese demonstrates this responsibility.

As well as the resilience of natural resources there are implications for the resilience of rural economy with shooting seen by some land owners as an additional income and by service providers, such as hotels, as providing business at quieter time of year.
There are potential health affects with positives for those taking part in the activities, the consumption of game as a healthy meat is also a positive, however the ingestion of lead has a negative effect.

Various stakeholders have reported the importance on shooting to rural communities and shooting's role in the culture of Wales.

7. Methodology for testing the evidence

7.1 Testing against our purpose [(1)]

The remit for the review is to assess the use of firearms on land managed by NRW in relation to NRW's purpose. Our purpose is to pursue the sustainable management of natural resources in relation to Wales and apply the principles of sustainable management of natural resources under the Environment Act 2016. This means 'using natural resources in a way and at a rate that promotes the maintenance and enhancement of the resilience of ecosystems and the benefits they provide, meeting the needs of present generations without compromising the ability of future generations to meet their needs and contribute to the achievement of the well-being goals under section 5 of the Well-being of future generations Act 2015 (3).

7.2 Testing against achieving SMNR

Evidence was assessed on its contribution to each of the SMNR principles [2]. The evidence which addresses the sustainable management of natural resources and through supporting management options contributes to applying the SMNR principles was considered relevant to the review. That evidence which did not meet these criteria was considered of less relevance to the review.

The application of the conclusions from the evidence to the estate managed by NRW has been considered to pursue SMNR.

7.3 Testing against contribution to the well-being goals

The seven well-being goals of the Well-being of future generations act 2015 were used to analyse the evidence. Evidence that supports actions contributing to the well-being goals was regarded as relevant, the more goals it was relevant to the more the evidence was considered relevant.

8. Quality Assurance

An external, independent assurance role of the evidence assessment stage of the Review has been procured.

Due to the level of stakeholder interest in this area, and the contentious nature of using firearms, we believe that additional independent assessment and evaluation of this evidence was required to ensure that the conclusions we have drawn, which form our recommendations and consultation proposals, are balanced, fair, and un-biased.

The report accompanies the consultation as paper 4.

9. Summary

Together with evidence sourced by NRW and from our own records over 250 pieces of evidence have been considered in drawing conclusions, making recommendations and a series of proposals for our consultation on the use of firearms by NRW on the land that we manage.

The review is considering how the use of firearms is consistent with NRW's purpose and the principles of the Sustainable Management of Natural Resources (SMNR). Activities will

need to demonstrate a beneficial contribution to the economy, environment, society and culture of Wales.

The review will inform NRW's position on the use of firearms to achieve positive outcomes on the land we manage.

The review encompasses a public call for evidence and full public consultation on our propositions to inform our position. It is consistent with NRW's Stakeholder Strategy the review will work with partners and those with a key interest to develop recommendations.

The review takes an inclusive approach to gathering evidence and full public consultation on our proposed position. Review recommendations will be based on evidence assessed against NRW's purpose and legislation directing our work.

END

Endnotes

[1] To find out more about what we do visit our website at https://naturalresources.wales/about-us/what-we-do/our-roles-and-responsibilities/?lang=en

[2] https://naturalresources.wales/about-us/what-we-do/how-we-work/how-we-work-natural-resources-management/?lang=en

https://naturalresources.wales/media/678317/introducing-smnr-booklet-english.pdf

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[4] The Project team were internal NRW staff independent of the management of firearms use on NRW managed land.
[5] The expert panel consisted of NRW experts including species and habitat experts, land management, economist, statistician and technical advisors.

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https://naturalresources.wales/media/2985/woodlands-for-wales-strategy.pdf (*The negative impacts on woodlands of species such as deer and grey squirrels are addressed*: page17? *Develop strategic and targeted approaches*, to help tackle threats from non-native and invasive species, particularly deer, grey squirrel and rhododendron: page 44?)

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Fuller, R.J. & Gill, R.A. (2001) Ecological impacts of increasing numbers of deer in British woodland. Forestry 74:193-199.

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