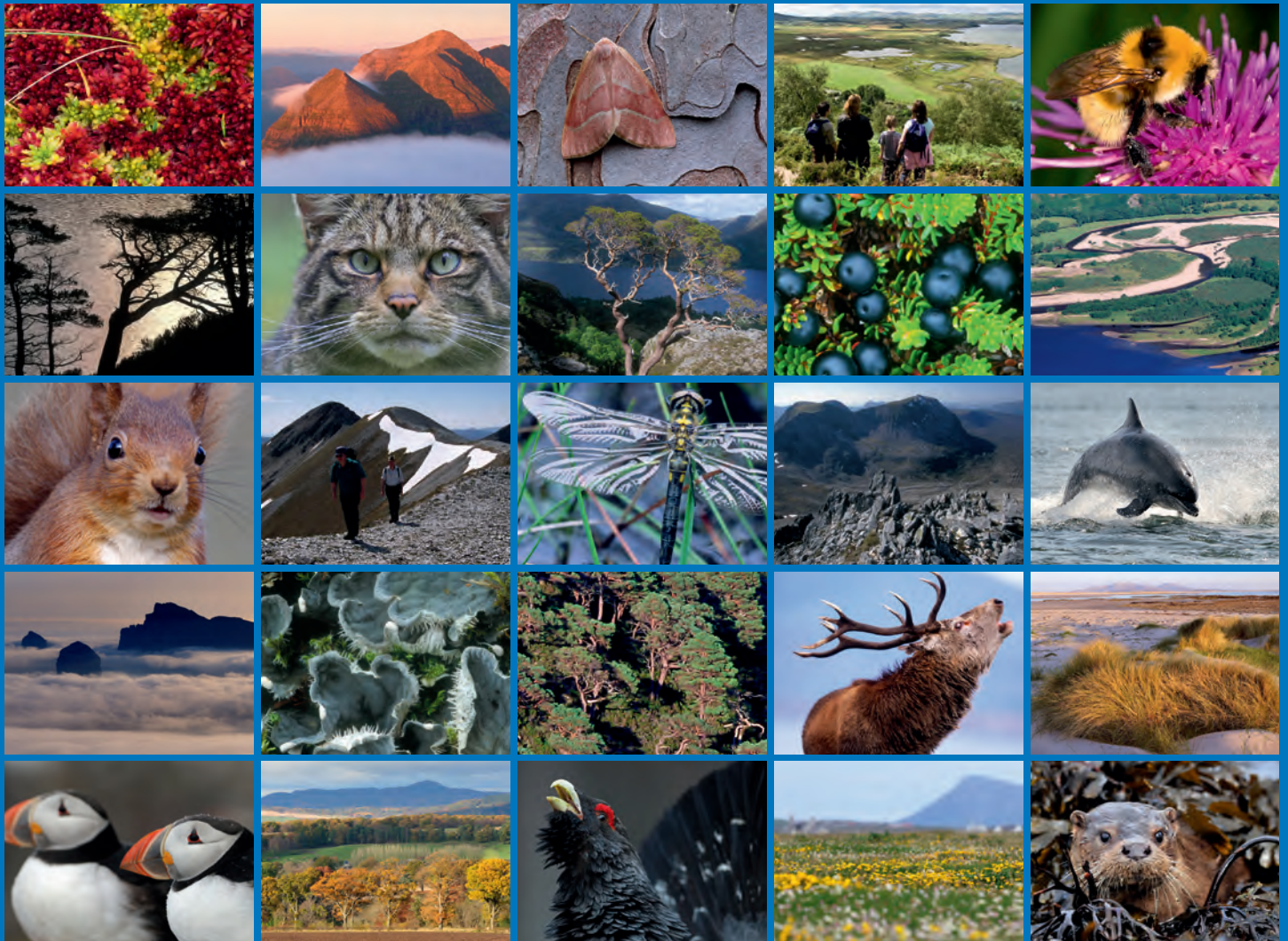


Building an evidence base for managing species conflicts in Scotland





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COMMISSIONED REPORT

Commissioned Report No. 611

Building an evidence base for managing species conflicts in Scotland

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COMMISSIONED REPORT

Summary

Building an evidence base for managing species conflicts in Scotland

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Background

Many wildlife species are perceived to have a negative impact on human livelihoods, for example through direct or indirect impacts on livestock, agricultural crops, forestry, game management and fisheries. These species can lead to conflict when parties with different strongly held views clash over their management and when one party tries to assert their interests at the expense of the other. Thus conflicts can arise because one party may seek to control a species which is protected by legislation and of interest to conservation, or because conservation organisations may seek to increase the abundance of a species that is perceived by others to be damaging. Many of these so-called human-wildlife conflicts are between stakeholders with conservation interests and those with other, primarily economic, interests. The conflicts are often damaging, divisive and intractable with impacts on conservation, livelihoods and relationships between organisations and individuals.

This report examines species conflicts in Scotland. We restrict ourselves to conflicts involving birds and mammals, and focus on terrestrial / freshwater systems, excluding marine issues. We consider those situations that fulfil the definition above and involve opposing groups of stakeholders. We exclude issues such as deer-vehicle collisions or bird- and bat-strike at wind farms that certainly may create wildlife management problems, but do not fall into this definition of conflict.

Main findings

- Conflicts arise when parties with different, strongly held views clash over species management and when one party tries to assert their interests at the expense of the other.
- Species conflicts occur across Scotland and involve a diversity of species and a diversity of sectors and stakeholders. In this report we explored the published material and have spoken with key stakeholders to assess the information, identify mitigation practices and produce guidelines as to what future work needs to be done to help mitigate species conflicts in different regions/habitats.
- We divided species conflicts up into those involving piscivores, raptors and protected mammalian predators, geese, badgers, gulls, deer, tick control and population control. In most cases, the stakeholders perceived that the species at the heart of the conflicts caused serious problems. However, these problems were not always evident from the scientific data, in many cases because appropriate studies had not been conducted. The level of evidence varied across conflicts, suggesting that there is a need to develop cost-effective ways of long-term monitoring of species and their impact.

- Stakeholders' concerns varied between conflicts and depended on their interests. However, there were a number of common threads. Generally there was a lack of trust among stakeholder groups towards SNH. Stakeholders often disagreed about the evidence and ignored or dismissed the science. There was concern amongst stakeholders that local knowledge was too readily dismissed. Indeed, in situations where stakeholders and scientists did come together, agreed evidence took the heat out of conflict. There was recognition that mitigation needs to be tailored to each specific conflict and that dialogue needs to be constructive and well managed.
- A wide range of mitigation tools and techniques are available. Some of these have been tested extensively in the field, whilst others have had limited testing. The level of testing varies from replicated experiments to unreported tests by individual stakeholders. There is a need for cost-effective testing of mitigation involving scientists and stakeholders. Most effective schemes appear to be those which integrate management and stakeholder dialogue, such as in the case of geese and seals.
- The aim of conflict management is to bring those parties involved in a dispute together to seek shared solutions within the legislative framework. Effective management will require building appropriate processes that consider stakeholder positions, an assessment of the evidence, aid negotiation and explore alternative mitigation.
- For any one conflict, management will be aided by developing an evidence base built on long-term monitoring, an understanding of impact and the effectiveness of alternative mitigation techniques in an open, collaborative and transparent way.
- As conflicts are fundamentally about people, conflict management techniques are most likely to succeed if they help build trust, link science and local knowledge, understand variation in attitudes across conflicts, and build partnerships and constructive media relations.

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Table of Contents	Page
1. BACKGROUND	1
1.1 An overview of species conflicts in Scotland	1
2. AIMS	2
3. METHODS	3
4. RESULTS	4
4.1 Species conflicts in Scotland	4
4.1.1 Piscivores	4
4.1.2 Raptors and protected mammalian predators	4
4.1.3 Geese	6
4.1.4 Badgers	7
4.1.5 Gulls	7
4.1.6 Deer	7
4.1.7 Tick control	8
4.1.8 Population control	8
4.2 Stakeholder Views	9
4.1.1 Attitudes towards opposing stakeholders	9
4.1.2 Attitudes towards SNH	9
4.1.3 Attitudes towards evidence	10
4.1.4 Attitudes towards mitigation	10
4.1.5 Attitudes towards legislation	11
4.3 Mitigation measures	11
4.1.1 Physical barriers	12
4.1.2 Scarers and deterrents	12
4.1.3 Diversionary feeding	15
4.1.4 Fertility control	16
4.1.5 Translocation	17
4.1.6 Lethal control	18
4.1.7 Habitat management	19
4.1.8 Zonation	20
4.1.9 Compensation, incentives or other payment schemes	20
4.1.10 Integrated management schemes	20
5. DISCUSSION	22
5.1 Mitigation	22
5.2 Evidence	23
6. APPROACHES TO CONFLICT MANGEMENT	25
7. RECOMMENDATIONS	27
7.1 Priorities for ecological understanding	27
7.2 Human dimensions	27
7.3 Opportunities for SNH	28
7.4 Next steps	28
8. REFERENCES	48
ANNEX 1: CONFLICTS EXCLUDED	65
ANNEX 2: BLOG SITES AND WEB LINKS CONSULTED	66
ANNEX 3: QUESTIONS DISCUSSED WITH STAKEHOLDERS DURING CONSULTATIONS	67
ANNEX 4: STAKEHOLDER CONSULTATIONS	68

1. BACKGROUND

Many wildlife species are perceived to have a negative impact on human livelihoods, for example through direct or indirect impacts on livestock, agricultural crops, forestry, game species and fisheries (Baxter and Galbraith, 2010; Thirgood *et al.*, 2005). These species can lead to conflict when parties with different strongly held views clash over their management and when one party tries to assert their interests at the expense of the other (Redpath *et al.* 2013). Thus for example conflicts can arise because one party may seek to control a species which is protected by legislation and of interest to conservation (Heydon *et al.*, 2010; Woodroffe *et al.*, 2005b), or because conservation organisations may seek to increase the abundance of a species that is perceived by others to be damaging. Many of these so-called human-wildlife conflicts are between stakeholders with conservation interests and those with other, primarily economic, interests associated with their livelihood (Redpath *et al.*, 2013; White and Ward, 2010; Young *et al.*, 2010). The conflicts are often damaging, divisive and intractable with impacts on conservation, livelihoods and relationships between organisations and individuals.

This report examines species conflicts in Scotland. We restrict ourselves to conflicts involving birds and mammals, and focus on terrestrial / freshwater systems, excluding marine issues. We consider those situations that fulfil the definition above and involve opposing groups of stakeholders. We exclude issues such as deer-vehicle collisions or bird- and bat-strike at wind farms that certainly may create wildlife management problems, but do not fall into this definition of conflict (see Annex 1).

1.1 An overview of species conflicts in Scotland

Across Scotland, there are a number of terrestrial wildlife species that bring people into conflict (Table 1). Many of the conflicts in Scotland arise from the impact of protected species on people's livelihood or well-being. Species include many predators and scavengers such as raptors, ravens, seals, piscivorous birds, gulls, badgers and pine martens, or herbivores such as geese and deer. Predators may have an ecological or economic impact on prey numbers (Park *et al.*, 2005), or even an emotional impact on observers (Burnett, 2012; MacPhee, 2012).¹ In a number of cases, the impact of predation may be perceived rather than actual (Butler *et al.*, 2011). It is often the case that the true extent of the impact is unknown due to a lack of quantitative ecological or economic data (Harris *et al.*, 2008) which can be extremely hard to gather without expensive research. In some situations in which the impact is perceived to be damaging, people may breach wildlife protection laws, thus bringing them directly into conflict with statutory agencies and conservation organisations (Etheridge *et al.*, 1997; RSPB, 2011).

Conflicts also occur where stakeholders disagree over the management of wildlife that is not necessarily protected. For example, stakeholders with sporting interests tend to manage deer populations with the aim of maintaining large populations. However, if neighbouring farmers, foresters or conservation agencies are trying to promote natural regeneration of native woodland then these differing objectives are likely to clash, leading to conflict (Austin *et al.*, 2010; Putman *et al.*, 2011; Scott and Palmer, 2000). Similarly, conflicts may arise due to growing public concern, on emotional, ethical, welfare or animal rights grounds, about the use of lethal methods of wildlife management (Animal Aid, 2012a; Barr *et al.*, 2002; Dandy *et al.*, 2011; Massei *et al.*, 2010). Such management may be carried out for legitimate exploitation (e.g. game species), or for other purposes such as population control (e.g. foxes), the removal of species that transmit diseases (e.g. badgers), or the removal of non-native species such as North American grey squirrels, or species outside their native

¹ <http://www.scotster.com/forums/scottish-wildlife/An-Unwelcome-Garden-Visitor.2784.html>

range, such as hedgehogs in the Western Isles of Scotland (Animal Aid, 2012c; Barr *et. al.*, 2002; Warwick *et. al.*, 2006; Webb and Raffaelli, 2008).

One area of potential future conflict arises from the growth of the ecotourism and wildlife watching sectors of Scotland's tourism industry. Scotland offers good opportunities for watching a variety of wildlife,² including birds, marine mammals and deer, with associated local economic benefits (Dickie *et. al.*, 2006; Parsons *et. al.*, 2003; Putman, 2012a). However, wildlife tourism requires visible, predictable and, in some cases, large wildlife populations which may cause conflicts with other sectors. For example, marine mammal tourism promotes the conservation of seals but may cause conflict with salmon interests (Butler *et. al.*, 2008), large deer herds or geese flocks may be impressive to visitors but can have negative impacts on conservation interests or local livelihoods (DCS, 2009; Rayment *et. al.*, 1998), and eagles, ospreys and other raptors may attract visitors (Dickie *et. al.*, 2006) but have perceived or real impacts on agricultural and sporting interests.

2. AIMS

The objectives of this report are to:

- 1) Highlight the diversity of species conflicts in Scotland
- 2) Map out the main stakeholders involved in these conflicts and their specific concerns
- 3) Identify any research being carried out relevant to each conflict
- 4) Identify any current mitigation management practices being carried out relevant to each conflict on an ad hoc basis to discover purpose and collate any existing information on the effectiveness (or lack of) for these techniques
- 5) Build an evidence base that collates and critically assesses the available information relative to each conflict
- 6) Produce general guidelines as to what future work needs to be done to mitigate species conflicts in different regions/habitats

² <http://www.wild-scotland.org.uk/>

3. METHODS

The project was carried out through a combination of desk study (of peer-reviewed and unpublished reports in the 'grey' literature) and discussion with stakeholders. ISI Web of Knowledge, Google Scholar and other internet search engines were used to identify key articles, and relevant papers and reports cited therein. The search terms used were specific to each conflict rather than generic (e.g. 'salmon AND seal' rather than 'wildlife conflict'). Search results were refined using terms such as 'management', 'conflict' or 'mitigation' where there were a large number of hits. Stakeholders were asked whether they knew of additional documentation. An impression of public opinion and stakeholder views was also gained from internet searches of blogs, social media sites and web forums (Annex 2). However, the use of quantitative tools, such as discourse analysis (see Webb and Raffaelli, 2008), to fully capture the diversity of views and analyse the results, was outside the scope of this study.

Stakeholder consultations were primarily carried out with representatives of stakeholder organisations rather than individuals with private interests. However, where specific individuals with relevant experience were identified, these were also contacted. The stakeholder organisations consulted are listed in Table 2, together with their acronyms. Stakeholders were asked what wildlife species caused conflicts to their interests, if they were aware of and had experience of any mitigation measures and if so, how effective they were. They were also asked the nature of any evidence or documentation. See Annex 3 for full list of questions.

We classified the types of evidence identified in this study into groups along a gradient of scientific rigour from scientific evidence based on peer-reviewed, replicated and controlled experiments or observational studies, to empirical evidence based on widely used practices or stakeholders' perceptions, to unconfirmed local knowledge and finally situations where there was no evidence (Table 3). See section 5.2 for further discussion of this issue.

4. RESULTS

In the following sections we address the project objectives, highlighting the species conflicts in Scotland (Objective 1) and current research (Objective 3) relevant to each one in section 4.1. We present the main concerns and attitudes of the stakeholders interviewed (Objective 2) in 4.2 and provide notes of the interviews in Annex 4. The mitigation methods that we have identified being used (Objective 4) are given in 4.3 and Table 5. We also collate evidence of their effectiveness on a conflict by conflict basis in Table 6 (Objective 5).

4.1 Species conflicts in Scotland

4.1.1 *Piscivores*

Seals and other piscivores such as cormorants and saw-billed ducks, and to a lesser extent, otters, shags and herons, are often at the centre of conflict when they feed on economically important fish, particularly salmonids, living wild in rivers or stocked in put-and-take fisheries and fish farms (e.g. Butler *et al.*, 2008; Carss, 1993; Harris *et al.*, 2008; Marquiss *et al.*, 1998; Park *et al.*, 2005; Quick *et al.*, 2004). Scientific evidence of an impact of predation by piscivorous birds on fisheries is scarce, in part due to difficulties in estimating the proportion of a fish population being removed by predation and the complex relationship between stock size and angling catch (Harris *et al.*, 2008). Some of the best scientific data come from the Loch Leven trout fishery (Carss and Marquiss, 1992, 1994; Stewart *et al.*, 2005; Winfield *et al.*, 2011; Wright, 2003), but even there, it has been shown both that cormorants had no effect on brown trout abundance or fishery performance (Wright, 2002, 2003) and, in contrast, that there was a high potential for competition between cormorants and the fishery (Stewart *et al.*, 2005). Despite cormorants removing almost 16 times the fishery catch of brown trout (Stewart *et al.* 2005), the impact of predation was unclear due to uncertainty in estimates of the fish population size (Winfield *et al.*, 2011).

There is some evidence that where saw-billed ducks feed heavily on salmon smolts they may have population-level impacts on salmon fisheries, particularly in rivers in the north of Scotland (Interview [23]; Harris *et al.*, 2008; Marquiss *et al.*, 1998). However, no attempt has been made to quantify the impact which is likely to vary between sites and be complicated by the high mobility of saw-billed ducks. A monitoring process to establish the population size of saw-billed ducks and model the number of birds that could be sustainably culled has begun in the Moray Firth (Interview [18]). An economic impact of predation can also occur indirectly, without a population-level predation effect, if fishing permit sales are reduced due to a perceived predation problem (Carss, 2003).

The perceived impact of predation is greater than the actual impact in the case of seal conflicts, in which anglers and netmen believe that seals have a significant impact on salmon stocks and catches (Butler *et al.*, 2011). Scientific evidence suggests that the major causal agent of observed declines in salmonid abundance is a decrease in marine survival rather than seal predation (Middlemas *et al.*, 2003). However, marine mammals could have substantial local effects where salmon numbers are low (Butler *et al.*, 2006; Middlemas *et al.*, 2003). The seal – salmon conflict has wider implications as seal control for salmon management has, in the past, had a negative impact on the conservation status of harbour seals (Thompson *et al.*, 2007), and could potentially impact on marine wildlife tourism (Butler *et al.*, 2008). There is on-going research by SMRU in developing and testing acoustic seal deterrent devices and investigating the behavioural responses of seals to electric fields in seawater.

4.1.2 *Raptors and protected mammalian predators*

Raptors and mammalian predators such as pine marten and badgers generate concern amongst the game bird shooting sector, the livestock industry especially sheep farmers, and

pigeon racers. In the first case, conflicts arise as a result of predation of adult and young birds, reduced breeding success, predation at pheasant release pens and disturbance to shoot days (Harradine *et al.*, 1997; JNCC, 2000; Kenward *et al.*, 2001; Park *et al.*, 2005; Park *et al.*, 2008; Thirgood *et al.*, 2000). However, as with piscivores (above), there are difficulties in determining the impact of predation on prey populations without detailed research, due to the challenges in getting good estimates of levels of predation, and in distinguishing between compensatory mortality, where prey killed by predators would have died anyway from other causes, and additive mortality, where predation is additional to other sources of death.

Park *et al.* (2005; 2008) and Valkama *et al.* (2005) reviewed the impacts of birds of prey on game birds and concluded that under certain conditions, raptor predation may limit game bird populations and reduce game bags. The most detailed studies have been done on the impact of birds of prey on red grouse populations in Scotland (The Joint Raptor Study at Langholm). Here, research strongly suggested that, under certain circumstances, predation by hen harriers and peregrines could limit grouse populations at low density and make driven grouse shooting economically unviable (Redpath and Thirgood, 1997). At the same time, illegal killing has had a major effect on raptors breeding on grouse moors (Amar *et al.*, 2012; Etheridge *et al.*, 1997; Redpath *et al.*, 2010 ; Watson and Whitfield, 2002). In England, the harrier has virtually disappeared as a breeding bird, with only 1 known pair breeding in 2012.³ The intensity of this conflict has not diminished in recent decades.

Current research on these issues includes stakeholder-funded population modelling of hen harriers, being carried out by University of Aberdeen, to investigate a quota scheme. The Langholm Moor Demonstration Project⁴ in the Scottish Borders is involved in a 10 year programme of activity to explore the effectiveness of diversionary feeding to allow hen harriers and red grouse to coexist. GWCT and Newcastle University have a PhD student studying buzzard predation on red grouse at Langholm. In addition, Scottish Raptor Study Group and conservation organisations continue to monitor raptor populations across Scotland and estimate the impact of illegal activity.

In a survey of gamekeepers, Harradine *et al.* (1997) found raptors caused the greatest concerns in lowland areas. They, and Kenward *et al.* (2001) in a study in the south of England, found that although in general raptors, particularly buzzards, accounted for a relatively low proportion of overall mortality among released pheasants, mortality could be high at some sites. Concerns over buzzards at release pens are still present, as witnessed by recent calls for licences to control buzzards (Lees *et al.*, 2013). Reviewing the effects of predation by birds of prey on captive-bred game birds, Park *et al.* (2005; 2008) concluded that raptor predation generally accounted for a small proportion of the total mortality and that the overall impact on subsequent shooting bags was unknown (Park *et al.*, 2008). BASC have a small research project planned for summer 2013 to investigate the effectiveness of raptor deterrents at pheasant release pens across a range of site conditions and pen sizes.

Raptors, notably golden and white-tailed eagles, and other predatory birds such as ravens, impact on agricultural livestock, particularly at lambing time, but can also affect free-range poultry (Campbell and Hartley, 2004; Marquiss *et al.*, 2003b; Ratcliffe, 1997 ; Simms *et al.*, 2010; Whitfield, 2000). Golden eagle predation of lambs is thought to occur because of a lack of natural prey (Whitfield, 2000). The majority of lambs taken by white-tailed eagles are individuals that have a high probability of dying of other causes (Marquiss *et al.*, 2001; Marquiss *et al.*, 2003b). This has been shown on Mull where white-tailed eagle predation represents a small proportion of overall lamb mortality (Marquiss *et al.*, 2003a; Marquiss *et al.*

³ <http://www.rspb.org.uk/community/ourwork/b/martinharper/archive/2012/05/15/hen-harriers-on-the-brink-it-s-time-for-action.aspx?PageIndex=2#comments>

⁴ <http://www.langholmproject.com>

al., 2003b). A pilot study in the Gairloch area also found little evidence of white-tailed eagles taking live lambs (Simms *et. al.*, 2010). Nonetheless in both cases, local impacts on some individual crofts were significant (Marquiss *et. al.*, 2003a; Simms *et. al.*, 2010). The re-introduction of white-tailed eagles has heightened the conflict with farmers and crofters, because an active decision was taken to impose this species on an unwilling and already vulnerable sector (Interview [22]). Furthermore, some farmers are concerned for the survival of their hefted flocks (Interview [16]).

Finally raptors, specifically sparrowhawks, peregrines and to a lesser extent goshawks, cause conflicts with pigeon racers due to predation of pigeons during training and races, and around lofts (Dixon *et. al.*, 2003; Henderson *et. al.*, 2004; JNCC, 2000; Shawyer *et. al.*, 2003). On average around half the pigeons are lost from each loft over the racing year (Henderson *et. al.*, 2004; Shawyer *et. al.*, 2003), but it has been estimated that <1% of all substantiated, probable and possible losses could be attributed to sparrowhawks in one Scottish study (Henderson *et. al.*, 2004) and 4.3% in another (Shawyer *et. al.*, 2003). Losses to peregrines tended to be higher, reported as 17% in Scotland (Shawyer *et. al.*, 2003).

Not all conflicts over predators are between conservation and other interests. Predation of protected species by other protected species causes a dilemma for conservation managers who may opt to prioritise the protection of one species over another depending on their relative level of protection. This has come to the forefront in the management of capercaillie (protected at the European level) which has been showing population declines since 1970s, associated with climate change (Moss *et. al.*, 2001). Simultaneously, pine marten (protected at the national level) populations have been recovering due to the relaxation of persecution (Baines *et. al.*, 2011b; Matthews, 2012; Summers *et. al.*, 2004). Pine martens are among the predators responsible for nest predation of capercaillie at Abernethy Forest Reserve (Summers *et. al.*, 2004; Summers *et. al.*, 2009). However they co-exist with capercaillie throughout their range in northern Europe (Matthews, 2012) and predation by pine martens is not the primary cause of the Scottish capercaillie population decline. Any negative relationship between pine marten abundance and capercaillie breeding success appears to be dependent on weather conditions (Baines *et. al.*, 2011a; Baines *et. al.*, 2011b). It is also not clear whether this relationship applies to other forests and there is a lack of evidence demonstrating a negative effect of pine martens on capercaillie at the population level.

PhD research into the ecology and conservation management of pine martens in fragmented landscapes is currently being carried out, funded by Forestry Commission, RSPB and University of Stirling. The Vincent Wildlife Trust is investigating the abundance and distribution of pine martens in the expansion zone in England and Wales.

4.1.3 Geese

Large, and very localised, seasonal aggregations of geese impact on agricultural areas during late winter (Cope *et. al.*, 2005). The issues vary between locations in Scotland depending on the species present, their population statuses, whether or not they are legal quarry species and whether they are migratory or resident. As a result of goose management policy, geese population sizes have increased by c. 17 % since 2000 (Crabtree *et. al.*, 2010). Although farmers, through various management schemes, have been working to support geese, they cannot continue to sustain greater and greater numbers indefinitely (Interview [20]). Farms in such areas are increasingly under threat of abandonment which would have a detrimental impact on geese and other aspects of biodiversity, as well as on the local social and economic situation (Young *et. al.*, 2010). There is considerable interest in current research into population modelling of geese to allow adaptive management of some populations such as greylag geese on Orkney. This could provide a strong scientific basis for agreeing a ceiling population size, beyond which numbers could be controlled.

4.1.4 Badgers

Badgers can impact on agriculture, forestry and property owners. The primary problem is due to excavations and consequent damage to agricultural crops and grazing lands (Moore *et. al.*, 1999) and, increasingly, to property in urban and residential areas (Davison *et. al.*, 2008; Delahay *et. al.*, 2009). Although predation, particularly of lambs, can be considered a problem, and was voiced as such by several stakeholders (Interviews [1,11, 22]), evidence tends to be circumstantial and scavenging may account for many observations (Moore *et. al.*, 1999). Scavenging of rubbish bins may also cause problems in residential areas although this is relatively easy to solve (Heydon *et. al.*, 2010). Badgers are the cause of a major conflict with the cattle industry in England and Wales due to their role as a reservoir of bovine tuberculosis (Gallagher and Clifton-Hadley, 2000). However, bTB is not endemic in badgers in Scotland, and Scotland has been granted 'Officially TB-Free' status by the EU (Kao, 2011). The badger - bTB conflict is therefore not currently an issue in Scotland.

4.1.5 Gulls

Gulls are becoming locally abundant in urban or residential areas causing a public nuisance (Belant, 1997; Calladine *et. al.*, 2006; Coulson and Coulson, 2009). They are perceived as a risk to public health, feeding on sewage outfall and landfill sites, and contaminating beaches (Baxter and Robinson, 2007; Butterfield *et. al.*, 1983; Ferns and Mudge, 2000; Girdwood *et. al.*, 1985; Moon, 2011; Smith *et. al.*, 1993; Whelan *et. al.*, 1988). Other issues include noise and debris associated with nesting on roof tops, scavenging from rubbish bins and bags and the associated mess, and aggression towards and intimidation of the public (Calladine *et. al.*, 2006; McCarthy, 2010; Rock, 2005). Noise and aggression are issues particularly associated with the chick-rearing period (Calladine *et. al.*, 2006; Rock, 2005). From a conservation perspective, gull populations are declining at the national level, especially in the case of the Herring gull which is now red listed,⁵ and therefore urban populations are becoming increasingly important.⁶ The high population growth rate of urban gulls means the conflict is likely to increase in the future (McCarthy, 2010; Rock, 2005). Given the scale of the problem, there is a remarkable lack of knowledge of the ecology of urban gulls (Calladine *et. al.*, 2006; but see Coulson and Coulson, 2009; Moon, 2011).

4.1.6 Deer

Impacts of deer on agriculture, forestry and vulnerable natural habitats are having increasing economic and environmental costs due to high population densities (Dolman *et. al.*, 2010; MacMillan and Leitch, 2008; Putman *et. al.*, 2011). On the other hand, red deer have important social, cultural and economic benefits associated with the stalking and tourism industries (Putman, 2012a), which may entail maintaining some high density or highly visible populations (Fraser *et. al.*, 2012). In addition, deer are a species attracting attention from members of the public opposed to hunting or lethal control (see section 4.1.8 below).

Localised seasonal aggregations of deer can cause conflicts with, for example, tenant farmers because they take the spring bite from grasslands used by grazing livestock (Putman *et. al.*, 2011; Scott and Palmer, 2000). Attempts to regenerate native woodland without fencing are a major cause of conflict between traditional and conservation deer managers (Interview [11]; John Muir Trust, 2012; Scottish Gamekeepers Association, 2011; Windmill *et. al.*, 2011). Some conservation stakeholders are against fencing due to its impacts on factors such as landscape, wildlife movement or connectivity and access to shelter (John Muir Trust, 2011). Furthermore, deer fences have been implicated in the decline of capercaillie and black grouse due to the number of bird strikes along fence lines (Moss *et. al.*, 2001). However, the heavy culling required for woodland regeneration without

⁵ <http://jncc.defra.gov.uk/page-2887>

⁶ <http://www.rspb.org.uk/advice/gardening/unwantedvisitors/gulls/urbangulls.aspx>

fencing may create a vacuum, drawing deer away from neighbouring sporting estates (Irvine, 2011; Putman, 2012b). There is a surprising lack of scientific research concerning red deer in the context of mainland, exploited populations, particularly in terms of spatial behaviour. Much reliance is placed on modelling, and extrapolation of research from Rum.

4.1.7 Tick control

Mountain hares and deer are increasingly involved in conflicts between grouse moor managers and conservationists due to their role in the complex epidemiology of the tick-borne disease, louping-ill (Gilbert *et al.*, 2012; Harrison *et al.*, 2010; Laurenson *et al.*, 2003). Large-scale culling of mountain hares is being carried out in an attempt to control ticks and louping-ill despite a potential conservation conflict (Harrison *et al.*, 2010; Newey *et al.*, 2008). Mountain hares are listed on Schedule V of the European Habitats Directive (1992). As such, the government has an obligation to ensure their favourable conservation status. However, there is currently no reliable method of assessing mountain hare numbers (Newey *et al.*, 2011) and insufficient data to be able to detect any changes in spatial distribution (Kinrade *et al.*, 2008). It is therefore not clear whether current levels of exploitation are sustainable and whether or not population size is stable (Newey *et al.*, 2008). The population response of mountain hares to culling is not well understood (Harrison *et al.*, 2010) and there are knowledge gaps in terms of mountain hare spatial and population ecology (Newey *et al.*, 2008). Meanwhile, a research project is being conducted by GWCT in the Angus Glens⁷ to investigate the effectiveness of using sheep 'tick mops' and removing deer and mountain hare tick hosts to reduce tick densities and louping-ill prevalence in grouse. A report is due in 2013. It should be noted that modelling suggests that very low deer densities and efficacy levels of acaricide of > 90% must be maintained for effective tick control using sheep 'tick mops' (Porter *et al.*, 2011). This requires more frequent gathering and dipping of sheep with acaricide than in livestock production systems, and is thus incompatible with sheep production. Tick-mops are labour-intensive and require shepherding rather than traditional grouse management skills.

4.1.8 Population control

Killing of wildlife occurs as legitimate exploitation of wild game species (i.e. shooting and hunting), and for other wildlife population management purposes such as vermin control or the removal of non-native species (Heydon *et al.*, 2010). Due to changing attitudes, there is increasing pressure from mainstream society for wildlife managers to find humane, non-lethal methods of population control, particularly as wildlife such as deer and badgers expands into urban and residential areas (Dandy *et al.*, 2011; Dandy *et al.*, 2012; Delahay *et al.*, 2009; Massei *et al.*, 2010). Population control is particularly controversial where well-loved species occur outside their native range. Examples are public opposition to the control of non-native North American grey squirrels where they threaten native red squirrel populations (Animal Aid, 2012b) and hedgehogs in the Western Isles (Warwick *et al.*, 2006; Webb and Raffaelli, 2008). Hedgehogs were believed to have a negative impact on internationally important populations of wading birds (Jackson, 2001, 2006) although more recent surveys suggest other unknown factors are also involved (Fuller *et al.*, 2010). Despite the fact that the stalking and shooting industry is an important employer in rural parts of Scotland, opposition to their killing game species by some sectors of society, particularly animal rights campaigners, centres on the perceived cruelty of so-called 'blood-sports'⁸ and the recreational aspect of shooting for 'sport'.

⁷ http://www.gwct.org.uk/about_us/news/3471.asp

⁸ <http://www.league.org.uk/content/514/What-we-do>

4.2 Stakeholder Views

Wildlife conflicts in Scotland tend to be between parties with conservation or welfare interests and those with other, primarily economic, interests associated with their livelihood (Table 2). Many of the stakeholders are involved in a number of wildlife conflicts. We have carried out 25 stakeholder consultations with individuals from government agencies, conservation bodies and charities, fisheries bodies and land management organisations (Table 4; Annex 3). Stakeholders' specific concerns varied between conflicts and depended on their interests. However, there were a number of common threads which we have grouped as 1) attitudes towards opposing stakeholders, 2) attitudes towards SNH, 3) attitudes towards evidence, 4) attitudes towards mitigation methods and 5) attitudes towards legislation.

4.2.1 Attitudes towards opposing stakeholders

There were a number of issues related to trust between stakeholders and understanding of other positions. It was apparent from consultations with land managers that underlying many conflicts was a feeling that their livelihoods did not matter to the conservationists (e.g. Interview [11, 20, 22]). Furthermore, it was suggested that diversity and integrity within the land management community were not always recognised by conservationists (Interview [13, 24]), with some conservation stakeholders appearing not to adhere to the presumption of innocence until proven otherwise (Interview [24]). One interviewee felt that conservationists need to recognise that some tolerance is required initially to build trust and cooperation at the local level, an important first step towards breaking down the current extreme polarisation of views (Interview [13]). Partnerships cooperating with moderate estates therefore should not be seen as being soft (Interview [13]).

Opposing views were also expressed that some landowners were too used to having their own way (Interviews [13] and did what they wanted regardless of the impact on others. Similarly some viewed landowners as not fully understanding Scotland's legal obligations and taking the attitude that because the conservationists' objectives are not economic, they are not equally legitimate to their own (Interview [9]). Consequently, land managers and owners were sometimes considered to show a lack of respect towards conservation managers (see also MacMillan *et. al.*, 2010). Similarly, some conservation landowners were thought to develop a similar attitude, whereby they carry out their own management without regard for neighbouring interests. Scepticism was expressed as to whether all stakeholders, particularly in the land management sector, constantly minimise the risk of predation and have tried available mitigation techniques sufficiently rigorously or in the most appropriate way (Interview [1, 6, 7, 19]).

4.2.2 Attitudes towards SNH

As the Scottish Government's conservation advisor and a regulatory body responsible for compliance with EU and Scottish legislation and enforcement of the Deer Act, some stakeholders perceive SNH as one of the protagonists in wildlife conflicts. In addition, as a landowner, SNH is directly involved in some conflicts, such as those involving deer movements between neighbouring properties. Therefore SNH may not be viewed as independent, or be the most appropriate body to mediate conflicts (Interview [5]). Similarly, on licensing issues, there is perceived to be some inconsistency between SNH staff on the balance taken between conservation perspectives and pragmatism (Interview [1]). One interviewee felt that no one at SNH was prepared to put their head above the parapet, so the default position was always to reject a licence application to remove predators (Interview [23]). Furthermore, there is frustration in some cases that licences to shoot a few individuals to gather scientific evidence are being denied, for example, in order to understand changes

in cormorant diet in relation to ecosystem changes⁹ or to monitor the effects of predator removal (Interview [7]). A greater level of trust between SNH and managers would give managers more independence and also enable the licensing process to move faster (Interview [6, 7, 23]). Some SNH staff were felt to have insufficient field experience (Interview [5]; MacMillan *et. al.*, 2010), or spend insufficient time interacting with stakeholders in the field (Interview [23]), although the merger of Deer Commission for Scotland (DCS) with SNH has increased some people's confidence in SNH's practical management (Interview [22]).

4.2.3 Attitudes towards evidence

Attitudes towards scientific evidence varied across sectors and conflicts. In general, salmon fisheries management is now very evidence based (Interview [18]). Having good evidence has made it easier to find common ground between opposing stakeholders (Interview [14]) and has taken the heat out of the seal-salmon conflict (Interview [18]). In other sectors, stakeholders whose impressions or observations contradict established scientific opinion, feel that their evidence is dismissed as unreliable and consequently they believe that no one is listening to the man on the ground (Interview [11, 16]). This could arise when the results of a scientific study from one locality are applied across a wider area, or where specific local conditions mean general results do not apply. A number of stakeholders strongly held the opinion that the evidence base required for a licence for predator removal to be issued was inappropriate (Interview [11, 14, 19, 22, 23]). For example, in the case of licences to take saw-billed ducks, the level of evidence required was thought to be disproportionately high in relation to the number of licences finally issued (Interview [14, 23]). Similarly, while it is theoretically possible to obtain a licence to control buzzards or ravens perceived to be impacting on wild bird populations, the evidence required is considered beyond the means of most applicants and disproportionately more difficult than getting a licence in the case of agricultural impacts (Interview [19]). Furthermore, one stakeholder felt that the goal posts were moving in terms of increases in the burden of evidence required (Interview [14]). If stakeholders perceive that the hoops for legal control are impossible to jump through, then there is an increased risk of illegal behaviour across a wider range of species than just raptors, particularly in remote areas (Interview [16, 23]; Heydon *et. al.* 2010).

4.2.4 Attitudes towards mitigation

Practitioners are interested in finding solutions to current problems, but emphasised the need for solutions to be tailored to individual situations (Interview [1, 20]). Many try different techniques, although the evidence supporting the effectiveness of these attempts is invariably not collected (Table 6). Various participatory mechanisms are increasingly being used to bring stakeholders together, to find common ground, break down barriers and build trust (Irvine *et. al.*, 2009; Redpath *et. al.*, 2013). However, there is a danger of "workshop fatigue" (Reed, 2008) and some stakeholders perceive it as a time-consuming delaying tactic, postponing any real action (Interview [11]). Furthermore, some stakeholders use meetings as an opportunity to humiliate members of opposing parties or for point scoring (Interview [5, 9]). However, concerns about the risks of humiliation can be reduced through using trained facilitators, and mediation could be effective if both sides are prepared to make compromises (Interview [12]).

Payment schemes, while welcome to some, can be viewed as morally insulting to other stakeholders, particularly in the case of farming (Interview [22]). Resolving agricultural conflicts is not just about money so much as trying to maintain an active hill farming community and a way of life (Interview [20, 22]). Many stakeholders have a strong negative attitude towards diversionary feeding as a way of reducing the impact of predators (Interview

⁹ <http://lochlevenfisheries.wordpress.com/2012/12/18/loch-leven-winter-report/>

[1, 11, 20, 22]). There is a perception that it will draw in predators or increase their numbers (Interview [1, 20]) and make them stronger or bolder (Interview [11]). It was seen as unreasonable to expect people to encourage something that could harm them, particularly when the issue of how to manage predators when their numbers are high is unresolved (Interview [22]).

4.2.5 Attitudes towards legislation

Some stakeholders felt that current legislation lacks contemporary relevance, including the new WANE Act (2011), because it is based on out-dated population statuses. Legislation is seen as being based on a period “when lapwings were abundant and ravens were rare” (Interview [7, 22]) and as such offers unnecessarily high protection to some increasingly abundant species such as buzzards whilst insufficient protection to declining species such as waders. In one case the new law was seen as a missed opportunity (Interview [7]).

4.3 Mitigation measures

A wide range of mitigation tools and techniques are available and a number have been used in more than one conflict (Table 5). However, in attempting to determine the extent of use and effectiveness of techniques (Objective 4), we have repeatedly come up against a lack of detailed evidence. Frequently stakeholders say they have tried a measure but it doesn't work, yet when asked for further details, they are unable to provide information concerning when, where, how or for how long the measure was tried. In such situations, it is impossible to draw clear inferences as to the extent to which these measures work. Furthermore, while SASA have wide ranging experience with numerous mitigation techniques across a variety of situations and species, most of this is not documented other than in the limited information recorded in case histories of SNH licence applications. SASA also stressed that as successful mitigation is often very dependent on the individuals involved and the particular circumstances of the case, it was difficult to make generalisations. There is therefore much local knowledge that it has not been possible for us to assess but may provide a future opportunity, if data collection can be supported in such situations.

A number of scientific reviews of mitigation measures have previously been carried out (Allen *et al.*, 2000; Baxter and Hart, 2010; Baxter and Robinson, 2007; Bishop *et al.*, 2003a; e.g. Calladine *et al.*, 2006; Crabtree *et al.*, 2010; Draulans, 1987; Gordon and Northridge, 2002; Heydon *et al.*, 2010; JNCC, 2000; Massei *et al.*, 2010; Massei *et al.*, 2011; Owen *et al.*, 2001; Quick *et al.*, 2004). These review the available literature including peer-reviewed scientific evaluations and unpublished reports of trials carried out by stakeholders and contractors. In the absence of formal scientific testing, some reviews rely on stakeholders' perceptions of effectiveness (e.g. Calladine *et al.*, 2006; Quick *et al.*, 2004). Rather than repeating this earlier work, we provide an up-dated summary and attempt to fill in or highlight gaps.

Mitigation measures broadly fall into the following categories, which are considered in turn below: 1) physical barriers, 2) scarers and deterrents, 3) diversionary feeding, 4) fertility control, 5) translocation, 6) lethal control, 7) habitat management, 8) zonation, 9) compensation, incentives or other payment schemes, and 10) integrated management schemes which combine several measures.

Various forms of participation have also been used to bring stakeholders together in a non-confrontational forum to discuss options, leading to the implementation of other measures (Irvine *et al.*, 2009; Redpath *et al.*, 2013; Reed, 2008). However, as this is not a mitigation technique in itself we have not included here.

4.3.1 Physical barriers

Physical barriers, including fences, gates, nets, wires, and nest cages, are widely used in a number of conflicts to exclude damaging wildlife from areas of human interest (Table 5). Empirical evidence suggests that they can be very effective across a range of wildlife species, for example, badger gates and fencing (Table 6h; Judge *et. al.*, 2011; Matthews and Wilson, 2005; Poole *et. al.*, 2002; Tolhurst *et. al.*, 2008), tree and stocking guards and deer fencing (Table 6j; Armstrong *et. al.*, 2003; Miller *et. al.*, 2011; Putman *et. al.*, 2004), gull exclusion netting at landfill sites or on buildings (Table 6i; Baxter, 2005; Calladine *et. al.*, 2006; Coulson and Coulson, 2009), anti-seal nets at fish farms (Table 6a; Northridge *et. al.*, 2010; Quick *et. al.*, 2004) and predator exclusion fences or nest cages to protect ground-nesting birds (Table 6l; Jackson, 2001; Smith *et. al.*, 2011).

Fencing is widely used to prevent damage by deer and is generally a publically acceptable form of management (Dandy *et. al.*, 2011; Table 6j). It is also the primary method used to prevent or control road crossings and deer-vehicle collisions at high risk sites (Putman *et. al.*, 2004). However, deer fences can also be the cause of conflicts where conservation stakeholders are against fencing due to negative impacts on landscape, wildlife movement, connectivity and access to shelter (John Muir Trust, 2011). Furthermore, unless deer fences are marked, they pose a collision risk to woodland grouse and other birds (Trout and Kortland, 2012). Attempts to regenerate native woodland without fencing are a major cause of conflict among deer managers (Interview [11]; John Muir Trust, 2012; Scottish Gamekeepers Association, 2011; Windmill *et. al.*, 2011). However, there seems considerable scope for testing the effectiveness of stocking guards (tubular stocking material used in Tasmania at a cost of $\leq 5\%$ of the cost of traditional tree guards (Miller *et. al.*, 2011)) in protecting natural regeneration against deer browsing.

More generally, fences, netting and other physical barriers tend to be expensive, especially in the case of electric fences (Poole *et. al.*, 2002), and consequently may only be implemented on a small scale, so limiting their overall effectiveness (Armstrong *et. al.*, 2003; Coulson and Coulson, 2009; Smith *et. al.*, 2011). Furthermore, the effectiveness of both fences and netting is strongly dependent on good maintenance (Baxter, 2005; Jackson, 2001). Poor implementation or maintenance of netting, in particular, can be hazardous to target and non-target wildlife species which may become entangled (Allen *et. al.*, 2000; Calladine *et. al.*, 2006; Northridge *et. al.*, 2010). Nonetheless, underwater tensioned or weighted nets and seal-blinds were generally considered to be highly effective controls against seals by fish farm managers and the best measure currently available (Table 6a; Northridge *et. al.*, 2010; Quick *et. al.*, 2004).

4.3.2 Scarers and deterrents

Scarers and deterrents include visual, acoustic and chemical measures. Visual and acoustic devices, alone or in combination, are widely used in a variety of conflicts with birds, including gulls (Table 6i), geese (Table 6g), piscivorous birds (Table 6b) and to some extent birds of prey, particularly at pheasant release pens (Table 6c; Allen *et. al.*, 2000). Acoustic deterrents are widely used against seals (Table 6a). Although less commonly used, various deterrents have also been tried against deer (Table 6j) and badgers (Table 6h). Of all mitigation methods, scarers and deterrents have been the most widely tested, although in many cases the rigour or methodology of trials has been called into question (Allen *et. al.*, 2000; Amar and Wilson, 2004; Calladine *et. al.*, 2006; Dixon and Hartley, 2002). Much practical advice on their use seems to be based on empirical experience rather than studies involving controlled replication and randomisation.

a) *Bird scarers* (Tables 6b, 6c, 6d, 6e, 6g, 6i): These include various scarecrows, hanging tapes, lights, kites and balloons, falconry, a variety of pyrotechnics and gas canons, and

broadcasting sounds including distress calls and artificial sounds. The literature on the effectiveness of bird scaring and management measures has been reviewed by McKay *et al.* (1999) and Carss (2003) in relation to damage to inland fisheries by piscivorous birds, by Allen *et al.* (2000) in relation to pheasant rearing pens, by Calladine *et al.* (2006) and Baxter and Hart (2010) for urban gulls and more generally by Bishop *et al.* (2003a).

In most cases, auditory scarers were considered relatively effective in the short-term but habituation reduced the benefits over time (e.g. Baxter and Robinson, 2007). The Civil Aviation Authority reported that broadcasting distress calls was effective, and in the long term, was the cheapest way to deter birds at airports (Bishop *et al.*, 2003a) and particularly effective when combined with fire-crackers (Owen *et al.*, 2001). The effectiveness of visual deterrents was extremely variable depending both on the device and its deployment. Traditional scarecrows, kites and balloons were generally considered ineffective (Allen *et al.*, 2000; Baxter and Robinson, 2007; SASA, 2011) while noisy and moving deterrents work best, especially if periodically reinforced with shooting to scare or, in the case of ravens, lethal shooting within sight of flock members (SASA, 2010, 2011). Human disturbance is particularly effective (Percival *et al.*, 1997; Vickery and Summers, 1992).

Advice guides stress the importance of frequently changing the type, location and deployment strategies of scaring devices to prevent habituation (BASC, 2002; SASA, 2011). This applies to visual and auditory scaring, and combinations. Failure to change the deployment strategy or to remove the scarer when it is no longer required may exacerbate problems as birds associate the scarer with food in the longer-term (Allen *et al.*, 2000). Scaring is only effective if there is an alternative forage source nearby, if not birds will tolerate the disturbance (Bishop *et al.*, 2003b). A limitation of scaring is therefore that birds are moved elsewhere, potentially moving rather than solving the problem unless acceptable alternative feeding areas or refuges are available (Vickery and Summers, 1992).

SASA also gives an overview of the deterrents available for urban gulls¹⁰ but have not explicitly tested the effectiveness of products and do not endorse them. A review of the effectiveness of urban gull mitigation methods used in Scotland found a marked lack of rigorous scientific evidence, having to rely on stakeholders' perceptions of effectiveness instead (Calladine *et al.*, 2006). Novel techniques such as the use of water jets have been tried on an ad hoc basis by SASA and found to be effective in the case of disturbing herons at an inland fishery but ineffective in the case of gulls on roof tops. In the latter case, the infra red sensor was triggered as the roof became warm in the sun. Tame hawks, and to a greater extent falcons, can provide effective scaring for gulls, for example at landfill sites (Baxter and Allan, 2006; Baxter and Robinson, 2007; Cook *et al.*, 2008). Habituation to falcons was low and it appears that the fact that they kill some gulls may be key to this (Baxter and Robinson, 2007) as using non-hunting falcons in an urban area was much less effective (Baxter, 2009).

Similarly shooting to scare can be relatively effective and have low levels of habituation because it includes a lethal element (Baxter and Robinson, 2007). However, it's effectiveness seems to vary between bird species, being highly effective in gulls (Baxter and Allan, 2008) and, to a lesser extent, cormorants (Parrott *et al.*, 2003), but ineffective in corvids at landfill sites (Baxter and Allan, 2008). The ineffectiveness to corvids is interesting in that advice given to farmers with a licence to shoot ravens, focuses on using it as a deterrent tool (SASA, 2010). It is not clear what the evidence is behind this advice.

Small scale tests of the effectiveness of visual raptor deterrents to reduce racing pigeon predation were inconclusive (Henderson *et al.*, 2004) because predation events were too rare to capture a sufficient number within such a short study (Amar and Wilson, 2004).

¹⁰ <http://www.sasa.gov.uk/document-library/urban-gull-deterrents>

However, owners of pigeon lofts using multiple deterrent techniques were more likely to report at least partial effectiveness of deterrents compared with those using a single deterrent type (Henderson *et. al.*, 2004). Tests of visual deterrents to raptor predation at pheasant release pens also suggested deterrents might be effective although trials were constrained by the quality of the data recording, warranting further testing (Allen *et. al.*, 2000). BASC are hoping to carry out some new trials in the near future. Pre-breeding season scaring of hen harriers on moorland to deter settling has been suggested, but would require derogation so has never been tested (JNCC, 2000).

b) Seal deterrents (Table 6a): There have been a number of trials of acoustic deterrent devices (also known as ADDs) to deter or scare seals from fish farm cages and rivers (Gordon and Northridge, 2002; Graham *et. al.*, 2009; Northridge *et. al.*, 2010). Generally, they have been limited to only a sample of available devices and a few of many potential deployment strategies. Reported efficacy of ADDs at fish farms was extremely variable, suggesting effectiveness may be site-specific or dependent on deployment strategy (Northridge *et. al.*, 2010; Quick *et. al.*, 2004). Consequently the best mode of use has not been established (Northridge *et. al.*, 2010). Furthermore, some devices have negative impacts on cetaceans and other wildlife, including damage to hearing (Gordon and Northridge, 2002). However, a new versatile acoustic device has recently been successfully trialled that can be tuned to deter only seals, only cetaceans or both (V. Janik, pers. comm.). Furthermore, it elicits sustained long-term avoidance behaviour in seals (Götz and Janik, 2011). It is currently being developed commercially and has the potential to be a more effective tool when more widely available. It is not yet clear what the device will cost and, as one fisheries manager pointed out, acoustic deterrents, although effective, are unlikely to be a cost-effective measure for many smaller rivers (Interview [23]).

c) Deer deterrents (Table 6j): Visual deterrents against deer are primarily found in the form of roadside reflectors, used in the context of attempting to reduce road traffic accidents. As such they fall outside our remit, suffice to say that the evidence of their effectiveness is equivocal (Putman *et. al.*, 2004). Furthermore, reflectors are obviously dependent on incident light and will therefore only ever be effective at night when a vehicle is passing (Putman *et. al.*, 2004).

Chemical deterrents against deer can be implemented either as an olfactory barrier repellent (a 'chemical fence') to protect an area, or as feeding repellents to protect individual food items. While chemical fences have been promoted for reducing road traffic accidents and protecting against browsing damage, evidence from controlled studies suggests they are ineffective due to rapid habituation, even to predator urine (Elmeros *et. al.*, 2011; Lutz, 1994). By contrast, protection as a feeding barrier was achieved in experimental trials with white-tailed deer by blood, which like other animal protein products modifies the flavour, and capsaicin which is an irritant (Kimball *et. al.*, 2009). The deer did not become habituated to either of these repellents, while the effectiveness of vapour repellents, which rely solely on neophobia, was limited by rapid habituation (Kimball *et. al.*, 2009). An egg and grit repellent has been scientifically tested under commercial forestry conditions in eucalyptus plantations and was found to significantly reduce browsing severity, particularly when combined with stocking guards (Miller *et. al.*, 2011).

A review of a diverse range of deer repellents,¹¹ including lion dung, moth balls, visual and sonic deterrents, found that apart from controlled experiments by the Forestry Authority of human hair, which was found to be ineffective in protecting areas of plantation forest, evidence for efficacy was limited to anecdote and a few uncontrolled trials, and deterrents were generally ineffective.

¹¹ http://www.bds.org.uk/deer_deterrents.html

d) *Badger deterrents* (Table 6h): Chemical repellents with the potential to reduce crop damage have been tested on badgers (Baker *et. al.*, 2005a; Baker *et. al.*, 2005b). In scientific trials, free-ranging wild badgers showed learned aversion (conditioned taste aversion) to odourless Ziram baits, which cause malaise, combined with the odour of clove oil (Baker *et. al.*, 2007). This suggests the technique has the potential to be applied to the protection of crops such as maize. However, such deterrents only prevent consumption of food that animals have been conditioned against, and do not repel them from the area (Ward *et. al.*, 2008). Experimental testing of ultrasonic deterrents, alone and in combination with a water jet device, were found to be ineffective in deterring badgers from urban gardens (Ward *et. al.*, 2008).

4.3.3 *Diversionsary feeding*

Diversionsary feeding has been tried with several different species of both predators and herbivores (Table 6c, 6d, 6g, 6j). In the case of predators, the aim is to see whether the provision of carrion can reduce the impact of predators on prey of interest. The best studied case is an experiment at Langholm Moor that showed that feeding hen harriers with carrion reduced predation on red grouse chicks by 86% (Redpath *et. al.* 2001). However, the experiment was limited to one site and was not able to test the impact of feeding on the number of generalist predators nor establish the long-term implications of feeding for the harrier population (Thirgood & Redpath 2008). These questions are being addressed in the current demonstration project at Langholm. Few attempts have been made by land managers to feed harriers elsewhere, although some success was reported in feeding harriers but not golden eagles during one breeding season at Glen Tanar and mixed success was achieved at Trough of Bowland. There is anecdotal evidence from central Scotland that golden eagles have been attracted to bait sites during winter [Interview 3]. However, prey availability in central Scotland in winter would be lower than in eastern Scotland in the breeding season which may account for the difference in success of attracting eagles to bait sites.

An initial attempt to determine the effectiveness of diversionsary feeding of pine martens as a means of reducing predation on capercaillie has been made, but was unsuccessful due to practical difficulties in attracting pine martens at the Trossachs field site (L. Kubasiewicz pers. comm.).

Winter feeding of deer and other large herbivores is increasingly being practised throughout Europe and parts of North America for a variety of reasons including diversion of animals from traffic arteries and to prevent damage to agriculture, forestry and vulnerable natural habitats (Andreassen *et. al.*, 2005; Putman and Staines, 2004; Smith, 2001; van Beest *et. al.*, 2010a; van Beest *et. al.*, 2010b). However, while there is some evidence to suggest that diversionsary feeding may reduce train collisions (Andreassen *et. al.*, 2005), the evidence of its effectiveness in reducing habitat damage is at best equivocal (Putman and Staines, 2004). Aggregation around feeding stations can lead to extremely high local damage (van Beest *et. al.*, 2010a) but the interpretation of this is not straightforward as baseline browsing surveys are rarely conducted and it is unknown whether heavy damage close to feeding stations is counteracted by reduced damage further away. Nonetheless, habitat selection studies of individuals using feeding stations suggest that they continue to use vulnerable forest stands (van Beest *et. al.*, 2010b). However, a number of authors have found that supplementary feeding can reduce bark stripping by deer (Rajský *et. al.*, 2008). Although there is no direct evidence from Scotland of the effects of supplementary feeding on deer habitat damage, it is a widely used practice to prevent marauding (Trenkel *et. al.*, 1998). Guidelines for best practice are available¹² which also emphasise the potential negative effects of supplementary feeding, such as the increased risk of disease transmission, which

¹² <http://www.bestpracticeguides.org.uk/crop/diversionary-feeding>

may outweigh the benefits. However, the disease transmission risk associated with supplementary feeding in Scotland is currently unknown.

4.3.4 Fertility control

Public demand for humane, non-lethal, wildlife management methods has become widespread due to concerns about animal welfare, human safety in urban settings, and the impact of poisons on non-target species and the environment (Massei *et. al.*, 2011). Measures that limit reproductive success are therefore an appealing alternative to some stakeholders. These could include disturbance of breeding, nest removal, egg removal or substitution, surgical sterilisation or contraception (Fagerstone *et. al.*, 2010). A disadvantage of fertility control is that it is comparatively slow, taking several years to have a noticeable impact on population abundance if used alone (Massei *et. al.*, 2011). In the context of our wildlife conflicts of interest, we consider nest and egg removal, egg sterilisation and substitution in urban gulls (Table 6i) and immunocontraception in a range of species such as grey squirrels, hedgehogs, wild boar, deer and seals (Tables 6a, 6j, 6l).

a) *Urban gulls* (Table 6i): Although nest and egg removal are perceived by stakeholders as being effective measures to reduce the conflict with urban gulls (Calladine *et. al.*, 2006), re-building of nests and relaying mean that the removal procedure must be repeated throughout the breeding season and to have a population-level effect must be carried out repeatedly at a colony scale (Coulson and Coulson, 2009; Owen *et. al.*, 2001). Egg oiling or pricking, which sterilises the eggs, or substitution with artificial eggs can be more effective because the period of incubation, during which gulls are quiet and occupied on roof-tops, is lengthened and the noise and aggression of the chick-rearing period are avoided (Moon, 2008; Rock, 2005). Recent developments with artificial eggs, particularly 'Ersatz' eggs,¹³ seem especially promising, giving longer incubation periods than either real eggs or standard plastic eggs and with fewer eggs rolling out of the nest (Moon, 2011; S. Moon, pers. comm.) Furthermore, egg substitution is cleaner and less labour intensive, so cheaper, than egg oiling. Population control via the restriction of breeding success by any of these methods involves intervention at the colony-scale and, given the longevity of gulls and the 2-4 year period of immaturity before breeding, is a lengthy process (Calladine *et. al.*, 2006). However, gulls experiencing repeated breeding failure may move elsewhere (Rock, 2005). While this may simply move the problem, if coordinated gull control is taken in urban centres, gulls may be moved to outlying industrial areas so reducing conflicts with the public in city centres (S. Moon, pers. comm.).

b) *Immunocontraception*: This is a non-hormonal fertility control method which works by inducing antibodies against reproductive hormones or proteins. The recent development of highly effective single-dose vaccines now makes immunocontraception a more realistic option for wildlife (Kirkpatrick *et. al.*, 2011; Massei *et. al.*, 2012). It has the potential to offer a long-term, effective and humane means of reducing the size and growth of overabundant wildlife populations (Fagerstone *et. al.*, 2010; Massei *et. al.*, 2011). As hormones are not administered, environmental contamination is limited. The concept has public support (Barr *et. al.*, 2002; Massei *et. al.*, 2011), including recognition by the Humane Society International.¹⁴ However, as vaccines currently have to be administered by injection, capturing and handling costs make it more expensive than lethal control. Furthermore, in common with other types of fertility control, it is a slow means of controlling population size so may be most effective in combination with lethal control.

Immunocontraception is most effective at reducing over-abundance in species with a high reproductive rate and low age of first reproduction (Fagerstone *et. al.*, 2010), suggesting it

¹³ www.urbanseagullcontroll.co.uk

¹⁴ <http://www.hsi.org/issues/immunocontraception/>

may be a particularly suitable method for controlling wild boar populations (Massei *et al.*, 2012). In the context of urban wildlife, the effectiveness of immunocontraception at a population-level may be limited by density-dependent immigration. However, research into this has yet to be conducted. While research has shown immunocontraception to be effective in over 85 species, implementation at the population management level has focused on only a few free-ranging wildlife species, namely wild horses, bison, urban white-tailed deer and North American elk, and African elephants (Kirkpatrick *et al.*, 2011). FERA have been conducting research into the use of immunocontraceptives in UK and are currently looking for isolated red deer populations in Scotland to run field trials (G. Massei, pers. comm.). Furthermore, they have the necessary vaccines and expertise to start an immunocontraception programme in hedgehogs on the Uists immediately, if there is the political will. Since lactating female hedgehogs cannot readily be distinguished from most females without young, the capture window in spring is limited to a few weeks in order to avoid capture of mothers with dependent young (Uist Wader Project, 2002). A benefit of using immunocontraception in hedgehogs is that the length of the capture window could be extended if females were vaccinated and released on first capture, but removed on subsequent capture after the first litter has become independent (G. Massei, pers. comm.).

Other wildlife conflict species for which immunocontraception could be a potential method of control are grey squirrels, seals and badgers, although vaccine development and testing are the limiting factors (Brown *et al.*, 1997; Pai *et al.*, 2011; Yoder *et al.*, 2011). There seems to be considerable support for the idea of immunocontraceptive control of grey squirrels (Barr *et al.*, 2002), although a modelling study suggests that this method alone is unlikely to be able to prevent extinction of red squirrels in isolated populations already surrounded by grey squirrels (Rushton *et al.*, 2002).

4.3.5 Translocation

Translocation involves the non-lethal removal of 'problem animals' from a conflict situation to a new location (Linnell *et al.*, 1997). It is often perceived as a humane, species-specific and effective solution to resolving wildlife conflicts where lethal control is considered publically unacceptable (Linnell *et al.*, 1997; Massei *et al.*, 2010). There are, nonetheless, considerable animal welfare issues, both of translocated individuals and those at the host site (Adams *et al.*, 2004; Teixeira *et al.*, 2007; Whisson *et al.*, 2012). There is also the potential for failure due to homing instincts (Linnell *et al.*, 1997; Robinson *et al.*, 2008), for exacerbation of conflicts (Athreya *et al.*, 2011) or spreading of disease (Massei *et al.*, 2010) and high economic costs¹⁵ (Reeve and Bristow, 2002). Despite these issues, translocation is occasionally used in Scotland in badger cases and is currently used to mitigate the impact of hedgehogs on wader populations in the Uists¹⁶ (Table 6I). While welfare concerns for translocated hedgehogs were the original reason for using lethal control (Uist Wader Project, 2002), the decision was reversed based on the results of a pilot study of 20 females monitored for one month which showed survival of >60% (Warwick *et al.*, 2006) and in the absence of any information regarding the impact on the host population. The effectiveness of hedgehog removal on wader populations has not been assessed (Fuller *et al.*, 2010). In the case of badger translocation under licence in England, two cases have been reported (Matthews and Wilson, 2005). In one, translocation was successful while in the other, of 4 adults and 10 cubs translocated, 4 died within 6 weeks and the fate of the remainder was unknown (Matthews and Wilson, 2005). When reviewing whether translocation is a useful tool to mitigate human-wildlife conflicts, Massei *et al.* (2010) conclude that it is unlikely to be the most effective humane method if the costs, including welfare costs, and the risk of spreading diseases are taken into account. Linnell *et al.* (2005), referring primarily to cases

¹⁵ <http://www.scotsman.com/news/revealed-163-1m-bill-to-banish-egg-stealing-hedgehogs-1-791982>

¹⁶ <http://www.snh.gov.uk/land-and-sea/managing-wildlife/uist-wader-research/aims-of-the-project/>

of large carnivores, go further, saying “translocation is more a public-relations exercise than an effective management tool”.

4.3.6 Lethal control

Shooting, trapping and poisoning are the most widely used lethal control methods in developed countries (Woodroffe *et al.*, 2005b). Each of these have pros and cons, which depend on species and conditions (e.g. Massei *et al.*, 2011), but poisoning is generally considered indiscriminate and the least humane, with members of the public expressing concern about effects on non-target species and the potential for animal suffering (Animal Aid, 2012a; Barr *et al.*, 2002; Massei *et al.*, 2011). Concerns over shooting tend to focus on human safety issues, especially in urban or sub-urban areas (Calladine *et al.*, 2006).

Although there is a growing demand for non-lethal wildlife control methods (Animal Aid, 2012a; Dandy *et al.*, 2011; Massei *et al.*, 2011), licensed removal of predators can be an important management tool (Table 5; Heydon *et al.*, 2010) and carnivore conservationists seem to agree that it will always be needed to minimise conflicts when carnivores move into multi-use landscapes (Herfindal *et al.*, 2005; Treves, 2009). However, evidence of its effectiveness is not clear, even at the local level, unless ‘rogue’ individuals can both be identified and selectively removed (Graham *et al.*, 2011; Linnell *et al.*, 1999; Treves, 2009). In the case of the Norwegian lynx-sheep predation conflict, hunting had a greater effect in reducing lamb losses through its effect on the regional lynx population size than through local removals (Herfindal *et al.*, 2005). More generally, whether lethal control provides long-term reductions in population abundance, and effective conflict resolution, may depend on the strength of density dependence in demographic rates or immigration. For example, culling adult gulls has been found to be ineffective at reducing colony size in a number of cases, owing to the birds’ high mobility (Owen *et al.*, 2001). Similarly, in 4 out of 5 grey squirrel culls, the population recovered from heavy trapping within 10 weeks, due to immigration (Lawton and Rochford, 2007). In the case of wild boar, heavy hunting pressure has been ineffective at halting population growth on the continent because it shortens generation time and increases recruitment (Servanty *et al.*, 2011).

Modelling of northern European cormorant populations has shown that culls have had a limited effect on population size due to strong density dependence in adult survival (Frederiksen *et al.*, 2001). More recently, an adaptive management approach to cormorant culling has been implemented in England, whereby an upper threshold to the number of individuals that can be removed under licence without affecting conservation status is decided based on population modelling (Heydon *et al.*, 2010; Smith *et al.*, 2008). While the concept of using modelling and adaptive management to inform culling seems popular with some stakeholders (Interviews [7, 19]) and is currently being trialled for geese, it can nonetheless be controversial due to modelling uncertainties, particularly in terms of estimating the strength and form of density dependence (Green, 2008). Furthermore, it is unclear whether increasing culling will reduce conflicts as the relationship between population size and damage may be non-linear or even negative (Bregnballe and Frederiksen, 2006; Frederiksen *et al.*, 2001). A model of seal removal from salmon rivers showed that although stock and catches would increase by one third on small rivers with monthly catches of fewer than 10 salmon, on larger rivers the effect would be less than a 10% increase in catch (Butler *et al.*, 2006).

Lethal control is a part of the badger licensing system (Table 6h). Stakeholders generally seem satisfied that the system works well (Interview [10, 20]) and over 80% of cases in England are resolved successfully (Delahay *et al.*, 2009). Real problems can be dealt with where necessary (Interview [20]), yet very few licences for lethal control are actually issued (Heydon *et al.*, 2010; Matthews and Wilson, 2005). However, licensing seems to be less effective in resolving conflicts in other species, presumably due to evidence issues (see 4.42

and 4.2.3 above) and the fact that where predation is the underlying problem alternative non-lethal solutions are perceived as ineffective (Interview [11]). In Scotland licensing issues are a particular cause of frustration and resentment among stakeholders in the case of ravens and raptor species that are perceived as numerous, such as buzzards (see section 4.1.2). This frustration is likely to increase the level of conflict.

Even when, for the reasons described above, removal does not have population-level effects, it may nonetheless be effective in taking the heat out of the conflict, as it gives stakeholders the feeling that they have some control (Linnell *et. al.*, 2010). In the case of the Norwegian lynx-livestock conflict, hunting lynx, a species with a favourable conservation status, has had benefits both in terms of reducing predation and reducing the wider social conflict (Herfindal *et. al.*, 2005; Linnell *et. al.*, 2010).

Where public opposition to lethal control is focussed on animal rights issues associated with the hunting and shooting of game species, it is not obvious how to mitigate the conflict. Due to the ideological and ethical nature of the arguments it seems more likely that a socio-political or legal solution will be required rather than a scientific one. Although the banning of fox-hunting in 2005 has led to drag hunting being developed as an alternative sport, the conflict continues.¹⁷

4.3.7 Habitat management

In some cases habitat management seems a potentially powerful tool to mitigate conflicts. Habitat improvement, particularly in terms of provision of submerged natural cover, is one of few techniques considered by stakeholders to be effective over the long-term in reducing cormorant conflict at inland fisheries (Carss, 2003; Table 6b). Furthermore, the effectiveness of artificial refuges in reducing cormorant predation has been demonstrated by experimental trials (McKay *et. al.*, 2003; Russell *et. al.*, 2008; Russell *et. al.*, 2003), but in practice will differ between sites (Natural England, 2007).

Habitat management has been proposed in the case of the hen harrier - grouse conflict (JNCC, 2000; Table 6c), either to reduce prey susceptibility to predation or to reduce harrier density (Thirgood and Redpath, 2005). However, the relationships are not straightforward (Thirgood and Redpath, 2005). We know that greater heather cover may limit the availability of alternative prey, thereby reducing harrier settling densities (Smith *et. al.*, 2001; Thirgood *et. al.*, 2000). On the other hand, there is also a positive relationship between heather cover around harrier nests and grouse predation rate (Amar *et. al.*, 2004). Increased heather cover may therefore reduce the number of predators, but increase the number of grouse chicks that the remaining ones take. Other evidence suggests that grouse nesting success is not dependent on habitat characteristics (Campbell *et. al.*, 2002), and that habitat does not influence strike success or survival rates (Thirgood *et. al.*, 2002). Finally, there is evidence that harriers breed in tall heather (Redpath *et. al.*, 1998), so management that keeps heather short, may reduce settling densities, although this has not been fully tested.

In commercially managed woodlands and forests, there is evidence that deer browsing impacts can be modified by forest management practices, associated with stand size and composition, stocking density and silviculture methods such as thinning (Andren and Angelstam, 1993; Bergqvist *et. al.*, 2001; Reimoser and Gossow, 1996; Scott *et. al.*, 2009). However, there is less evidence of the effects of management of the natural habitat on browsing damage. Nonetheless, it is considered best practise to include rides and glades within forest plans to facilitate deer control¹⁸ (Table 6j).

¹⁷ <http://www.huntwatch.info/about.htm>

¹⁸ <http://www.bestpracticeguides.org.uk/crop/woodland-design>

Habitat management has been proposed as a potential tool in the minimisation of pine marten predation of capercaillie (Table 6f). This is based on observed differences in predation pressure between forests in Strathspey where both species occur (Baines *et. al.*, 2011b; Baines *et. al.*, 2004). Although capercaillie breeding success does not appear to differ between forest types (native pinewood, pine plantation or mixed plantation; Baines *et. al.*, 2011a), it is hypothesised that increasing grassiness may be associated with an increase in availability of alternative prey species of pine marten. This theory has yet to be tested.

4.3.8 Zonation

Zoning aims to reduce wildlife conflicts by creating separate zones in which either wildlife or economic interests are prioritised. For highly mobile conflict species such as raptors and large carnivores, zones need to be large and buffer zones may also be necessary. This may limit the usefulness of zonation in Scotland. It is currently primarily used in goose management in Scotland (Table 6g), whereby some grasslands are managed to attract geese in disturbance-free feeding refuges, while intensive coordinated scaring detracts geese from other fields (Patterson and Fuchs, 2001; Vickery and Gill, 1999). However, it is not clear whether the aggregation of refuges into zones is necessary (Vickery and Gill, 1999) or more cost-effective than dispersed refuges (Crabtree *et. al.*, 2010). Furthermore, increasing pressure on refuges due to rising goose numbers is reducing their effectiveness (Cope *et. al.*, 2003). Elsewhere zoning has been widely used for large carnivore management (Linnell *et. al.*, 2005). Zonation helps limit the financial cost of conflict mitigation by constraining the area in which mitigation is implemented. However, while the material conflicts may be effectively reduced by zoning, this can be at the expense of increased social conflicts (Linnell *et. al.*, 2005).

4.3.9 Compensation, incentives or other payment schemes

In Scotland there are a variety of conservation payment schemes, of which the most relevant to conflict mitigation are payments made to farmers within goose management schemes (Table 6g) and SNH Natural Care management schemes¹⁹ for golden and white-tailed eagles (Table 6d). An emphasis is placed on incentives for positive management rather than compensation. As such, payments are made to farmers within local goose management areas on a per-hectare basis for positive goose management rather than as compensation for lost yield (Cope *et. al.*, 2005). Although expensive, the conservation benefits of goose management pre-2000 were found to outweigh the costs (MacMillan *et. al.*, 2004). More recently, payment schemes are considered to have been successful in reducing conflict in goose management (Cope *et. al.*, 2005; Crabtree *et. al.*, 2010). In other geographic areas, payments are made for animal health measures to make livestock less vulnerable to attack by white-tailed eagles, for habitat improvement to increase the prey base for golden eagles, for provision of deer carrion to support overwintering eagles and for crow control. Evidence of the effectiveness of these payments in reducing conflicts is largely lacking. While payments can sometimes help, especially in livelihoods that are economically vulnerable such as farming, they can be morally insulting as farmers don't want to be paid to do nothing (Interview [22]) and there are important socio-economic reasons for maintaining an active hill farming community (Interview [20]). Where wildlife conflicts involve wealthy stakeholders or the main management objective is not economic, incentive payments are much less likely to be effective in reducing conflict (MacMillan and Phillip, 2010; Redpath *et. al.*, 2013).

4.3.10 Integrated management schemes

In reviewing the effectiveness of mitigation measures, a number of studies state that a combination of measures is most effective, particularly in the context of scaring (Allen *et. al.*,

¹⁹ <http://www.snh.gov.uk/land-and-sea/managing-the-land/farming-crofting/grants-and-funding/natural-care-programme/>

2000; Baxter and Robinson, 2007; Bishop *et. al.*, 2003b; Henderson *et. al.*, 2004). Integrated management schemes incorporate this in a holistic approach to managing wildlife conflicts. Such schemes generally involve several different mitigation measures coordinated over a relatively large area, and importantly, these schemes also directly involve the stakeholders. In only a few conflicts has the management developed to the extent of having an integrated system. Of these, the best examples are a) goose management and b) the Moray Firth seal management, which are discussed below.

a) *Goose management in Scotland* involves a number of local goose management groups within a national framework (Crabtree *et. al.*, 2010). Each group implements a scheme involving measures such as coordinated scaring, shooting, payments to farmers, zonation, and reseedling and fertilisation of grassland refuges. These schemes have gone a long way towards relieving the conflict locally and reducing tensions, as well as allowing goose populations to increase markedly (Cope *et. al.*, 2005; Crabtree *et. al.*, 2010). The national body has also been effective in building consensus and allowing collaborative partnership activity (Crabtree *et. al.*, 2010). While integrated goose management seems to have been effective in reducing the conflict from the perspective of many stakeholders, rising goose numbers mean that the current increases in costs will not be sustainable into the future. The potential for increased conflict is therefore rising again (Interview [15]) and changes need to be made to the existing management (Crabtree *et. al.*, 2010).

b) *The Moray Firth Seal Management Plan* is an adaptive framework for managing seals in the context of other stakeholder interests including salmon fisheries and wildlife tourism (Butler *et. al.*, 2008). It is evidence-based, relying on salmon monitoring by district fisheries boards and seal monitoring data collected by SMRU to estimate the number of harbour seals that can be removed without causing a population decline. In addition, seal removals are targeted to management areas in rivers and estuaries and carried out by trained nominated marksmen. Most stakeholders involved in the management feel the scheme has been effective in reducing conflict (Interviews [14, 18]), at the same time as reducing the number of seals killed (Butler, 2011). However, among netsman and anglers, seals are still perceived as a problem despite the lack of scientific evidence to support this (Interview [18]; Butler *et. al.*, 2011). These results are based on a survey conducted around the time when the scheme started suggesting a new survey might be valuable to determine the effectiveness of the strategy in changing attitudes. This is likely to be important to the long-term sustainability of this approach.

5. DISCUSSION

Across Scotland, people come into conflict over the impacts of certain species and the way they are managed. These conflicts have proved very challenging to resolve. It is clear from this review that conflicts vary widely in relation to their intensity, the number of stakeholders involved, and, particularly, the level of information that exists. There are some success stories, such as the seal management plans in the Moray Firth (Butler *et. al.*, 2008), but generally the conflicts are divisive, damaging and costly. Effective management is often hindered by strongly held opinions, differences in the way conflicts are framed and understood, divergent goals, a lack of trust and willingness to negotiate, a lack of resources and a lack of political will (Redpath *et. al.*, 2013). Yet, none of these problems is insurmountable if appropriate conflict management processes are in place. In this section we draw together the main elements from this review and recommend some next steps.

Predatory species lie at the heart of many of these conflicts. On the one hand many of our larger predators are seen as posing a threat to livelihoods, whilst on the other hand they are often of conservation importance and may provide economic benefits to other sectors such as tourism (Dickie *et. al.*, 2006). This is of course not just a problem in Scotland, but worldwide (Woodroffe *et. al.*, 2005b). Conflicts can be exacerbated when the species involved are increasing in abundance and range, following a recovery from over-exploitation, persecution or the effects of pesticides, and they come into contact with people who have become used to living without them (Woodroffe *et. al.*, 2005a) and do not always welcome their return (Amar *et. al.*, 2010; Galbraith *et. al.*, 2003). At the same time, the history of past persecution and the population lows or extirpations are likely to make conservation organisations less trusting of those who caused the initial declines and less likely to consider any form of predator control under any circumstances.

Predators can also come into the spotlight when their prey populations are declining and vulnerable due to other factors such as climate or land use change. Examples are wild salmon stocks (Middlemas *et. al.*, 2003) and capercaillie populations (Moss *et. al.*, 2001). Similarly, the current economic vulnerability of farming communities in marginal areas means that some farms are less resilient to the impacts of predation than they would be in a different economic climate [Interview 20]. Predation is perceived by some as the straw that breaks the camel's back.

However, it is not just predatory species that are involved in conflict (Table 1). Conflicts will emerge whenever people have strong, divergent views about species and their management and when one of the parties is perceived to assert its interests over another (Redpath *et. al.*, 2013; Young *et. al.*, 2010). Therefore we see conflicts involving a wide range of interests, including conservation, farming, fisheries, forestry, game shooting, tourism, animal welfare and public health interests. Whilst the details of these conflicts are quite different, they are all consistent in that they are between groups of people with different objectives and goals. Conflict management therefore involves bringing parties together to find shared solutions to the problems and exploring alternative mitigation techniques.

5.1 Mitigation

Numerous mitigation techniques have been tested across a variety of conflicts (Tables 5 and 6). Some conflicts have been the focus of more work than others in this regard. For example, there have been numerous trials of mitigation techniques in the conflicts over deer and geese, but none for conflicts over pine marten (Table 5). This probably reflects the willingness to fund studies of mitigation techniques, which will in turn reflect the spatial and temporal scale of the conflict, the sectors involved and the perceived level of threat to livelihoods. Of the various mitigation techniques that have been tested, studies on the use of physical barriers and lethal control are the most common, whereas the use of contraceptives

in the UK is limited to trials of wild boar, badgers and goats (Table 5). Even though lethal control is widely used, its effectiveness in resolving conflict is by no means clear.

Several of the most widely used mitigation measures are technical devices or physical solutions, which often focus on treating the symptoms of the conflict rather than the cause. Depending on the conflict, physical barriers, such as fences and netting, are often, depending on the conflict, perceived as the most effective measures. Various visual and acoustic deterrents are also widely used although effectiveness is more variable (Table 5). This variability seems to be largely due to differences in mode of use or site- or individual-specific conditions (Northridge *et. al.*, 2010), which could include the hunger or motivational state of the 'problem animals', the relative availability of alternative food or the motivation of the stakeholder.

Our ability to tease apart the conditions under which a method is or is not effective has been severely hampered by a lack of rigorous testing under controlled conditions. Fully replicated, randomised trials are of course extremely expensive and may be locally specific. Many stakeholders are naturally more interested in finding solutions that work for them, than in more widely applicable trials. They therefore try techniques locally, often without recording any information concerning the number of trials, prevailing conditions, season, details of techniques used, or indeed the success of the trial. In these situations, it is hard to determine the effectiveness of the trial or apply the lessons to other areas.

An additional, potentially limiting factor in the implementation of some mitigation measures may arise if they require a different skill set to that currently held by managers or employees. For example, the use of sheep mops to control tick numbers if employed by gamekeepers will require shepherding experience. Additional training or hiring in relevant expertise could solve such issues but would likely increase costs.

5.2 Evidence

A general theme running through the conflicts considered here is that there is a gap between the perceptions held by those on either side of the debate. Stakeholders may totally disagree over the extent of the impact of a species or the effectiveness of the various mitigation techniques. Rigorous scientific studies may help reduce the level of mismatch in understanding, but this can only be the case when stakeholders understand and value the information coming out of scientific studies. Our ability to understand impact and learn from mitigation successes and failures will be much greater when the evidence is experimental and independently collected, as this will reduce the risks associated with uncertainty and bias. Nonetheless, stakeholders may disagree with or dismiss the science, relying instead on knowledge from their own experience or that of their peers.

The acceptance of scientific evidence by some practitioners depends in part on the extent to which the findings agree with their perceptions. For example, research showing that white-tailed eagles prey predominantly on poor quality lambs (Marquiss *et. al.*, 2003b) is not accepted by those whose personal experiences are different (Interview [16]). Similarly, evidence suggesting that ravens had limited impacts on upland birds (Amar *et. al.*, 2010) was not well received amongst the shooting community.²⁰ Salmon fishermen and netsman still perceive seals to be a threat (Butler *et. al.*, 2011), despite evidence to the contrary (Middlemas *et. al.*, 2003). In addition, the acceptance of evidence may depend on who has collected or interpreted it and the extent to which they are perceived to be independent of the conflict. For example, monitoring data collected by SMRU and used in seal conflict management is generally accepted by stakeholders, while data collected by the Raptor Study groups is viewed as biased by some grouse managers.

²⁰ http://www.shootingtimes.co.uk/blogs/444949/Raven_research_misses_its_target.html

Conflicting interpretation of scientific evidence can hinder resolution or even create conflicts (Young *et. al.*, 2010). For example, the research conducted by Laurenson *et. al.* (2003), into the effect of controlling mountain hares on louping ill in red grouse, has been interpreted differently by grouse managers and conservationists. Grouse managers have picked up on the information that experimentally reduced hare densities led to fewer ticks, reduced louping-ill prevalence and improved grouse chick survival (Laurenson *et. al.*, 2003). However, conservationists focus on the fact that the study found no evidence of an increase in grouse densities following hare culling and emphasise that particular features of the study site, such as the absence of red deer, very high louping-ill prevalence and intensive sheep management, may have contributed to the observed results and reduce the study's general applicability (Harrison *et. al.*, 2010).

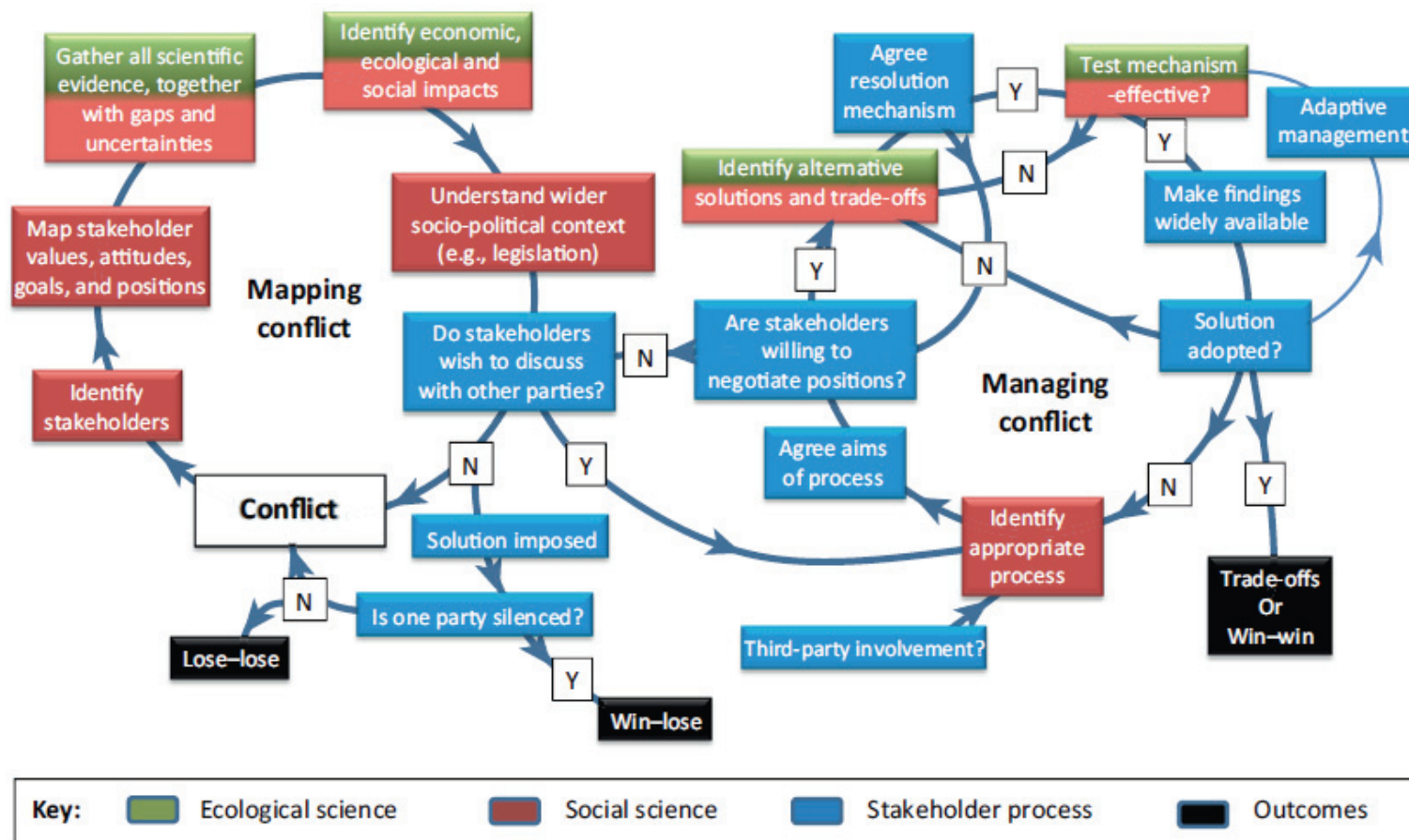
In conflicts, these different forms of knowledge and understanding can create a real barrier to progress. In some cases, such problems can be overcome through partnership, co-management and joint knowledge creation (Anderson, 2004; Butler *et. al.*, 2008; Raymond *et. al.*, 2010). However, such approaches are still dependent on the parties coming together to discuss the problem and seek solutions, so the development of trust and understanding in each others' viewpoints can be important here. A close partnership of scientists and stakeholders from across a conflict can greatly reduce the cost of research, help gather new data and generate understanding, whilst ensuring that biases are minimised and stakeholders are engaged (Butler *et. al.*, 2011). Importantly, such approaches are also more likely to lead to information that is accepted by all sides and therefore enable more rapid progress (Butler, 2011).

Effective conflict management strategies are more likely to be developed when parties are brought together to understand each others' perspectives and develop trust, shared understanding and shared solutions (Redpath *et. al.* 2013). It is important, however, that such approaches do make progress, otherwise they are viewed as "talking shops" (Interview [11]) and lead to stakeholder fatigue (Reed, 2008). Conflict management will also benefit from strong, independent leadership and facilitation that encourages dialogue and the development and testing of alternative mitigation techniques. SNH is not well placed to fulfil this role due to its regulatory responsibilities, and effective involvement would be hindered by the way they are viewed by some practitioners (section 4.2.2) and in particular because of a lack of trust. Nevertheless, the organisation can play a vital role in supporting such processes, bringing parties to the table and encouraging dialogue and a genuine search for solutions.

6. APPROACHES TO CONFLICT MANGEMENT

Typically, parties in conflict become increasingly polarised and unable to have meaningful dialogue. The aim of conflict management is to bring those parties involved in a dispute together to seek shared solutions within the framework of any relevant legislation, rather than allowing each side to continue to strive for a win, irrespective of the cost to the other side (Redpath *et. al.* 2013 and refs therein). There are many approaches to managing conflict, from imposing solutions through legislation and enforcement through to consensus building techniques. In addition, the form of any dialogue and negotiation will also vary, depending on the type of facilitation, the role of government and policy makers and the way stakeholders are selected and involved (Figure 1).

Effective engagement will involve a building of trust between parties and bringing them together in a process that is transparent, so that all parties can understand each other's positions and goals, the legislative constraints, the available evidence with its uncertainties and gaps, and the trade-offs associated with alternative interventions. It is also important firstly, that the long-term ecological, economic and social consequences are weighed up in the decision-making process, and secondly that the process is supported by government so that agreed outcomes can be acted on.



TRENDS in Ecology & Evolution

Figure 1. A roadmap to guide conflict management (from Redpath et. al., 2013). Effective management first requires ecological science, social science and stakeholder dialogue. The first step is to map out the main stakeholders, their views of the conflict, the ecological, social and economic data within the socio-political context, so that any decisions are ultimately taken within the framework of existing legislation. Without intervention or dialogue the conflict is likely to persist. If stakeholders (including the policy makers) are willing to engage then a variety of alternative processes can be put in place to support discussions and negotiations and to search for effective mitigation. Again, mitigation techniques must be mindful of the legislation. The black boxes indicate alternate outcomes for the sides involved in conflict.

7. RECOMMENDATIONS

Based on our review and discussions with stakeholders we have split this section into 1) priorities for ecological understanding, 2) building partnerships, 3) human dimensions, 4) opportunities for SNH, and 5) next steps.

7.1 Priorities for ecological understanding

There are a number of key gaps in our ecological knowledge related to the conflicts described in terms of a) understanding of the systems, b) understanding species impacts and how and why these vary and c) understanding variation in the effectiveness of mitigation measures.

a) Understanding the systems: baseline monitoring of species involved is central to understanding conflict. For example, stakeholders have expressed particular interest in better, large-scale monitoring of mountain hares, sawbilled duck, raven and buzzard populations, to allow national estimates of population size and conservation status to be made, and if appropriate, to determine the number of individuals that could be sustainably removed. Given the issues raised above concerning acceptance of evidence (section 5.3), it is important that monitoring is conducted in an open and transparent way so that results are accepted by all parties. Collaborative monitoring may be one way of achieving this, or a system whereby practitioners carry out the monitoring but it is overseen by an independent body.

In other systems, there are specific gaps in our knowledge including, but not limited to, aspects of urban gull ecology (Calladine *et al.*, 2006; Coulson and Coulson, 2009), the sustainability of current mountain hare exploitation (Newey *et al.*, 2008) and how forest characteristics affect the relationships between capercaillie breeding success and pine marten predation.

b) Understanding impacts: To manage conflicts effectively there is a clear need to understand and explain spatial and temporal variation in impact. Studies need to identify where the main problems occur and under what conditions. Risks of disagreements and biases need to be minimised through open, transparent and collaborative management.

c) Mitigation: Types of potential mitigation will be specific to each conflict. The need here is to ensure that alternative techniques are explored in collaboration between researchers and practitioners and that they are tested in such a way that the data are not biased or perceived as biased and they enable us to learn about their effectiveness. Trials that involve interested stakeholders from the outset are likely to be most effective. There is some limited evidence available in case notes from SASA / SNH licence applications on effectiveness of local mitigation techniques. This information could usefully be drawn together to guide future trials and could be structured more effectively in the future to enable lessons to be learned.

7.2 Human dimensions

Given the fundamental human dimension to conflicts, there are some key issues that need to be addressed to build effective partnerships.

a) Trust: Trust is invariably lacking in conflicts. There is therefore a fundamental need to understand where and why trust is lacking and how it can be built up. This applies not just to those parties engaged in conflict, but also the scientists and policy makers / advisers who are seeking to understand the issue and find solutions.

b) Knowledge: In a conflict some people gain their knowledge more from scientific evidence and dismiss local knowledge as anecdotal and irrelevant, whilst others focus on their

personal experience and dismiss science as irrelevant. We therefore need to understand how different groups gain knowledge and how we can most effectively link knowledge from these two approaches.

c) Variation in attitudes across conflicts: Conflicts vary in their scope, their impact on livelihoods and in the likelihood that they can be quickly and effectively managed. There is therefore variation in how rapidly conflicts can be effectively managed and changed from destructive and damaging to constructive. To prioritise the conflicts that are most likely to be rapidly transformed, there is a need to understand variation in the divergence of views across conflicts, to assess how attitudes vary between stakeholders and therefore how likely we are to be able to find management solutions that reduce the extent of conflict.

d) Media: The media present a challenge and an opportunity to conflict management. In the worst case they can highlight the conflict aspects and sensationalise rather than educate. Building good relationships with the media and supporting constructive journalism are therefore an important part of conflict management. Similarly, building education programmes that support a conflict management process will aid more rapid progress and build an understanding as to why certain decisions are made.

e) Building partnerships: Conflicts are often between people who frame the issue in very different ways and rely on very different forms of knowledge. Conflict management relies on bringing these different groups together to search for shared solutions. Central to this is the need to build partnerships between scientists, practitioners and policy makers to co-build knowledge and understanding and to test alternative mitigation techniques. The processes that build dialogue and reduce conflict can take different forms – e.g. whether or not to involve facilitators or government. At the outset, careful consideration needs to be given to the design and establishment of these processes to ensure their effectiveness at reducing conflict.

7.3 Opportunities for SNH

Conflict will always exist when different parties with incompatible strongly-held objectives are involved. However, there is genuine potential to reduce the impact and cost of these conflicts by supporting the processes that bring parties together in the search for shared solutions. SNH can play a vital role in this, although the organisation is hindered by the fact that it is not always trusted and is viewed as biased by some stakeholders. However, there is clearly an opportunity for SNH to take a leadership role in supporting conflict management processes and partnerships across Scotland, as it has already attempted in the Langholm Management Demonstration Project.

7.4 Next steps

Here we outline possible next steps that we consider would help support the management of species conflicts in Scotland.

- a) Prioritise the conflicts. Given the diversity and divergence of conflicts outlined in this report, there is a need to prioritise, based on a series of criteria important to SNH. This could be done through multi-criteria decision making within SNH but would also require some new information, regarding the variance in stakeholder attitudes across conflicts, so that those conflicts most likely to yield more rapid results can be identified
- b) Build trust. Trust is central to conflict management. It will help SNH to understand how the organisation is perceived across stakeholder groups and consider options for improving trust with these groups and how to deal with any lack of trust within the conflict management process.

- c) Identify the processes. Develop a toolkit to help identify which conflict management processes are most appropriate for different conflicts.
- d) Media & education. At the start of any process, careful consideration will need to be given to developing a strategy for dealing with the media. Similarly, conflict management would be aided through supporting an education programme for how the conflict is being tackled and why.
- e) Evidence. Explore ways to support the linkage of scientific evidence with local knowledge. This will involve shifts in terms of how scientists work and interact with stakeholders and the public, but the integration of unbiased scientific advice together with local knowledge will represent a major step forward and enable conflict management to occur more rapidly and more cost-effectively.
- f) Partnerships. Support cost-effective partnerships that link science and stakeholders to build both monitoring programmes that are supported by all sides and to test mitigation strategies.
- g) Case studies. Once conflicts have been prioritised, it may be sensible to establish one or two case studies, to learn from the process of conflict management so that future processes can adapt accordingly.
- h) Post-conflict management. Once conflict mitigation has been put in place there is an important requirement to continue supporting that process to ensure mitigation is taken up and enable the process to strengthen and not slide back into conflict.

Table 1. Overview of Scottish wildlife conflicts included in this study

Conflict	Species involved	Sectors involved
Predation in rivers and inland fisheries	Harbour & grey seals, cormorants, shags, herons, otters, saw-billed ducks - wild salmon, trout	Conservation, welfare, angling, tourism
Predation at fish farms	Harbour & grey seals, cormorants, shags, herons, otters, saw-billed ducks - farmed salmon	Conservation, welfare, fish farming, aquaculture, tourism
Predation of game birds	Eagles, buzzards, harriers, kite, goshawk, pine marten, wild cats, ravens - grouse, pheasants, partridges	Conservation, game bird shooting
Predation of livestock	Ravens, buzzards, white-tailed eagle, golden eagle	Conservation, farming & crofting, tourism
Predation of racing pigeons	Peregrine, sparrowhawks - domestic pigeons	Conservation, pigeon racing
Predation of protected sp. by protected sp.	e.g. Pine marten - capercaillie & other ground nesting birds	Conservation, tourism
Damage to agriculture & forestry	Badger, geese (greylag, pink-footed, barnacle, bean, white-fronted geese), deer (all sp. especially red)	Conservation, agriculture, tourism, forestry, stalking
Damage to buildings	Badger, Bats	Property
Public health risk & nuisance due to gulls	Larus gulls	Public health, local authorities, urban residents
Habitat impact by deer	All deer sp. but especially red	Stalking, natural heritage, tourism
Ethics of population control	All deer species, hedgehogs, grey squirrels, foxes, gulls, seals	Land managers, conservation, welfare
Tick control for grouse management	Mountain hares, deer, red grouse	Conservation, game bird shooting

Table 2. Stakeholder organisations involved in Scottish wildlife conflicts which have been consulted during the course of this project.

Stakeholder	Acronym
Association of Deer Management Groups	ADMG
Association of Salmon Fishery Boards	ASFB
British Association for Shooting & Conservation	BASC
Food & Environment Research Agency	FERA
Forestry Commission Scotland	FCS
Game & Wildlife Conservation Trust	GWCT
John Muir Trust	JMT
Marine Scotland	
National Farmers Union Scotland	NFUS
Rivers & Fisheries Trusts of Scotland	RAFTS
Royal Society for the Protection of Birds	RSPB
Scottish Agricultural Science Agency	SASA
Scottish Gamekeepers Association	SGA
Scottish Land & Estates	SLE
Scottish Natural Heritage	SNH
Sea Mammal Research Unit, University of St. Andrews	SMRU

Table 3. Evidence types identified during the course of this study. Arrows indicate decreasing ability to draw clear inferences from the findings.

Evidence type	Description	Code
Scientific evidence	Peer-reviewed controlled experiment	PRx
	Peer-reviewed observational study	PRo
	Peer-reviewed modelling study	PRm
	Peer-reviewed literature review	PRlr
	Non-reviewed experiment	NRx
	Non-reviewed report, literature review, modelling study or postgraduate thesis	NRr
Empirical evidence	Stakeholders perceptions including questionnaire results	Em1
	Widely used / best practise	Em2
	Limited small-scale, non-reviewed trials without replication or control	LT
	Unconfirmed local knowledge	LK
No evidence	Untested	U

Table 4. Stakeholder consultations by sector. Note that some organisations may overlap sectors but here have been classified by their primary interest.

Sector	No.
Government agency	8
Conservation body	7
Farming & land / fisheries management	9
Independent	1

Effective	Perceived effective	Partially effective	Ineffective	Not tested	Not relevant
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Table 5. Summary of effectiveness of mitigation tools across conflicts

Mitigation method Conflict	Physical barriers (e.g. nets & fences)	visual deterrent	Acoustic deterrent	Chemical deterrent	Lethal control	Translocation	Diversionary feeding	Immuno-contraception	Payments & incentive	Habitat management	Integrated management	Zonation	Other
Seal predation - angling								Available for trial					
Seals predation - fish farms						Ineffectv. in fur seal		Available for trial					Stock management
Fish-eating bird predation - angling													Fish refuges
Fish-eating bird predation - fish farms													
Predation of game birds													Cover at release pens
Predation of livestock					Only for ravens								
Raptor pred. of racing pigeon													Change dates of racing season
Pine marten - capercaillie													
Geese - agriculture							Refuges						Crop management, Combinations
Badgers - agric./ forestry / property													Water jets
Urban gulls - public health / nuisance													Falcons, egg sub. Combinations
Deer - agric./ forestry / habitat								Available for trial					
Tick control (Hares - grouse)				Sheep mops									
Hedgehog - waders								Available for trial					

Table 6a. Mitigation measures used in conflicts with seals and salmon at a) rivers and inland fisheries and b) fish farms. See Table 3 for Evidence codes.

Measure	Use	Evidence	Mitigation success	Limitations of mitigation	References
<i>a) Rivers and inland fisheries</i>					
Lethal control of rogue individuals		U	Untested	Small proportion of seals use rivers, rouge harbour seals less easy to define	(Graham <i>et. al.</i> , 2011)
Seal removal		PRm	Effective on smaller rivers	Ineffective on rivers catching >34 fish/month	(Butler <i>et. al.</i> , 2006)
Acoustic deterrent devices		PRx, NRr	Effective in reducing seal movement upstream. Effect on catch unknown	Some devices harmful / have negative impacts on cetaceans & other wildlife. Expensive. Effectiveness depends on deployment strategy.	(Gordon and Northridge, 2002; Graham <i>et. al.</i> , 2009)
Immuno-contraception		U	Tested in Canada but not UK. New vaccines likely to be effective		(Brown <i>et. al.</i> , 1997; Scotsman, 2003)
Adaptive management	Combines monitoring, modelling & lethal control	Em1	Most stakeholders believe it is effective in reducing conflict	Some anglers & netsmen perceive problem despite evidence	(Butler <i>et. al.</i> , 2011; Butler <i>et. al.</i> , 2008); Interviews [18,23]
<i>b) Fish farms</i>					
Shooting, removal of rouge seal		NRr, Em1	Considered effective by stakeholders		(Northridge <i>et. al.</i> , 2010; Quick <i>et. al.</i> , 2004)
Acoustic deterrent devices		NRr, Em1	No consensus on overall effectiveness	Optimal deployment strategy unknown. Can exclude cetaceans from general area. May affect hearing of marine mammals. Seals may habituate.	(Gordon and Northridge, 2002; Northridge <i>et. al.</i> , 2010; Quick <i>et. al.</i> , 2004)
Netting	Wide variety of types & designs	NRr, Em1, Em2	Tensioned nets & seal blinds considered highly effective	Other types of nets widely used but only considered partially effective	(Northridge <i>et. al.</i> , 2010; Quick <i>et. al.</i> , 2004)
Stock management	Removal of dead fish, reducing stocking densities	NRr, Em1, Em2	Effective in reducing predation risk		(Northridge <i>et. al.</i> , 2010)
Translocation		PRo	Ineffective in fur seals		(Robinson <i>et. al.</i> , 2008)
Immuno-contraception		U	Tested in Canada but not UK. New vaccines likely to be effective		(Brown <i>et. al.</i> , 1997; Scotsman, 2003)

Table 6b. Mitigation measures used in conflicts with picivorous birds at a) rivers and inland fisheries and b) fish farms. See Table 3 for Evidence codes.

Measure	Use	Evidence	Mitigation success	Limitations of mitigation	References
<i>a) Rivers and inland fisheries</i>					
Habitat management	Improving fish habitat quality & availability of submerged natural cover	Em1	Perceived as effective over long-term		(Carss, 2003)
Refuges	Protects fish from predators	PRx, Em2	Trials suggest effective	Need to be marked to avoid fouling angling gear	(McKay <i>et al.</i> , 2003; Natural England, 2007; Russell <i>et al.</i> , 2008)
Lethal control		PRm, PRx, NRr, Em1	Little impact at population level, effect on catch unclear, may reduce birds locally at inland fisheries	Density-dependence; effectiveness of lethal control no greater than shooting to scare & varies between sites, possibly due to site size or availability of refuges	(Carss, 1994; Frederiksen <i>et al.</i> , 2001; Parrott <i>et al.</i> , 2003; Stewart <i>et al.</i> , 2005; Wright, 2002)
Shooting to scare		PRx	Effective in reducing cormorant numbers	Effectiveness varies between sites, possibly due to site size & availability of refuges	(Parrott <i>et al.</i> , 2003)
Scaring		NRr, Em2	Partially effective, may be short-term	Moves problem elsewhere. More manageable at small site	(Bishop <i>et al.</i> , 2003a; Moran Committee) Interview [21]
Laser deterrent		LT, NRr	Partially effective	Ineffective in daylight, expensive, some birds may be resistant, manually operated	(Bishop <i>et al.</i> , 2003a; McKay <i>et al.</i> , 1999) Interview [1]
Water jet	At fishery pond	LT	Effective against herons		Interview [1]
Top netting	Inland fisheries	Em2	Effective	Only useful on small ponds	Interview [21]
Improving water quality	Increase stocks of alternative prey	U	Speculation at Loch Leven		(Winfield <i>et al.</i> , 2011) ²¹
Stock management	Change stock size or density, trickle stock	PRo, Em1	Partially effective. Stocking effects number of cormorants	Only at stocked fisheries	(Carss, 2003; Stewart <i>et al.</i> , 2005) Interview [21]

²¹ <http://lochlevenfisheries.wordpress.com/2012/04/10/loch-leven-fishing-report-week-ending-8th-april-2012/>

<i>b) Fish farms</i>					
Top netting & wires		NRr, Em1	Most operators perceive as very effective		(Northridge <i>et. al.</i> , 2010; Quick <i>et. al.</i> , 2004)
Anti-predator nets	Submerged nets	NRr, Em1	Not favoured	Can lead to entanglement of wildlife & equipment	(Carss, 1994; Northridge <i>et. al.</i> , 2010)
Shooting		Em1	Considered effective by operators	Likely short term effect & little population level effect	(Carss, 1994; Quick <i>et. al.</i> , 2004)
Scaring	Acoustic deterrents	NRr, Em1	Effectiveness depends on deployment method	Habituation, frequent changes required	(Bishop <i>et. al.</i> , 2003a; Quick <i>et. al.</i> , 2004)
Visual	Visual deterrents	Em1	Relatively ineffective	Habituation	(Bishop <i>et. al.</i> , 2003a; Quick <i>et. al.</i> , 2004)

Table 6c. Mitigation measures used in the raptor – game bird conflict. See Table 3 for Evidence codes.

Mitigation	Use	Evidence	Mitigation success	Limitations of mitigation	References
Translocation /reintroduction	Improve raptor population status over wide area	U	Untested	Would require derogation	(Hodgson <i>et. al.</i> , 2012; Watson and Thirgood, 2001)
Scaring (Harriers)	Pre-breeding season using visual or auditory deterrent	U	Untested	Under licence	(JNCC, 2000)
Scaring (at release pens)	Visual deterrents	LT, LK	Preliminary trials appear effective	Short-term deployment	(Allen <i>et. al.</i> , 2000; Riddle, 2009)
Physical deterrents	Netting along flight lines at pheasant release pens	LK	Effective in combination with other methods (not tested formally)		(Riddle, 2009)
Release pen management	Pheasants	PRo, LT, Em1, Em2	Dense understory vegetation have lower predation	Unclear what causes age effect	(Allen <i>et. al.</i> , 2000; BASC, 2002; Harradine <i>et. al.</i> , 1997; Kenward <i>et. al.</i> , 2001)
Tame hawk deterrent	Harris hawk at release pens	LK	Apparently effective but not tested formally		(Riddle, 2009)
Diversiory feeding (Peregrines)	Dovecot on moors to reduce peregrine predation of grouse	LT	Perceived as effective by 5 / 13 stakeholders practising it	May be legal & ethical issues	(Naylor <i>et. al.</i> , 2005)
Diversiory feeding (Eagles)		LK	Will go to baits in winter, needs further testing in breeding season. Not tried on shoot days	Effectiveness in breeding season may depend on availability of alternative prey	Interviews [2, 3]
Diversiory feeding (Harriers)	In breeding season	PRx, LT	Effective in reducing grouse predation rate	Formal experiments only at low grouse density	(Amar <i>et. al.</i> , 2004; Redpath <i>et. al.</i> , 2001) Langholm Moor ²² ; Interview [2]
Diversiory feeding (Buzzards)		LK	Not formally tested but reported as effective or partially effective	Not effective against sparrowhawks or tawny owls. Most effective in combination with other deterrents	(Riddle, 2009; Staples, 2010)
Raptor quotas	Move surplus broods from grouse moors and rear young in captivity until	U	Untested	Would require derogation	(JNCC, 2000; Potts, 1998; Thirgood and Redpath, 2008)

²² <http://www.langholmproject.com/diversioryfeeding.html>

	fledging				
Habitat management for harriers	Reduce grass within heather to limit alternative prey	PRx, PRO	Unclear - contradictory evidence		(Amar <i>et. al.</i> , 2004; Smith <i>et. al.</i> , 2001)
Habitat management for grouse	Reduce prey susceptibility, increase breeding success or survival	PRO	Ineffective, factors are independent of habitat type		(Campbell <i>et. al.</i> , 2002; Thirgood <i>et. al.</i> , 2002)
Zonation	Different raptors numbers accepted in different zones	U	Tried for large carnivores - useful e.g. for livestock protection, especially if combined with lethal control. Untested in raptors	Practical difficulties with mobile raptors. Would require derogation	(Hogg, 2011; Linnell <i>et. al.</i> , 2005)
Trap & transfer of grouse	Improve grouse numbers by moving in from elsewhere	NRr, LT	25% of transferred birds subsequently bred	Survival low. Predator control may be necessary. Unacceptable to majority of stakeholders.	(Hudson, 1992; JNCC, 2000; Naylor <i>et. al.</i> , 2005)
Rear & release red grouse	Rear grouse in captivity to increase numbers	NRr, LT	Partially successful in a small scale study	Practical difficulties in both rearing & releasing. Low survival of released birds. Unacceptable to majority of stakeholders.	(Lance, 1974; Naylor <i>et. al.</i> , 2005; Price, 1995)
Conditioned taste aversion		U	Untested	Chemicals must be cleared safe for field use in UK	(Allen <i>et. al.</i> , 2000; JNCC, 2000)
Temporary removal of young harriers during shooting season		U	Untested	Would require derogation	(JNCC, 2000)

Table 6d. Mitigation measures used in conflicts between predatory birds and livestock for a) ravens and buzzards and b) white-tailed and golden eagles. See Table 3 for Evidence codes.

Methods	Use	Evidence	Mitigation success	Limitations of mitigation	References
<i>a) Ravens and buzzards</i>					
Licenced shooting of ravens	Shooting to scare	PRx, Em2	Evidence from landfill sites suggest ineffective. Most effective if linked with other scaring methods	Ravens learn to recognise shooter making subsequent killing harder	(Baxter and Allan, 2008; SASA, 2010)
Visual & acoustic scaring		Em2	Believed to be most effective against large flocks of ravens	Scaring methods must be changed frequently & be unpredictable. Not possible for farmers to manage landscape-scale scaring or maintain effort during lambing season	(SASA, 2010) Interview [20]
Diversionary feeding		LK	Not formally tested. Some practitioner experience	Only suitable for short duration during periods of greatest risk	(SASA, 2010)
Livestock management	Keep vulnerable animals indoors or close to human activity	Em2	Perceived as effective		(SASA, 2010)
<i>b) White-tailed and golden eagles</i>					
Improving flock condition		NRr	Effective		(Marquiss <i>et. al.</i> , 2003b)
Livestock management	Lambing indoors or in-bye	NRr	Effective	Not possible in all locations. Not a solution for survival of hefted flocks.	(Marquiss <i>et. al.</i> , 2003b)
Natural Care / Rural Priorities payments		LK	Partially effective	Not a solution for survival of hefted flocks or maintaining active farming community	Interview [16]
Eagle tourism		NRr	Economic benefit at community level but no evidence that conflict with farmers is reduced	Sheep farmers don't benefit directly & does not maintain active farming community	(Dickie <i>et. al.</i> , 2006)
Habitat management	Increase alternative prey of golden eagles	U			(Whitfield, 2000)

Table 6e. Mitigation measures used in conflict between raptors and racing pigeons. See Table 3 for Evidence codes.

Mitigation methods	Use	Evidence	Mitigation success	Limitations of mitigation	References
Change race season dates	Race outside raptor breeding season	U	Untested but likely to be effective	Has potentially serious consequences for peregrine breeding success	(Dixon <i>et. al.</i> , 2003)
Loft-based raptor deterrents	Balloon, whistle, eyespots, replica owl, mirrors/reflectors at loft	LT	Overall ineffective, but mirrors/reflectors partially successful & more effective where multiple-techniques used. Not rigorously tested	Deployment strategies unknown / untested. Study based on respondents' opinions	(Henderson <i>et. al.</i> , 2004)
Pigeon-based raptor deterrents	wing transfers, sequins, Bali-bells fitted to birds during training or racing	LT	Sequins & wing-transfers largely ineffective, Bali-bells partially successful	Respondents opinions & scientific testing, but trials not powerful enough to determine effectiveness	(Henderson <i>et. al.</i> , 2004)

Table 6f. Effectiveness of mitigation measures used in the conservation conflict arising when predation by protected predators (e.g. pine marten) impacts on protected species (e.g. capercaillie). See Table 3 for Evidence codes.

Mitigation methods	Use	Evidence	Mitigation success	Limitations of mitigation	References
Diversionary feeding		U	Under trial		L. Kubasiewicz pers. comm.
Habitat management	Improve availability of preferred prey e.g. voles	U	Untested		

Table 6g. Mitigation measures used in the goose – agriculture conflict. See Table 3 for Evidence codes.

Mitigation	Use	Evidence	Mitigation success	Limitations of mitigation	References
Zonation	Refuges or alternative feeding areas	PRx, PRm, PRlr, Em2	Effective	As population grows, so refuge area required increases or effectiveness is reduced	(Cope <i>et. al.</i> , 2003; Jensen <i>et. al.</i> , 2008; McKay <i>et. al.</i> , 2001; SASA, 2011; Vickery and Gill, 1999)
Fertilisation of grassland & refuges		PRx, PRlr	Effective to extent that breeding success considerably enhanced	Expensive & costs increase as population size increases	(Patterson and Fuchs, 2001; Vickery and Gill, 1999; Vickery <i>et. al.</i> , 1994)
Crop management	Planting non-preferred / seasonally compatible crops in high risk areas, vulnerable crops near human activity	Em1,Em2	Effective - early harvesting barley cropped before geese arrive & then stubble field used as refuge (supplemented with cereals)	Harvest yield of early-cropping barley is lower	(Hake <i>et. al.</i> , 2010; SASA, 2011)
Scaring		PRx, PRlr, NRr, Em2	Initially effective but moves the problem elsewhere. Coordinated scaring together with undisturbed feeding areas effective	Geese quickly habituated - needs reinforcement & frequent changes. Effectiveness depends on methods - moving & noisy are best, kites & balloons less effective, traditional scarecrows ineffective.	(Bishop <i>et. al.</i> , 2003a; Cope <i>et. al.</i> , 2005; Fuchs, 1996; SASA, 2011; Vickery and Summers, 1992)
Shooting to scare		Em2	Effective in scaring but moves rather than solves problem		(SASA, 2011)
Lethal control		Em2	Effectiveness for population control unclear (past over-exploitation yet negligible impact of close season licences on greylags on Orkney)	Quarry species only or under licence. Politically sensitive. Number of wildfowl hunters in UK may be insufficient to limit populations	(Cope <i>et. al.</i> , 2005; Crabtree <i>et. al.</i> , 2010; Ebbinge, 1991; Owen, 1990; SASA, 2011)
Fencing	Electric fencing; goose fencing	LT	Not formally evaluated but seems effective (Goose fencing Sweden), or has potential (Uists)	Practical difficulties erecting electric fencing, non-electrified temporary fence may suffice	(Hake <i>et. al.</i> , 2010; SASA, 2002)
Payments	To farmers for damage	NRr	Effective	Costs have increased so not sustainable in long term	(Crabtree <i>et. al.</i> , 2010; Jensen <i>et. al.</i> , 2008)

Table 6h. Effectiveness of mitigation measures used in badger conflicts. See Table 3 for Evidence codes.

Mitigation methods	Use	Evidence	Mitigation success	Limitations of mitigation	References
Badger gates	Prevention of access, closure of setts	PRx, Em2	Highly effective	Gates must be closed properly. One-way gates can only be used under licence	SASA ²³ ; (Delahay <i>et al.</i> , 2009; Judge <i>et al.</i> , 2011; SNH, 2001)
Electric fencing	Preventing damage to crop fields or access to farm buildings	PRx, Em2	Highly effective when used throughout whole season	Fence must be maintained. Not cost-effective for low damage levels or low value crop. Displaced badgers may become problem elsewhere	SASA ¹³ ; (Poole <i>et al.</i> , 2002; Rural Development Service, 2004; Tolhurst <i>et al.</i> , 2008)
Chemical deterrent		U		None legally available	Badgerland ²⁴
Taste aversion	Chemical repellent in bait	PRx(LT)	Ziram baits effective	Limited trials	(Baker <i>et al.</i> , 2005a; Baker <i>et al.</i> , 2005b)
Translocation		Em2	Partially effective	Strongly discouraged, potential welfare issues	(Balestrieri <i>et al.</i> , 2006; Matthews and Wilson, 2005; SNH, 2001)
Ultrasonic devices & water jets	In residential areas	PRx	Ineffective alone or in combination		(Ward <i>et al.</i> , 2008)
Licensed shooting		NRr	Effective	Less effective by shotgun than rifle	(GCT, 2006)

²³ <http://www.sasa.gov.uk/document-library/badger-fencing-and-gates>

²⁴ http://www.badgerland.co.uk/help/solutions/chemical_deterrent.html

Table 6i. Mitigation measures used in urban gull conflicts. See Table 3 for Evidence codes.

Mitigation	Use	Evidence	Mitigation success	Limitations of mitigation	References
Nest removal		LT	Effective if multiple nests & eggs removed (colony scale disturbance) throughout season	Moves problem elsewhere if single isolated nests removed	(Coulson and Coulson, 2009)
Egg oiling	Sterilises egg	Em1	Perceived to be effective	Expensive, messy, some birds re-lay. Would require large effort over several years for a colony level effect	(Calladine <i>et. al.</i> , 2006)
Egg substitution	Replace with dummy eggs e.g. "Ersatz"	NRx	Effective - gulls incubate longer. Cheaper, cleaner & easier than oiling	Would require large effort over several years for a colony level effect	(Moon, 2008) ²⁵
Lethal control	Removal of adults	PRx, NRr	Effective in reducing birds at landfill, limited effect on colony size - short-term & local scale effect	Density-dependence means breeding success of remaining birds increased and individuals move in from other colonies	(Baxter and Allan, 2008; Baxter and Robinson, 2007; Owen <i>et. al.</i> , 2001)
Shooting to scare		PRx	Effective	No habituation	(Baxter and Allan, 2008; Baxter and Robinson, 2007)
Flying hawks or falcons		PRx, NRr, Em1	Falcons more effective than hawks in reducing gulls at landfill sites. Only partially effective in cities - further trials required under different conditions.	Practical limitations to continuous flying especially during poor weather. Habituation may occur & no affect on gull breeding success. Time of year started may be important. Use of hunting falcons may increase success	(Baxter, 2009; Baxter and Allan, 2006; Baxter and Robinson, 2007; Calladine <i>et. al.</i> , 2006; Owen <i>et. al.</i> , 2001)
Infrasound deterrents	Low-frequency sound, tested in relation to airfield bird-strike	NRx	Ineffective - changes in bird behaviour recorded but didn't cause birds to lift or disperse		(Fidgen <i>et. al.</i> , 2005)
Automated acoustic scarer		PRx	Ineffective	Gulls quickly become habituated	(Baxter and Robinson, 2007)
Broadcasting distress calls		PRx, NRx, NRr	Effective, especially if combined with fire crackers	Limited to duration of broadcast, habituation can occur	(Baxter and Robinson, 2007; Bishop <i>et. al.</i> , 2003a; Fidgen <i>et. al.</i> ,

²⁵ <http://www.urbanseagullcontrol.co.uk>

Pyrotechniques		PRx, NRr	Effective	Only effective during firing period, causes noise disturbance, increased number of rockets needed over time	2005; Owen <i>et. al.</i> , 2001) (Baxter and Robinson, 2007; Bishop <i>et. al.</i> , 2003a)
Helium filled kites / balloons		PRx	Ineffective		(Baxter and Robinson, 2007)
Netting	e.g. at landfill sites or gull-proofing buildings	NRx, NRr, Em1	Perceived as most effective method but may move problem elsewhere	Expensive to net whole building so tends to be small-scale. Poor maintenance could lead to ensnaring. Breakdowns in landfill nets need to be fixed within 20 min	(Baxter, 2005; Bishop <i>et. al.</i> , 2003a; Calladine <i>et. al.</i> , 2006; Coulson and Coulson, 2009)
Physical deterrents	Wires and monofilament lines	NRr	Effective e.g. at tern breeding colonies	Time-consuming to set up, only effective for period of deterrent, most suitable for small areas	(Owen <i>et. al.</i> , 2001)
Physical deterrents	Spikes fitted to roofs or chimneys	Em1	Not formally tested but appear ineffective, move problem elsewhere	Incorrect installation & poor maintenance limit effectiveness	(Calladine <i>et. al.</i> , 2006; Coulson and Coulson, 2009; Rock, 2005)
Integrated management	Combinations of methods at landfill sites	NRx	Effective especially in combination with netting	Effectiveness greater for first-last light than dawn-dusk & for 7 day/week deterrence	(Baxter, 2005)

Table 6j. Mitigation methods used in relation to deer conflicts. See Table 3 for Evidence codes.

Mitigation	Use	Evidence	Mitigation success	Limitations of mitigation	References
Fencing	Exclosures & open strategic fencing	PRo, NRr, Em2	Effective in allowing habitat recovery. Most effective measure for road safety	Must not exclude access to shelter & deer density outside must be reduced. Maintenance required. Expensive. Must be marked to avoid bird collisions. May cause other conflicts e.g. access, aesthetics	(Putman <i>et. al.</i> , 2004; Scott, 2002; Scott <i>et. al.</i> , 2000) ^{26, 27}
Fencing	Around agricultural areas	Em1	Effective		(Scott and Palmer, 2000)
Tree guards	Protect individual trees	PRx, Em2	Partially effective. Field trials of stocking guards needed in Scotland	Traditional models expensive so only useful on small scale; cheaper stocking guards may increase number of stem deformities; protection limited to period when seedling within guard	(Armstrong <i>et. al.</i> , 2003; Miller <i>et. al.</i> , 2011)
Sonic & visual deterrents	e.g. for gardens	LK	Ineffective		British Deer Soc. ²⁸
Chemical deterrents		PRx	Odour repellents generally ineffective, some feeding repellents effective	Effectiveness depends on motivation state & availability of alternative food, many need reapplying after rain	(Elmeros <i>et. al.</i> , 2011; Kimball <i>et. al.</i> , 2009; Lutz, 1994) ²²
Lethal control	Owner/occupier right to shoot marauding deer	Em1	Effective	Since change in law, some farmers unclear where they stand	(Scott and Palmer, 2000)
Population control	For habitat conservation	PRo	Effective in reducing numbers but may cause conflict.	Immigration & seasonal use by transient animals mean relatively high cull has to be sustained	(Putman <i>et. al.</i> , 2005)
Habitat management / forest design	Create grazing & control areas for safe shooting in woodland	Em2	Perceived as effective		Best Practice ²⁹
Forest management	Tree stocking density	Pro, Em2	High stocking density reduces browsing damage	Increases cost.	(Armstrong <i>et. al.</i> , 2003; Scott <i>et. al.</i> , 2009)
Diversionary feeding		U	No evidence from Scotland, elsewhere equivocal	Potential negative effects e.g. disease transmission may outweigh benefits	(Putman and Staines, 2004) ³⁰

²⁶ <http://www.bestpracticeguides.org.uk/crop/fencing>

²⁷ <http://www.bestpracticeguides.org.uk/reference/compensatory-culls>

²⁸ http://www.bds.org.uk/deer_deterrents.html

²⁹ <http://www.bestpracticeguides.org.uk/crop/woodland-design>

Immuno-contraception	Fertility control, esp. urban & suburban pops.	U	Effective in trials in N. America	Vaccines subject to regulatory control, expensive	(Fagerstone <i>et. al.</i> , 2010; Massei <i>et. al.</i> , 2012; Massei <i>et. al.</i> , 2011)
Financial incentives		U	Unlikely to be effective based on economic study	May be socially unacceptable	(MacMillan and Phillip, 2010)

³⁰ <http://www.bestpracticeguides.org.uk/crop/diversionary-feeding>

Table 6k. Effectiveness of mitigation measures to control tick densities used in the mountain hare – red grouse conflict. See Table 3 for Evidence codes.

Mitigation methods	Use	Evidence	Mitigation success	Limitations of mitigation	References
Lethal control of hares	Tick control	PRx, PRLr, PRm	Effective in reducing ticks but no compelling evidence that it increases grouse densities.	Limited by presence of other tick hosts	(Gilbert <i>et. al.</i> , 2001; Harrison <i>et. al.</i> , 2010; Laurenson <i>et. al.</i> , 2003)
Deer culling	Tick control	PRx	Effectively reduces tick density		(Gilbert <i>et. al.</i> , 2012)
Fencing	Tick control	PRx	Effectively reduces tick density within fenced areas	Sized of fenced enclosure & type of fencing (whether hares & rabbits excluded) may influence effectiveness	(Gilbert <i>et. al.</i> , 2012)
Sheep mops	Tick control	PRm, NRx	Seems effective against ticks but requires hare & deer removal	Intensive management (expensive). Sheep meat unusable. Minimum required densities of other tick hosts unknown	GWCT unpub.; (Porter <i>et. al.</i> , 2011)

Table 6l. Mitigation methods used in relation to hedgehog conflict in the Uists. See Table 3 for Evidence codes.

Mitigation	Use	Evidence	Mitigation success	Limitations of mitigation	References
Lethal control		U, NRr	Effect on wader population unknown. Modelling shows seasonal control relatively ineffective	Very short capture season, unpalatable to public	(Fuller <i>et. al.</i> , 2010; Shirley and Lurz, 2010; Uist Wader Project, 2002; Webb and Raffaelli, 2008)
Hedgehog-proof fences	To prevent spread of hedgehogs	PRx	Partially effective	Local / short-term, requires good maintenance, easy for rabbits to dig under	(Jackson, 2001)
Nest cages	Protects nests of ground-nesting birds	PRlr	Partially effective but limited trials - need further tests	Only suitable for bird species that flush early, most suitable on small scale /emergency measure. Costly & may cause disturbance	(Smith <i>et. al.</i> , 2011)
Translocation		U	Effect on wader population unknown, survival rates of hedgehogs >60%	Very short capture season, expensive, welfare considerations during period in captivity & post release, success greatest for females >550g, impact on population at release site unknown	(Reeve and Bristow, 2002; Warwick <i>et. al.</i> , 2006)
Immuno-contraception	Increase length of capture season	U	Technically ready, not yet tried		G. Massei pers. comm.

8. REFERENCES

- Adams, L.W., Hadidian, J., Flyger, V., 2004. Movement and mortality of translocated urban–suburban grey squirrels. *Anim. Welf.* 13, 45–50.
- Allen, D.S., Packer, J.J., Feare, C.J., Blanchard, C., 2000. *Raptors and the rearing of pheasants: problems and management needs*. Report to British Association for Shooting and Conservation. ADAS.
- Amar, A., Arroyo, B., Redpath, S., Thirgood, S., 2004. Habitat predicts losses of red grouse to individual hen harriers. *Journal of Applied Ecology* 41, 305–314.
- Amar, A., Court, I.R., Davison, M., Downing, S., Grimshaw, T., Pickford, T., Raw, D., 2012. Linking nest histories, remotely sensed land use data and wildlife crime records to explore the impact of grouse moor management on peregrine falcon populations. *Biological Conservation* 145, 86–94.
- Amar, A., Redpath, S., Sim, I., Buchanan, G., 2010. Spatial and temporal associations between recovering populations of common raven *Corvus corax* and British upland wader populations. *Journal of Applied Ecology* 47, 253–262.
- Amar, A., Wilson, J., 2004. RSPB Scotland response to the licensed translocation of sparrowhawks.
- Anderson, B., 2004. Operation Countrywatch Partnership Project Brief.
- Andreassen, H.P., Gundersen, H., Storaas, T., 2005. The effect of scent-marking, forest clearing, and supplemental feeding on moose–train collisions. *J. Wildl. Manage.* 69, 1125–1132.
- Andren, H., Angelstam, P., 1993. Moose browsing on Scots pine in relation to stand size and distance to forest edge. *J. Appl. Ecol.* 30, 133–142.
- Animal Aid, 2012a. *Alternatives to culling. Effective, cost-efficient ways in which local authorities can deter wild species*. Animal Aid, Tonbridge, Kent. <http://www.animalaid.org.uk/images/pdf/factfiles/alternativestoculling.pdf>, p. 22.
- Animal Aid, 2012b. *Factfile: grey squirrels*. <http://www.animalaid.org.uk/images/pdf/factfiles/Squirrel.pdf>.
- Animal Aid, 2012c. *Wildlife campaigns*. <http://www.animalaid.org.uk/h/n/CAMPAIGNS/wildlife/ALL>.
- Armstrong, H.M., Gill, R.M.A., Mayle, B.A., Trout, R.C., 2003. *Protecting trees from deer: an overview of current knowledge and future work*. Forest Research Annual Report, 2001–2002, The Stationary Office, Edinburgh.
- Athreya, V., Odden, M., Linnell, J.D.C., Karanth, K.U., 2011. Translocation as a Tool for Mitigating Conflict with Leopards in Human-Dominated Landscapes of India. *Conservation Biology* 25, 133–141.
- Austin, Z., Smart, J.C.R., Yearley, S., Irvine, R.J., White, P.C.L., 2010. Identifying conflicts and opportunities for collaboration in the management of a wildlife resource: a mixed-methods approach. *Wildlife Research* 37, 647–657.

Baines, D., Aebischer, N., M., B., Macleod, A., 2011a. Analysis of capercaillie brood count data: Long term analysis. *Scottish Natural Heritage Commissioned Report No.435*.

Baines, D., Aebischer, N., MacLeod, A., Woods, J., 2011b. Assessing the activity of predators in relation to capercaillie hen densities and breeding performance. *Scottish Natural Heritage Commissioned Report No.415*.

Baines, D., Moss, R., Dugan, D., 2004. Capercaillie breeding success in relation to forest habitat and predator abundance. *Journal of Applied Ecology* 41, 59-71.

Baker, S.E., Ellwood, S.A., Slater, D., Watkins, R.W., Macdonald, D.W., 2005a. Food aversion plus odor cue protects crop from wild mammals. *Journal of Wildlife Management* 72, 785-791.

Baker, S.E., Ellwood, S.A., Watkins, R., MacDonald, D.W., 2005b. Non-Lethal Control of Wildlife: Using Chemical Repellents as Feeding Deterrents for the European Badger *Meles meles*. *Journal of Applied Ecology* 42, 921-931.

Baker, S.E., Johnson, P.J., Slater, D., Watkins, R.W., Macdonald, D.W., 2007. Learned food aversion with and without an odour cue for protecting untreated baits from wild mammal foraging. *Applied Animal Behaviour Science* 102, 410-428.

Balestrieri, A., Remonti, L., Prigioni, C., 2006. Reintroduction of the Eurasian badger (*Meles meles*) in a protected area of northern Italy. *Ital. J. Zoolog.* 73, 227-235.

Barr, J.J.F., Lurz, P.W.W., Shirley, M.D.F., Rushton, S.P., 2002. Evaluation of immunocontraception as a publicly acceptable form of vertebrate pest species control: the introduced grey squirrel in Britain as an example. *Environmental Management* 30, 342-351.

BASC, 2002. *Birds of prey at pheasant release pens. A practical guide for game managers and gamekeepers*. BASC, Wrexham.

Baxter, A., 2009. *Use of falcons to displace nesting gulls from an urban area, Final Report*. Scottish Executive, Edinburgh.

Baxter, A., Hart, J., 2010. *A review of management options for resolving conflicts with urban geese*. FERA, York, p. 18.

Baxter, A.T., 2005. *Effectiveness of best practice bird control on landfill sites in relation to gull feeding behaviour 27th International Bird Strike Committee meeting*, Athens, p. 8.

Baxter, A.T., Allan, J.R., 2006. Use of raptors to reduce scavenging bird numbers at landfill sites. *Wildlife Society Bulletin* 34, 1162-1168.

Baxter, A.T., Allan, J.R., 2008. Use of lethal control to reduce habituation to blank rounds by scavenging birds. *Journal of Wildlife Management* 72, 1653-1657.

Baxter, A.T., Robinson, A.P., 2007. A comparison of scavenging bird deterrence techniques at UK landfill sites. *International Journal of Pest Management* 53, 347-356.

Baxter, J.M., Galbraith, C.A., 2010. Species conflicts - real or perceived, in: Baxter, J.M., Galbraith, C.A. (Eds.), *Species Management: Changes and Solutions for the 21st Century*. TSO Scotland, Edinburgh, pp. 289-302.

Belant, J.L., 1997. Gulls in urban environments: landscape-level management to reduce conflict. *Landscape and Urban Planning* 38, 245-258.

Bergqvist, G., Bergstrom, R., Edenius, L., 2001. Patterns of stem damage by moose (*Alces alces*) in young *Pinus sylvestris* stands in Sweden. *Scandinavian Journal of Forest Research* 16, 363-370.

Bishop, J., McKay, H., Parrott, D., Allan, J., 2003a. Review of international research literature regarding the effectiveness of auditory bird scaring techniques and potential alternatives. *DEFRA commissioned report*. Central Science Laboratory.

Bishop, J., McKay, H., Parrott, D., Allan, J., 2003b. Review of international research literature regarding the effectiveness of auditory bird scaring techniques and potential alternatives. *DEFRA commissioned report*. Central Science Laboratory.

Bregnballe, T., Frederiksen, M., 2006. Net-entrapment of great cormorants *Phalacrocorax carbo sinensis* in relation to individual age and population size. *Wildlife Biology* 12, 143-150.

Brown, R.G., Bowen, W.D., Eddington, J.D., Kimmins, W.C., Mezei, M., Parsons, J.L., Pohajdak, B., 1997. Evidence for a long-lasting single administration contraceptive vaccine in wild grey seals. *Journal of Reproductive Immunology* 35, 43-51.

Burnett, B., 2012. *A change in our skies: raptor predation*. Chairman's Blog 03/04/12. Scottish Gamekeepers Association.

<http://www.scottishgamekeepers.co.uk/content/change-our-skies-raptor-predation>.

Butler, J.R.A., 2011. The challenge of knowledge integration in the adaptive co-management of conflicting ecosystem services provided by seals and salmon. *Anim. Conserv.* 14, 599-601.

Butler, J.R.A., Middlemas, S.J., Graham, I.M., Harris, R.N., 2011. Perceptions and costs of seal impacts on Atlantic salmon fisheries in the Moray Firth, Scotland: Implications for the adaptive co-management of seal-fishery conflict. *Marine Policy* 35, 317-323.

Butler, J.R.A., Middlemas, S.J., Graham, I.M., Thompson, P.M., Armstrong, J.D., 2006. Modelling the impacts of removing seal predation from Atlantic salmon, *Salmo salar*, rivers in Scotland: a tool for targeting conflict resolution. *Fisheries Management and Ecology* 13, 285-291.

Butler, J.R.A., Middlemas, S.J., McKelvey, S.A., McMyn, I., Leyshon, B., Walker, I., Thompson, P.M., Boyd, I.L., Duck, C., Armstrong, J.D., Graham, I.M., Baxter, J.M., 2008. The Moray Firth Seal Management Plan: an adaptive framework for balancing the conservation of seals, salmon, fisheries and wildlife tourism in the UK. *Aquatic Conservation-Marine and Freshwater Ecosystems* 18, 1025-1038.

Butterfield, J., Coulson, J.C., Kearsey, S.V., Monaghan, P., McCoy, J.H., Spain, G.E., 1983. The herring gull *Larus argentatus* as a carrier of salmonella. *Journal of Hygiene* 91, 429-436.

Calladine, J.R., Park, K.J., Thompson, K., Wernham, C.V., 2006. *Review of urban gulls and their management in Scotland, Final Report*. Scottish Executive, Edinburgh, pp. 1-111.

Campbell, S., Hartley, G., 2004. *Investigation into golden eagle predation of lambs on Benbecula in 2003*. Scottish Agricultural Science Agency, Edinburgh, pp. 1-42.

- Campbell, S.C., Smith, A.A., Redpath, S.M., Thirgood, S.J., 2002. Nest site characteristics and nesting success in red grouse. *Wildlife Biology* 8, 169-174.
- Carss, D.N., 1993. Grey heron, *Ardea cinerea* L., predation at cage fish farms in Argyll, western Scotland. *Aquaculture and Fisheries Management* 24, 29-45.
- Carss, D.N., 1994. Killing of piscivorous birds at Scottish fin fish farms, 1984-87. *Biological Conservation* 68, 181-188.
- Carss, D.N., 2003. *Reducing the conflict between Cormorants and fisheries on a pan-European scale, REDCAFE Final Report*. Centre for Ecology & Hydrology, Banchory, UK.
- Carss, D.N., Marquiss, M., 1992. *Cormorants and the Loch Leven trout fishery*. Report to Scottish Natural Heritage. Institute of Terrestrial Ecology, Banchory, UK, p. 37.
- Carss, D.N., Marquiss, M., 1994. *The stomach contents of Cormorants from Loch Leven, 1992-1994*. Institute of Terrestrial Ecology, Banchory, UK.
- Cook, A., Rushton, S., Allan, J., Baxter, A., 2008. An evaluation of techniques to control problem bird species on landfill sites. *Environmental Management* 41, 834-843.
- Cope, D.R., Pettifor, R.A., Griffin, L.R., Rowcliffe, J.M., 2003. Integrating farming and wildlife conservation: the Barnacle Goose Management Scheme. *Biological Conservation* 110, 113-122.
- Cope, D.R., Vickery, J.A., Rowcliffe, J.M., 2005. From conflict to coexistence: a case study of geese and agriculture in Scotland, in: Woodroffe, R., Thirgood, S., Rabinowitz, A. (Eds.), *People and Wildlife, Conflict or Coexistence?* Cambridge University Press, Cambridge, U.K., pp. 176-191.
- Coulson, J.C., Coulson, B.A., 2009. Ecology and colonial structure of large gulls in an urban colony: investigations and management at Dumfries, SW Scotland. *Waterbirds* 32, 1-15.
- Crabtree, R., Humphreys, E., Moxey, A., Wernham, C.V., 2010. *2010 Review of Goose Management Policy in Scotland*. A report to the Scottish Government. British Trust for Ornithology Scotland, Stirling, UK, pp. 1-304.
- Dandy, N., Ballantyne, S., Moseley, D., Gill, R., Peace, A., Quine, C., 2011. Preferences for wildlife management methods among the peri-urban public in Scotland. *European Journal of Wildlife Research* 57, 1213-1221.
- Dandy, N., Ballantyne, S., Moseley, D., Gill, R., Quine, C., van der Wal, R., 2012. Exploring beliefs behind support for and opposition to wildlife management methods: a qualitative study. *European Journal of Wildlife Research* 58, 695-706.
- Davison, J., Huck, M., Delahay, R.J., Roper, T.J., 2008. Urban badger setts: characteristics, patterns of use and management implications. *Journal of Zoology* 275, 190-200.
- DCS, 2009. *Challenges and opportunities of deer watching as a commercial activity: a critical review*. Deer Commission for Scotland, Inverness.
- Delahay, R.J., Davison, J., Poole, D.W., Matthews, A.J., Wilson, C.J., Heydon, M.J., Roper, T.J., 2009. Managing conflict between humans and wildlife: trends in licensed operations to resolve problems with badgers *Meles meles* in England. *Mammal Review* 39, 53-66.

Dickie, I., Hughes, J., Esteban, A., 2006. *Watched Like Never Before... the local economic benefits of spectacular bird species*. RSPB.

Dixon, A., Hartley, I.R., 2002. Book review: A Study into the Raptor Predation of Domestic Pigeons by Shawyer *et. al.* 2000. *Biological Conservation* 105, 405-406.

Dixon, A., Richards, C., Lawrence, A., Thomas, M., 2003. Peregrine (*Falco peregrinus*) predation on racing pigeon (*Columba livia*) in Wales., in: Thompson, D.B.A., Redpath, S.M., Fielding, A.H., Marquiss, M., Galbraith, C.A. (Eds.), *Birds of Prey in a Changing Environment*. The Stationary Office, Edinburgh, pp. 255-261.

Dolman, P., Fuller, R., Gill, R., Hooton, D., Tabor, R., 2010. Escalating ecological impacts of deer in lowland woodland. *British Wildlife* 2010, 242–254.

Draulans, D., 1987. The effectiveness of attempts to reduce predation by fish-eating birds - a review. *Biological Conservation* 41, 219-232.

Ebbinge, B.S., 1991. The impact of hunting on mortality-rates and spatial-distribution of geese wintering in the western palearctic. *Ardea* 79, 197-209.

Elmeros, M., Winbladh, J.K., Andersen, P.N., Madsen, A.B., Christensen, J.T., 2011. Effectiveness of odour repellents on red deer (*Cervus elaphus*) and roe deer (*Capreolus capreolus*): a field test. *European Journal of Wildlife Research* 57, 1223-1226.

Etheridge, B., Summers, R.W., Green, R.E., 1997. The effects of illegal killing and destruction of nests by humans on the population dynamics of the hen harrier *Circus cyaneus* in Scotland. *Journal of Applied Ecology* 34, 1081-1105.

Fagerstone, K.A., Miller, L.A., Killian, G., Yoder, C.A., 2010. Review of issues concerning the use of reproductive inhibitors, with particular emphasis on resolving human-wildlife conflicts in North America. *Integr. Zool.* 5, 15-30.

Ferns, P.N., Mudge, G.P., 2000. Abundance, diet and *Salmonella* contamination of gulls feeding at sewage outfalls. *Water Research* 34, 2653-2660.

Fidgen, H., Robinson, A., Baxter, A.T., 2005. *Do birds respond to infrasound? A study of low frequency sound as bird-detering technology*. International Bird Strike Committee 27, Athens, p. 12.

Fraser, P., MacKenzie, A., MacKenzie, D., 2012. *The economic importance of red deer to Scotland's rural economy and the political threat now facing the country's iconic species*. Scottish Gamekeepers Association.

Frederiksen, M., Lebreton, J.-D., Bregnballe, T., 2001. The interplay between culling and density-dependence in the great cormorant: a modelling approach. *Journal of Applied Ecology* 38, 617-627.

Fuchs, R.M.E., 1996. *The effect of controlled scaring measures on grey goose distribution in the North-East of Scotland*, Brighton Crop Protection Conference: Pests & Diseases Nov. 18-21, 1996. British Crop Protection Council, Brighton, pp. 823-828.

Fuller, R.J., Humphreys, E.M., Wilson, J.D., Hoccom, D.G., Calladine, J., 2010. Changes in the breeding wader populations of the machair of the Western Isles, Scotland, between 2000 and 2007. *Bird Study* 57, 121-124.

- Galbraith, C.A., Stroud, D.A., Thompson, D.B.A., 2003. Towards resolving raptor-human conflicts, in: Thompson, D.B.A., Redpath, S.M., Fielding, A.H., Marquiss, M., Galbraith, C.A. (Eds.), *Birds of Prey in a Changing Environment*. The Stationary Office, Edinburgh, pp. 527-535.
- Gallagher, J., Clifton-Hadley, R.S., 2000. Tuberculosis in badgers; a review of the disease and its significance for other animals. *Res. Vet. Sci.* 69, 203-217.
- GCT, 2006. *Shooting as a potential tool in badger population control*. Report to DEFRA. Game Conservancy Trust.
- Gilbert, L., Maffey, G.L., Ramsay, S.L., Hester, A.J., 2012. The effect of deer Management on the abundance of *Ixodes ricinus* in Scotland. *Ecol. Appl.* 22, 658-667.
- Gilbert, L., Norman, R., Laurenson, K.M., Reid, H.W., Hudson, P.J., 2001. Disease persistence and apparent competition in a three-host community: an empirical and analytical study of large-scale, wild populations. *J. Anim. Ecol.* 70, 1053-1061.
- Girdwood, R.W.A., Fricker, C.R., Munro, D., Shedden, C.B., Monaghan, P., 1985. The incidence and significance of salmonella carriage by gulls (*Larus* spp) in Scotland. *Journal of Hygiene* 95, 229-241.
- Gordon, J., Northridge, S., 2002. *Potential impacts of Acoustic Deterrent Devices on Scottish Marine Wildlife*. Scottish Natural Heritage, p. 63.
- Götz, T., Janik, V.M., 2011. Repeated elicitation of the acoustic startle reflex leads to sensitisation in subsequent avoidance behaviour and induces fear conditioning *BMC Neuroscience* 12, 30.
- Graham, I.M., Harris, R.N., Denny, B., Fowden, D., Pullan, D., 2009. Testing the effectiveness of an acoustic deterrent device for excluding seals from Atlantic salmon rivers in Scotland. *Ices Journal of Marine Science* 66, 860-864.
- Graham, I.M., Harris, R.N., Matejusova, I., Middlemas, S.J., 2011. Do 'rogue' seals exist? Implications for seal conservation in the UK. *Anim. Conserv.* 14, 587-598.
- Green, R.E., 2008. Assessing the impact of culling on population size in the presence of uncertain density dependence: lessons from a great cormorant population. *Journal of Applied Ecology* 45, 1683-1688.
- Hake, M., Månsson, J., Wiberg, A., 2010. A working model for preventing crop damage caused by increasing goose populations in Sweden. *Ornis Svecica* 20, 225-233.
- Harradine, J., Reynolds, N., Laws, T., 1997. *Raptors and gamebirds. A survey of game managers affected by raptors*. British Association for Shooting and Conservation, Wrexham.
- Harris, C.M., Calladine, J.R., Wernham, C.V., Park, K.J., 2008. Impacts of piscivorous birds on salmonid populations and game fisheries in Scotland: a review. *Wildlife Biology* 14, 395-411.
- Harrison, A., Newey, S., Gilbert, L., Haydon, D.T., Thirgood, S., 2010. Culling wildlife hosts to control disease: mountain hares, red grouse and louping ill virus. *Journal of Applied Ecology* 47, 926-930.

Henderson, I., Parrott, D., Moore, N., 2004. *Racing pigeons – Impact of raptor predation*, Report to Scottish Natural Heritage & Scottish Homing Union. Central Science Laboratory, p. 109.

Herfindal, I., Linnell, J.D.C., Moa, P.F., Odden, J., Austmo, L.B., Andersen, R., 2005. Does recreational hunting of lynx reduce depredation losses of domestic sheep? *Journal of Wildlife Management* 69, 1034-1042.

Heydon, M.J., Wilson, C.J., Tew, T., 2010. Wildlife conflict resolution: a review of problems, solutions and regulation in England. *Wildlife Research* 37, 731-748.

Hodgson, D.J., Schuett, W., Redpath, S., Palmer, S., Travis, J., Saunders, R., 2012. *The feasibility of translocating hen harriers to southern England, and prioritisation of potential translocation sites and strategies*. Report to Natural England.

Hogg, A., 2011. *Getting into the zone*, Scotland News. Game & Wildlife Conservation Trust, p. 24.

Hudson, P.J., 1992. *Grouse in space and time*. The Game Conservancy.

Irvine, J., 2011. *Sustainable Upland Management. A summary of research outputs from the Scottish Government's "Environment – Land Use and Rural Stewardship" research programme*. Macaulay Land Use Research Institute Aberdeen.

Irvine, R.J., Fiorini, S., Yearley, S., McLeod, J.E., Turner, A., Armstrong, H., White, P.C.L., van der Wal, R., 2009. Can managers inform models? Integrating local knowledge into models of red deer habitat use. *Journal of Applied Ecology* 46, 344-352.

Jackson, D.B., 2001. Experimental removal of introduced hedgehogs improves wader nest success in the Western Isles, Scotland. *Journal of Applied Ecology* 38, 802-812.

Jackson, D.B., 2006. The breeding biology of introduced hedgehogs (*Erinaceus europaeus*) on a Scottish Island: lessons for population control and bird conservation. *Journal of Zoology* 268, 303-314.

Jensen, R.A., Wisz, M.S., Madsen, J., 2008. Prioritizing refuge sites for migratory geese to alleviate conflicts with agriculture. *Biological Conservation* 141, 1806-1818.

JNCC, 2000. *Report of the UK Raptor Working Group*. Commissioned research. DETR.

John Muir Trust, 2011. Deer Management Policy.
<http://www.jmt.org/assets/pdf/policy/deer%20management.pdf>.

John Muir Trust, 2012. *Deer management: why it matters*. News: Tuesday 23rd October, 2012, <http://www.jmt.org/news.asp?s=2&nid=JMT-N10730>.

Judge, J., McDonald, R.A., Walker, N., Delahay, R.J., 2011. *Effectiveness of biosecurity measures in preventing badger visits to farm buildings*. PloS One 6, e28941.

Kao, R., 2011. Risk-based surveillance for tuberculosis in cattle (bTB), *Commissioned Report No. CR/2009/47*. The Scottish Government, Edinburgh, p. 42.

Kenward, R.E., Hall, D.G., Walls, S.S., Hodder, K.H., 2001. Factors affecting predation by buzzards *Buteo buteo* on released pheasants *Phasianus colchicus*. *Journal of Applied Ecology* 38, 813-822.

- Kimball, B.A., Taylor, J., Perry, K.R., Capelli, C., 2009. Deer Responses to Repellent Stimuli. *J. Chem. Ecol.* 35, 1461-1470.
- Kinrade, V., Ewald, J., Smith, A., Newey, S., Iason, G., Thirgood, S., Raynor, R., 2008. The distribution of Mountain Hare (*Lepus timidus*) in Scotland (2006/07). *Scottish Natural Heritage Commissioned Report No. 278*.
- Kirkpatrick, J.F., Lyda, R.O., Frank, K.M., 2011. Contraceptive vaccines for wildlife: a review. *American Journal of Reproductive Immunology* 66, 40–50.
- Lance, A.N., 1974. Releases of pen-reared Red Grouse (*Lagopus lagopus scoticus*) to restock breeding populations in Ireland. Proceedings of International Congress. *Game Biology* 11 225-229.
- Laurenson, M.K., Norman, R.A., Gilbert, L., Reid, H.W., Hudson, P.J., 2003. Identifying disease reservoirs in complex systems: mountain hares as reservoirs of ticks and louping-ill virus, pathogens of red grouse. *Journal of Animal Ecology* 72, 177–185.
- Lawton, C., Rochford, J., 2007. *The recovery of grey squirrel (Sciurus carolinensis) populations after intensive control programmes*. Biol. Environ.-Proc. R. Irish Acad. 107B, 19-29.
- Lees, A.C., Newton, I., Balmford, A., 2013. *Pheasants, buzzards, and trophic cascades*. Conservation Letters.
- Linnell, J.D.C., Aanes, R., Swenson, J.E., Odden, J., Smith, M.E., 1997. Translocation of carnivores as a method for managing problem animals: a review. *Biodivers. Conserv.* 6, 1245-1257.
- Linnell, J.D.C., Broseth, H., Odden, J., Nilsen, E.B., 2010. Sustainably harvesting a large carnivore? Development of Eurasian lynx populations in Norway during 160 years of shifting policy. *Environmental Management* 45, 1142–1154.
- Linnell, J.D.C., Nilsen, E.B., Lande, U.S., Herfindal, I., Odden, J., Skogen, K., Andersen, R., Breitenmoser, U., 2005. Zoning as a means of mitigating conflicts with large carnivores: principles and reality, in: Woodroffe, R., Thirgood, S., Rabinowitz, A. (Eds.), *People and Wildlife, Conflict or Coexistence?* Cambridge University Press, Cambridge, U.K., pp. 163-175.
- Linnell, J.D.C., Odden, J., Smith, M.E., Aanes, R., Swenson, J.E., 1999. Large carnivores that kill livestock: do "problem individuals" really exist? *Wildlife Society Bulletin* 27, 698-705.
- Lutz, W., 1994. Trial results of the use of a duftzaun (scent fence) to prevent game losses due to traffic accidents. *Z. Jagdwiss.* 40, 91-108.
- MacMillan, D., Hanley, N., Daw, M., 2004. Costs and benefits of wild goose conservation in Scotland. *Biological Conservation* 119, 475-485.
- MacMillan, D.C., Leitch, K., 2008. Conservation with a gun: understanding landowner attitudes to deer hunting in the Scottish Highlands. *Human Ecology* 36, 473–484.
- MacMillan, D.C., Leitch, K., Wightman, A., Higgins, P., 2010. The management and role of Highland sporting estates in the early twenty-first century: the owner's view of a unique but contested form of land use. *Scottish Geographical Journal* 126, 24–40.

MacMillan, D.C., Phillip, S., 2010. Can Economic Incentives Resolve Conservation Conflict: The Case of Wild Deer Management and Habitat Conservation in the Scottish Highlands. *Human Ecology* 38, 485-493.

MacPhee, C., 2012. *Crofters lament lethal attacks by sea eagles*. The Press and Journal, 13/10/2012. <http://www.pressandjournal.co.uk/Article.aspx/2971031>.

Marquiss, M., Carss, D.N., Armstrong, J.D., Gardiner, R., 1998. *Fish-eating birds and salmonids in Scotland*. The Scottish Office Agriculture, Department of Environment and Fisheries, Edinburgh.

Marquiss, M., Madders, M., Carss, D.N., 2003a. White-tailed eagles (*Haliaeetus albicilla*) and lambs (*Ovis aries*). in: Thompson, D.B.A., Redpath, S.M., Fielding, A.H., Marquiss, M., Galbraith, C.A. (Eds.), *Birds of Prey in a Changing Environment*. The Stationary Office, Edinburgh, pp. 471-479.

Marquiss, M., Madders, M., Irvine, J., Carss, D.N., 2001. *The impact of White-tailed Eagles on Sheep Farming on Mull*. Scottish Natural Heritage Unpublished Commissioned Report.

Marquiss, M., Madders, M., Irvine, J., Carss, D.N., 2003b. *The impact of Whitetailed Eagles on Sheep Farming on Mull, Final Report*. Centre for Ecology and Hydrology, Banchory, U.K.

Massei, G., Cowan, D.P., Coats, J., Bellamy, F., Quy, R., Pietravallo, S., Brash, M., Miller, L.A., 2012. Long-term effects of immunocontraception on wild boar fertility, physiology and behaviour. *Wildlife Research* 39, 378-385.

Massei, G., Quy, R.J., Gurney, J., Cowan, D.P., 2010. Can translocations be used to mitigate human-wildlife conflicts? *Wildlife Research* 37, 428-439.

Massei, G., Roy, S., Bunting, R., 2011. Too many hogs? A review of methods to mitigate impact by wild boar and feral hogs. *Human-Wildlife Interactions* 5, 79-99.

Matthews, A.J., Wilson, C.J., 2005. *The management of problems involving badgers (Meles meles)*. *Protection of Badgers Act 1992 licensing cases 1997–1999*. Department for Environment, Food and Rural Affairs, London.

Matthews, F., 2012. Pine Marten-Capercaillie Conflict. Should pine martens in Scotland be culled? *Mammal News* Autumn 2012, 8-9.

McCarthy, M., 2010. *Far from the sea, urban seagulls terrorise skies*. Independent <http://www.independent.co.uk/environment/nature/far-from-the-sea-urban-seagulls-terrorise-skies-2064013.html>.

McKay, H., Furness, R., Russell, I., Parrott, D., Rehfish, M., Watola, G., Packer, J., Armitage, M., Gill, E., Robertson, P., 1999. *The assessment of the effectiveness of management measures to control damage by fish-eating birds to inland fisheries in England and Wales*. Report to the Ministry of Agriculture, Fisheries and Food. Central Science Laboratory, p. 127 + appendices.

McKay, H.V., Milsom, T.P., Feare, C.J., Ennis, D.C., O'Connell, D.P., Haskell, D.J., 2001. Selection of forage species and the creation of alternative feeding areas for dark-bellied brent geese *Branta bernicla bernicla* in southern UK coastal areas. *Agriculture, Ecosystems and Environment* 84, 99-113.

McKay, H.V., Russell, I.C., Rehfisch, M.M., Armitage, M., 2003. Pilot trials to assess the efficacy of fish refuges in reducing the impact of cormorants on inland fisheries, in: Cowx, I.G. (Ed.), *Interactions between fish and birds: implications for management*. Blackwell Science Ltd pp. 278-287.

Middlemas, S.J., Armstrong, J.D., Thompson, P.M., 2003. *The significance of marine mammal predation on salmon and sea trout*.

Miller, A.M., O'Reilly-Wapstra, J.M., Potts, B.M., McArthur, C., 2011. Repellent and stocking guards reduce mammal browsing in eucalypt plantations. *New For.* 42, 301-316.

Moon, S., 2008. *The Management of Nuisance Urban Gulls by Deployment of Egg Substitutes*. De Monfort University, Leicester, UK.

Moon, S., 2011. *Urban gull research: increasing our knowledge base*. Pest Control News December 2011, 21.

Moore, N., Whiterow, A., Kelly, P., Garthwaite, D., Bishop, J., Langton, S., Cheeseman, C., 1999. Survey of badger *Meles meles* damage to agriculture in England and Wales. *Journal of Applied Ecology* 36, 974-988.

Moran Committee, *Protecting your fishery from cormorants*. Moran Committee Joint Bird Group.

http://www.environment-agency.gov.uk/static/documents/Business/protectingfisherya4_615574.pdf

Moss, R., Oswald, J., Baines, D., 2001. Climate change and breeding success: decline of the capercaillie in Scotland. *Journal of Animal Ecology* 70, 47-61.

Natural England, 2007. Reducing the impact of cormorants: the use of fish refuges, *Natural England Technical Information Note TIN028*.

Naylor, A.J., White, R.M., Mougeot, F., 2005. *Assessing the feasibility and acceptability of rear and release, trap and transfer and the use of dove-cotes as management options for red grouse, Lagopus lagopus scoticus*. Report to Scotland's Moorland Forum. Centre for Ecology and Hydrology, Banchory.

Newey, S., Iason, G., Raynor, R., 2008. The conservation status and management of mountain hares. *Scottish Natural Heritage Commissioned Report No. 287*.

Newey, S., Potts, J., Baines, D., Castillo, U., Duncan, M., Harrison, A., Ramsay, S., Thirgood, S., Iason, G., 2011. Development of a reliable method for estimating mountain hare numbers. *Scottish Natural Heritage Commissioned Report No. 444*.

Northridge, S.P., Gordon, J.G., Booth, C., Calderan, S., Cargill, A., Coram, A., Gillespie, D., Lonergan, M., Webb, A., 2010. *Assessment of the impacts and utility of acoustic deterrent devices*. Final Report Scottish Aquaculture Research Forum, p. 34.

Owen, M., 1990. The damage-conservation interface illustrated by geese. *Ibis* 132, 238-252.

Owen, M., Kirby, J., Holmes, J., 2001. Review of effectiveness of gull culling for nature conservation purposes. *Natural England Report No. 438*.

- Pai, M., Bruner, R., Schlafer, D.H., Yarrow, G.K., Yoder, C.A., Miller, L.A., 2011. Immunocontraception in eastern gray squirrels (*Sciurus carolinensis*): morphologic changes in reproductive organs. *Journal of Zoo and Wildlife Medicine* 42, 718-722.
- Park, K.J., Calladine, J.R., Graham, K.E., Stephenson, C.M., Wernham, C.V., 2005. *The impacts of predatory birds on waders, songbirds, gamebirds and fisheries interests*. Report of research contract FO4AC20. Moorland Forum, p. 211.
- Park, K.J., Graham, K.E., Calladine, J., Wernham, C.W., 2008. Impacts of birds of prey on gamebirds in the UK: a review. *Ibis* 150, 9-26.
- Parrott, D., McKay, H.V., Watola, G.V., Bishop, J.D., Langton, S., 2003. Effects of a short-term shooting program on nonbreeding cormorants at inland fisheries. *Wildlife Society Bulletin* 31, 1092-1098.
- Parsons, E.C.M., Warburton, C.A., Woods-Ballard, A., Hughes, A., Johnston, P., 2003. The value of conserving whales: the impacts of cetacean-related tourism on the economy of rural West Scotland. *Aquatic Conservation: Marine and Freshwater Ecosystems* 13, 397-415.
- Patterson, I.J., Fuchs, R.M.E., 2001. The use of nitrogen fertilizer on alternative grassland feeding refuges for pink-footed geese in spring. *Journal of Applied Ecology* 38, 637-646.
- Percival, S.M., Halpin, Y., Houston, D.C., 1997. Managing the distribution of barnacle geese on Islay, Scotland, through deliberate human disturbance. *Biological Conservation* 82, 273-277.
- Poole, D.W., McKillop, I.G., Western, G., Hancocks, P.J., Packer, J.J., 2002. Effectiveness of an electric fence to reduce badger (*Meles meles*) damage to field crops. *Crop Protection* 21, 409-417.
- Porter, R., Norman, R., Gilbert, L., 2011. Controlling tick-borne diseases through domestic animal management: a theoretical approach. *Theor. Ecol.* 4, 321-339.
- Potts, G.R., 1998. Global dispersion of nesting hen harriers *Circus cyaneus*; implications for grouse moors in the UK. *Ibis* 140, 76-88.
- Price, A.J., 1995. *Aspects of rearing red grouse* (*Lagopus lagopus scoticus* (Lath.)) *in captivity and their release onto moorland*. University of Aberdeen.
- Putman, R., 2012a. Scoping the economic benefits and costs of wild deer and their management in Scotland. *Scottish Natural Heritage Commissioned Report No. 526*.
- Putman, R.J., 2012b. Effects of heavy localised culling on population distribution of red deer at a landscape scale: an analytical modelling approach. *European Journal of Wildlife Research* 58(5), 781-796.
- Putman, R.J., Duncan, P., Scott, R., 2005. Demographic changes in a Scottish red deer population (*Cervus elaphus* L.) in response to sustained and heavy culling: an analysis of trends in deer populations of Creagh Meagaidh National Nature Reserve 1986-2001. *Forest Ecology and Management* 206, 263-281.
- Putman, R., Langbein, J., Green, P., Watson, P., 2011. Identifying threshold densities for wild deer in the UK above which negative impacts may occur. *Mammal Review* 41, 175-196.

Putman, R.J., Langbein, J., Staines, B.W., 2004. *Deer and road traffic accidents: a review of mitigation measures, costs and cost-effectiveness*. Report for the Deer Commission for Scotland; Contract RP23A.

Putman, R.J., Staines, B.W., 2004. Supplementary winter feeding of wild red deer *Cervus elaphus* in Europe and North America: justifications, feeding practice and effectiveness. *Mammal Review* 34, 285-306.

Quick, N.J., Middlemas, S.J., Armstrong, J.D., 2004. A survey of antipredator controls at marine salmon farms in Scotland. *Aquaculture* 230, 169-180.

Rajský, M., Vodňanský, M., Hell, P., Slamečka, J., Kropil, R., Rajský, D., 2008. Influence supplementary feeding on bark browsing by red deer (*Cervus elaphus*) under experimental conditions. *European Journal of Wildlife Research* 54, 701-708.

Ratcliffe, D., 1997. *The raven: a natural history in Britain and Ireland*. T & A D Poyser London.

Rayment, M., Sankey, S., Shedden, C., 1998. *Geese and local economies in Scotland*. A Report to the National Goose Forum by RSPB and BASC.

Raymond, C.M., Fazey, I., Reed, M.S., Stringer, L.C., Robinson, G.M., Evely, A.C., 2010. Integrating local and scientific knowledge for environmental management. *Journal of Environmental Management* 91(8), 1766-1777.

Redpath, S., Amar, A., A., S., Thompson, D., Thirgood, S., 2010 People and nature in conflict: can we reconcile hen harrier conservation and game management? , in: Baxter, J.M., Galbraith, C.A. (Eds.), *Species management - challenges and solutions for the 21st Century*. The Stationery Office, Edinburgh.

Redpath, S., Madders, M., Donnelly, E., Anderson, B., Thirgood, S., Martin, A., McLeod, D., 1998. Nest site selection by hen harriers in Scotland. *Bird Stud.* 45, 51-61.

Redpath, S.M., Thirgood, S.J., 1997. *Birds of Prey and Red Grouse*. HMSO, London.

Redpath, S.M., Thirgood, S.J., Leckie, F.M., 2001. Does supplementary feeding reduce predation of red grouse by hen harriers? *Journal of Applied Ecology* 38, 1157-1168.

Redpath, S.M., Young, J., Evely, A., Adams, W.M., Sutherland, W.J., Whitehouse, A., Amar, A., Lambert, R.A., Linnell, J.D.C., Watt, A., Gutiérrez, R.J., 2013. *Understanding and managing conservation conflicts*. Trends in Ecology and Evolution.

Reed, M.S., 2008. Stakeholder participation for environmental management: a literature review. *Biological Conservation* 141, 2417–2431.

Reeve, N.J., Bristow, S., 2002. Feasibility study on a small-scale translocation of hedgehogs from the Uists to mainland Scotland: a non-lethal alternative to humane killing to achieve hedgehog population reduction. *Scottish Natural Heritage Commissioned Report F01LC03*. p. 67.

Reimoser, F., Gossow, H., 1996. Impact of ungulates on forest vegetation and its dependence on the silvicultural system. *Forest Ecology and Management* 88, 107-119.

Riddle, A., 2009. Keeping pens buzzard-free Shooting Times 16 September 2009, 40-41.

Robinson, S., Terauds, A., Gales, R., Greenwood, M., 2008. Mitigating fur seal interactions: relocation from Tasmanian aquaculture farms. *Aquatic Conservation-Marine and Freshwater Ecosystems* 18, 1180-1188.

Rock, P., 2005. Urban gulls: problems and solutions. *British Birds* 98, 338-355.

RSPB, 2011. *A review of the illegal killing of birds of prey in Scotland in 2010*. RSPB, Edinburgh.

Rural Development Service, 2004. *Badger problems: use of electric fencing to prevent agricultural damage*. Technical Advice Note 15. DEFRA.

Rushton, S.P., Gurnell, J., Lurz, P.W.W., Fuller, R.M., 2002. Modeling impacts and costs of gray squirrel control regimes on the viability of red squirrel populations. *Journal of Wildlife Management* 66, 683-697.

Russell, I., Parrott, D., Ives, M., Goldsmith, D., Fox, S., Clifton-Dey, D., Prickett, A., Drew, T., 2008. Reducing fish losses to cormorants using artificial fish refuges: an experimental study. *Fisheries Management and Ecology* 15, 189-198.

Russell, I.C., Dare, P.J., McKay, H.V., S.J., I., 2003. The potential for using fish refuges to reduce damage to inland fisheries by cormorants, *Phalacrocorax carbo*, in: Cowx, I.G. (Ed.), *Interactions between fish and birds: implications for management*. Blackwell Science Ltd, pp. 259-277.

SASA, 2002. *Goose damage to pre-harvest crops. Preliminary trial of mitigation fencing*. Benbecula, August 2002.

SASA, 2010. *Raven predation: a guide for farmers*. SASA, Edinburgh.

SASA, 2011. *Managing geese on agricultural land*. Produced for Scottish Government. SASA, Edinburgh.

Scotsman, 2003. *Salmon lobby calls for grey seal birth control* (07/10/2003), <http://www.scotsman.com/news/uk/salmon-lobby-calls-for-grey-seal-birth-control-1-667467>.

Scott, D., 2002. Recovery of a dwarf birch (*Betula nana*) population following reduction in grazing by red deer (*Cervus elaphus*). *Botanical Journal of Scotland* 53, 155-167.

Scott, D., Palmer, S.C.F., 2000. *Damage by deer to agriculture and forestry*. Report to Deer Commission for Scotland. Institute of Terrestrial Ecology, Banchory, U.K., pp. 1-55.

Scott, D., Welch, D., Elston, D.A., 2009. Long-term effects of leader browsing by deer on the growth of Sitka spruce (*Picea sitchensis*). *Forestry* 82, 387-401.

Scott, D., Welch, D., Thurlow, M., Elston, D.A., 2000. Regeneration of *Pinus sylvestris* in a natural pinewood in N.E. Scotland following reduction in grazing by *Cervus elaphus*. *Forest Ecology and Management* 130, 199-211.

Scottish Gamekeepers Association, 2011. *Misguided "conservation" strategy slammed by SGA* 03/01/2011. <http://www.scottishgamekeepers.co.uk/content/misguided-conservation-strategy-slammed-sga>.

Servanty, S., Gaillard, J.-M., Ronchi, F., Focardi, S., Baubet, E., Gimenez, O., 2011. Influence of harvesting pressure on demographic tactics: implications for wildlife management. *J. Appl. Ecol.* 48, 835-843.

Shawyer, C., Clarke, R., Dixon, N., 2003. Causes of racing pigeon (*Columba livia*) losses, including predation by raptors, in the United Kingdom, in: Thompson, D.B.A., Redpath, S.M., Fielding, A.H., Marquiss, M., Galbraith, C.A. (Eds.), *Birds of Prey in a Changing Environment*. The Stationary Office, Edinburgh, pp. 263-267.

Shirley, M.D.F., Lurz, P.W.W., 2010. Development of a population model for the management of hedgehogs on the Uists and Benbecula. *Scottish Natural Heritage Commissioned Report No. 372*.

Simms, I.C., Ormston, C.M., Somerwill, K.E., Cairns, C.L., Tobin, F.R., J., J., Tomlinson, A., 2010. A pilot study into sea eagle predation on lambs in the Gairloch area. *Scottish Natural Heritage Commissioned Report No. 370*.

Smith, A.A., Redpath, S.M., Campbell, S.T., Thirgood, S.J., 2001. Meadow pipits, red grouse and the habitat characteristics of managed grouse moors. *Journal of Applied Ecology* 38, 390-400.

Smith, B.L., 2001. Winter feeding of elk in western North America. *J. Wildl. Manage.* 65, 173-190.

Smith, G.C., Parrott, D., Robertson, P.A., 2008. Managing wildlife populations with uncertainty: cormorants *Phalacrocorax carbo*. *Journal of Applied Ecology* 45, 1675-1682.

Smith, H.V., Brown, J., Coulson, J.C., Morris, G.P., Girdwood, R.W.A., 1993. Occurrence of oocysts of *Cryptosporidium* sp in *Larus* spp gulls. *Epidemiology and Infection* 110, 135-143.

Smith, R.K., Pullin, A.S., Stewart, G.B., Sutherland, W.J., 2011. Is nest predator exclusion an effective strategy for enhancing bird populations? *Biological Conservation* 144, 1-10.

SNH, 2001. *Scotland's Wildlife: Badgers and Development*. Scottish Natural Heritage.

Staples, C., 2010. *Diversionsary feeding*. Shooting Times 1st September 2010.

Stewart, D.C., Middlemas, S.J., Gardiner, W.R., Mackay, S., Armstrong, J.D., 2005. Diet and prey selection of cormorants (*Phalacrocorax carbo*) at Loch Leven, a major stocked trout fishery. *Journal of Zoology* 267, 191-201.

Summers, R.W., Green, R.E., Proctor, R., Dugan, D., Lambie, D., Moncrieff, R., Moss, R., Baines, D., 2004. An experimental study of the effects of predation on the breeding productivity of capercaillie and black grouse. *Journal of Applied Ecology* 41, 513-525.

Summers, R.W., Willi, J., Selvidge, J., 2009. Capercaillie *Tetrao urogallus* nest loss and attendance at Abernethy Forest, Scotland. *Wildlife Biology* 15, 319-327.

Teixeira, C.P., de Azevedo, C.S., Mendl, M., Cipreste, C.F., Young, R.J., 2007. Revisiting translocation and reintroduction programmes: the importance of considering stress. *Animal Behaviour* 73, 1-13.

Thirgood, S., Redpath, S., 2005. Hen harriers and red grouse: the ecology of a conflict, in: Woodroffe, R., Thirgood, S., Rabinowitz, A. (Eds.), *People and Wildlife, Conflict or Co-existence?* Cambridge University Press, Cambridge, U.K., pp. 192-208.

- Thirgood, S., Redpath, S., 2008. Hen harriers and red grouse: science, politics and human-wildlife conflict. *Journal of Applied Ecology* 45, 1550-1554.
- Thirgood, S., Redpath, S., Newton, I., Hudson, P., 2000. Raptors and Red Grouse: Conservation conflicts and management solutions. *Conservation Biology* 14, 95-104.
- Thirgood, S., Woodroffe, R., Rabinowitz, A., 2005. The impact of human-wildlife conflict on human lives and livelihoods, in: Woodroffe, R., Thirgood, S., Rabinowitz, A. (Eds.), *People and Wildlife. Conflict or coexistence?* Cambridge University Press, Cambridge, U.K., pp. 13-26.
- Thirgood, S.J., Redpath, S.M., Campbell, S., Smith, A., 2002. Do habitat characteristics influence predation on red grouse? *Journal of Applied Ecology* 39, 217-225.
- Thompson, P.M., Mackey, B., Barton, T.R., Duck, C., Butler, J.R.A., 2007. Assessing the potential impact of salmon fisheries management on the conservation status of harbour seals (*Phoca vitulina*) in north-east Scotland. *Anim. Conserv.* 10, 48-56.
- Tolhurst, B., Ward, A.I., Delahay, R.J., MacMaster, A.-M., Roper, T.J., 2008. The behavioural responses of badgers (*Meles meles*) to exclusion from farm buildings using an electric fence. *Applied Animal Behaviour Science* 113, 224-235.
- Trenkel, V.M., Partridge, L.W., Gordon, I.J., Buckland, S.T., Elston, D.A., McLean, C., 1998. The management of red deer on Scottish open hills: results of a survey conducted in 1995. *Scottish Geographical Magazine* 114, 57-62.
- Treves, A., 2009. Hunting for large carnivore conservation. *Journal of Applied Ecology* 46, 1350-1356.
- Trout, R., Kortland, K., 2012. Fence marking to reduce grouse collisions. *Technical Note FCTN019*. Forestry Commission, p. 12.
- Uist Wader Project, 2002. Three potential methods of reducing the non-native Uist hedgehog population to conserve breeding waders: animal welfare and conservation considerations. *Scottish Natural Heritage Commissioned Report*. p. 16.
- Valkama, J., Korpimäki, E., Arroyo, B., Beja, P., Bretagnolle, V., Bro, E., Kenward, R., Manosa, S., Redpath, S.M., Thirgood, S., Vinuela, J., 2005. Birds of prey as limiting factors of gamebird populations in Europe: a review. *Biol. Rev.* 80, 171-203.
- van Beest, F.M., Gundersen, H., Mathisen, K.M., Milner, J.M., Skarpe, C., 2010a. Long-term browsing impact around diversionary feeding stations for moose in Southern Norway. *Forest Ecology and Management* 259, 1900-1911.
- van Beest, F.M., Loe, L.E., Myrsetrud, A., Milner, J.M., 2010b. Comparative space use and habitat selection of moose around feeding stations. *J. Wildl. Manage.* 74, 219-227.
- Vickery, J.A., Gill, J.A., 1999. Managing grassland for wild geese in Britain: a review. *Biological Conservation* 89, 93-106.
- Vickery, J.A., Summers, R.W., 1992. Cost-effectiveness of scaring brent geese *Branta bernicla-bernicla* from fields of arable crops by a human bird scarer. *Crop Protection* 11, 480-484.

- Vickery, J.A., Sutherland, W.J., Lane, S.J., 1994. The management of grass pastures for brent geese. *Journal of Applied Ecology* 31, 282-290.
- Ward, A.I., Pietravallo, S., Cowan, D.P., Delahay, R.J., 2008. Deterrent or dinner bell? Alteration of badger activity and feeding at baited plots using ultrasonic and water jet devices. *Applied Animal Behaviour Science* 115, 221-232.
- Warwick, H., Morris, P., Walker, D., 2006. Survival and weight changes of hedgehogs (*Erinaceus europaeus*) translocated from the Hebrides to Mainland Scotland. *Lutra* 49, 89-102.
- Watson, J., Whitfield, P., 2002. A conservation framework for the Golden Eagle (*Aquila chrysaetos*) in Scotland. *Journal of Raptor Research* 36, 41-49.
- Watson, M., Thirgood, S., 2001. Could translocation aid hen harrier conservation in the UK? *Anim. Conserv.* 4, 37-43.
- Webb, T.J., Raffaelli, D., 2008. Conversations in conservation: revealing and dealing with language differences in environmental conflicts. *Journal of Applied Ecology* 45, 1198–1204.
- Whelan, C.D., Monaghan, P., Girdwood, R.W.A., Fricker, C.R., 1988. The significance of wild birds (*Larus* sp) in the epidemiology of campylobacter infections in humans. *Epidemiology and Infection* 101, 259-267.
- Whisson, D.A., Holland, G.J., Carlyon, K., 2012. Translocation of overabundant species: Implications for translocated individuals. *Journal of Wildlife Management* 76, 1661-1669.
- White, P.C.L., Ward, A.I., 2010. Interdisciplinary approaches for the management of existing and emerging human-wildlife conflicts. *Wildlife Research* 37, 623-629.
- Whitfield, P., 2000. Golden eagle *Aquila chrysaetos* ecology and conservation issues, *Scottish Natural Heritage Review* No. 132.
- Windmill, D., Putman, R., Maxwell, J., 2011. *Report for the board of the National Trust for Scotland into the management of deer, woodland and moorland at Mar Lodge Estate.* <http://www.marlodgereview.org.uk/>. Mar Lodge Estate Independent Review.
- Winfield, I.J., Adams, C.E., Armstrong, J.D., Gardiner, R., Kirika, A., Montgomery, J., Spears, B.M., Stewart, D.C., Thorpe, J.E., Wilson, W., 2011. Changes in the fish community of Loch Leven: untangling anthropogenic pressures. *Hydrobiologia* 681, 73-84.
- Woodroffe, R., Thirgood, S., Rabinowitz, A., 2005a. The future of coexistence: resolving human-wildlife conflicts in a changing world., in: Woodroffe, R., Thirgood, S., Rabinowitz, A. (Eds.), *People and wildlife. Conflict or coexistence?* Cambridge University Press, Cambridge, U.K., pp. 388-405.
- Woodroffe, R., Thirgood, S., Rabinowitz, A., 2005b. The impact of human-wildlife conflict on natural systems, in: Woodroffe, R., Thirgood, S., Rabinowitz, A. (Eds.), *People and wildlife. Conflict or coexistence?* Cambridge University Press, Cambridge, U.K., pp. 1-12.
- Wright, G.A., 2002. *Cormorants and the Loch Leven trout fishery*. University of Glasgow, PhD, Glasgow, p. 250.

Wright, G.A., 2003. Impact of cormorants on the Loch Leven trout fishery and the effectiveness of shooting as mitigation, in: Cowx, I.G. (Ed.), *Interactions between fish and birds: implications for management*. Blackwell Science Ltd pp. 288-297.

Yoder, C.A., Mayle, B.A., Furcolow, C.A., Cowan, D.P., Fagerstone, K.A., 2011. Feeding of grey squirrels (*Sciurus carolinensis*) with the contraceptive agent DiazaCon (TM): effect on cholesterol, hematology, and blood chemistry. *Integr. Zool.* 6, 409-419.

Young, J.C., Marzano, M., White, R.M., McCracken, D.I., Redpath, S.M., Carss, D.N., Quine, C.P., Watt, A.D., 2010. The emergence of biodiversity conflicts from biodiversity impacts: characteristics and management strategies. *Biodivers. Conserv.* 19, 3973-3990.

ANNEX 1: CONFLICTS EXCLUDED

- 1) All conflicts relating to species other than birds & mammals (working definition of 'wildlife')
- 2) All wildlife management issues where there are not 2 or more opposing groups of stakeholders e.g. Deer causing traffic accidents, Bats in buildings, Bats & birds at wind farms, Badgers & development
- 3) Ospreys at fish farms where conflicts offset by photography opportunities
- 4) Beaver conflicts with riparian, fisheries & forestry interests - currently subject of re-introduction trials. Whole case, including conflicts, will be reviewed at the end of the trial in 2015
- 5) Non-native invasive species, e.g. American mink - subject to their own report
- 6) Salmon farming conflicts with wild salmon fisheries - a conflict arising from the impact of one industry / stakeholder group directly on another, akin to environmental / conservation impacts of mining or agriculture
- 7) Non-terrestrial species conflicts, therefore exclude those associated with marine fisheries & sea birds, eider ducks and mussel farming, etc.
- 8) Badgers & bovine tuberculosis - bTB is not endemic in badgers in Scotland

ANNEX 2: BLOG SITES AND WEB LINKS CONSULTED

en-gb.facebook.com/pages/Scottish-Gamekeepers-Association-SGA/167161106680272
forums.shootinguk.co.uk/
heathertrust.blogspot.co.uk
heathertrust.blogspot.co.uk/2010/07/culling-mountain-hares-for-tick-and.html
lochlevenfisheries.wordpress.com/
lochlevenfisheries.wordpress.com/2012/04/10/loch-leven-fishing-report-week-ending-8th-april-2012/
markavery.info/
northernredsquirrels.org.uk/about.htm
raptorpersecutionscotland.wordpress.com/
raptorpolitics.org.uk/
www.animalaid.org.uk/h/n/CAMPAIGNS/wildlife/ALL
www.animalaid.org.uk/h/n/CAMPAIGNS/wildlife/ALL/595/
www.badgerland.co.uk/help/solutions.html
www.basc.org.uk/en/codes-of-practice/
www.bbc.co.uk/blogs/natureuk/2011/11/liz-bonnin-the-science-behind.shtml
www.bbc.co.uk/news/uk-scotland-highlands-islands-17230980
www.bbc.co.uk/news/uk-scotland-highlands-islands-20875309
www.birdforum.net
www.bovinetb.info/scotland.php
www.facebook.com/redsquirrels-survival-trust
www.forestry.gov.uk/pdf/fcpn6.pdf/\$FILE/fcpn6.pdf
www.jmt.org/news.asp?s=2&nid=JMT-N10730
www.knowledgescotland.org/briefings.php?id=158
www.langholmproject.com
www.league.org.uk/blogs/2/league-against-cruel-sports
www.moorlandforum.org.uk/Who+are+we
www.newscientist.com/article/mg19325920.500-controlling-hedgehogs.html
www.onekind.org/all_blogs/
www.onekind.org/useful_links/media/for_immediate_release_onekind_calls_for_a_close_season_for_seal_mothers_and
www.rspb.org.uk/advice/gardening/unwantedvisitors/gulls/thelaw.aspx
www.salmonfishingforum.com/forums/
www.sciencedaily.com/releases/2011/05/110510074426.htm
www.scotland.gov.uk/Topics/Environment/Wildlife-Habitats/management/species/geese
www.scotlink.org/files/policy/PressReleases/LINKDeerTFPressReleaseFeb12.pdf
www.scotster.com/forums/scottish-wildlife/
www.scotster.com/forums/scottish-wildlife/An-Unwelcome-Garden-Visitor.2784.html
www.scottishbadgers.org.uk
www.scottishgamekeepers.co.uk/blog_archive
www.scottishgamekeepers.co.uk/content/change-our-skies-raptor-predation
www.scottishlandandestates.co.uk/index.php?option=com_content&view=category&id=94&Itemid=127&tag=3&type=41
www.snh.gov.uk/about-scotlands-nature/wildlife-and-you/badgers/mitigation/
www.tayside.police.uk/wildlife/countrywatch-partnership.htm
www.the-environment-council.org.uk
www.thestalkingdirectory.co.uk/forumdisplay.php/8-General-Discussion
www.thestalkingdirectory.co.uk/showthread.php/19741-the-article-in-the-sun-news-paper?
www.thestalkingdirectory.co.uk/showthread.php/54404-demise-of-the-red-deer
www.urbanseagullcontroll.co.uk
www.wildlifeextra.com/go/news/scottish-countrywatch.html#cr

ANNEX 3: QUESTIONS DISCUSSED WITH STAKEHOLDERS DURING CONSULTATIONS

Name / organisation	
What do you / your members perceive as the main wildlife conflicts, issues or management practices relevant to conflicts that you deal with?	
What are your specific concerns regarding these?	
Are you aware of any mitigation management practices being carried out to resolve these?	
If so, how effective are they? Under what conditions?	
What's the evidence?	
And to what extent are they being carried out?	
Ideas / suggestions of what should be done	
Are there any specific individuals involved in testing mitigation methods that it would be useful for me to speak to?	
Have any reports, articles or other documentation been produced regarding these mitigation methods?	
Other comments	

ANNEX 4: STAKEHOLDER CONSULTATIONS

(1) Sector	Government Agency
What do you / your members perceive as the main wildlife conflicts, issues or management practices relevant to conflicts that you deal with?	Remit covers mammals and birds except deer (DCS/SNH) & seals/ cetaceans (SMRU). Conflict species and associated issues are numerous and vary regularly, being influenced by the nature of conflict (financial implications & number of people affected), changes in the population size of the wildlife species in question, and changes to the regulatory environment.
What are your specific concerns regarding these? Main issues regarding badger conflict in Scotland	Varies with each species, and changes over time. For example, since the 1992 Badgers Act the badger population in Scotland has increased, and probably continues to do so. Conflict has included minor nuisance through to extreme cases of subsidence & erosion caused by excavation, damage to a variety of different crops (field and stored), predation of livestock, and disease risks and implications. Depending upon the nature of the conflict, obtaining adequate/suitable evidence for a licence may be problematic, and finding an effective, simple solution that the complainant is willing to try, can raise additional difficulties. Probably a need to review or broaden policy?
Are you aware of any mitigation management practices being carried out to resolve these? If so, how effective are they? Under what conditions?	In licensing cases, a wide range of non-lethal mitigation techniques will be discussed with applicants, as well as the implications of lethal control (not always the most effective solution, although applicants may not believe this is the case). Most are techniques that have been used elsewhere, and often well established, although the applicant may not be aware of them or may not have considered them feasible. Some techniques are identified from discussions with colleagues elsewhere or experienced stakeholders. Many identified from searching, knowledge and application of scientific literature where techniques have been trialled, and others trialled directly. Efficacy of a given technique will be dependent upon species, behavioural context of conflict, logistical nature of the conflict, time of year, and willingness of applicant to apply mitigation. In most cases, appropriate mitigation depends on individual & site-specific circumstances.
What's the evidence?	Often evidence of effectiveness is based on scientific scrutiny when tested experimentally and published. Sometimes evidence is anecdotal but based on experiences of a large number of people. Very occasionally based on first-hand experience when trialled. May possibly include an element of novel application across species.
And to what extent are they being carried out?	Site visit essential for licence application – important for determining what can /cannot

	reasonably be achieved given the individual circumstances. Very dependent on the context & the individual – problem not necessarily with techniques but with the people applying them or willing to try them. Applicants may claim to have tried a technique but questioning may reveal a lack of understanding of the technique and unsuitable application of it. Very rarely conduct additional site visit to check mitigation techniques are being tried – too time & resource consuming.
Ideas / suggestions of what should be done	Need for:- 1. formal review of acceptable techniques/outcomes based on conservation status of species in question; 2. investigations into novel mitigation techniques; 3. education of applicants, e.g. through appropriate guidance; 4. consistent approach by licensing representatives.
Have any reports, articles or other documentation been produced regarding these mitigation methods?	Many techniques based on published research. Some techniques tested less rigorously or could be derived anecdotally. Individual case histories for licences may reveal some patterns.
Other comments	Site visit often essential for licence applications allowing individual circumstances to be assessed. Often a case of advising applicant how to go about collecting necessary evidence to support a licence application. Licence applicants often haven't thought through full extent of problem or tried possible alternative techniques, and opinion may be confounded by misinformation from lay sources, e.g. the use of diversionary feeding in time limited circumstances. Ideally, techniques need to be easy to encourage use of them.

(2) Sector	Land/ Fisheries Management
What do you / your members perceive as the main wildlife conflicts, issues or management practices relevant to conflicts that you deal with?	deer / forestry raptor / grouse hares no problem, not many. Neighbour killed all the hares & now regretting it as hares are important eagle prey. So now eagle takes grouse.
What are your specific concerns regarding these?	Grouse management - very heather dominated, little grass, so little alternative prey & harriers do take lot of grouse. Eagles - c.70 adult grouse found at nest post-fledging per season. Total take will be much higher.
Are you aware of any mitigation management practices being carried out to resolve these?	Deer/forestry – public sector (FC) strategy going for v. low density, commercial sector have higher dens deer - able to get 2 nd rotation up better than expected. Estate could support higher deer pop but keep it low to reduce conflict with neighbouring farmers. Strategic deer fence allows hill & forest deer to be managed as 2 pops. Harrier / grouse – diversionary feeding.

If so, how effective are they? Under what conditions?	Strategic fencing works well Diversionary feeding (DF) works well for harriers, feed 50 m from nest, female has alternative perches so put food out on those. Trialled in 2011, best grouse year for 24 y but not a simple cause and effect as the trial coincided with peak grouse year. Eagles difficult to feed because no strategic point for putting food out & too much live prey. May work better in west? Also they would not tolerate the daily disturbance of DF close to the nest in the same way that harriers do. Hare culling: Estates where hares shot out (& deer fenced out or shot & sheep mops used) successful in getting high grouse density – seems effective.
What's the evidence?	DF: field observations in one season. Put up hide at provisioning sites, counted food items, black & red grouse, pipits (50:50). Estimate 200 grouse chicks saved during season – 1 harrier pair (didn't feed every day so could count difference in natural food deliveries). All fledglings marked. Most lost tags over winter but 1 female returned briefly before moving away.
And to what extent are they being carried out?	Don't know anywhere else feeding harriers except Langholm
Ideas / suggestions of what should be done	Tougher deterrents would reduce persecution rates
Have any reports, articles or other documentation been produced regarding these mitigation methods?	Only 1 season's data of diversionary feeding, not written up
Other comments	Capercaillie, pine marten – no management, lots of pine marten, now few caper but probably not due to predation

(3) Sector	Government Agency
What do you / your members perceive as the main wildlife conflicts, issues or management practices relevant to conflicts that you deal with?	Testing diversionary feeding (DF) of raptors (but not in context of conflict)
What are your specific concerns regarding these?	Use DF as means of catching raptors for monitoring projects and also releasing black grouse from predation.
Are you aware of any mitigation management practices being carried out to resolve these?	On-going, expanding DF programme for buzzards, eagles, ravens, crows, goshawks. Habitat management to remove invasive plants (Rhododendron) & improve natural prey base for predators.
If so, how effective are they? Under what conditions?	DF works really well – seems all raptors would use bait, especially effective for eagles, buzzards and ravens. Need to match season with territorial behaviour if using for conflict mitigation. Buzzards & eagles fed in winter - use shot goat / deer carcasses (badly shot /

	young). Need big bait for eagles that they can't carry away. Also stops fox or badger taking it. Raised plinth or urinate round it to keep mammals away. Little eagle food in winter available locally (C&W Scotland). Not tried feeding buzzards or eagles in summer when flies are a problem, although eagles will come to bait sites in late summer. Goshawks fed in breeding season with grey squirrel & rabbit (not possible in winter as they go off territory).
What's the evidence?	Camera traps at each bait site, record number of visits, sp. & ID. Many of raptors marked so camera traps could be used for CMR. Haven't collected data to show whether it reduces predation on vulnerable species or improves fledging success.
And to what extent are they being carried out?	Over a dozen sites, mostly C. Scotland but now starting in West. Feeding 30-40 buzzard territories & 6 different eagle territories. Up to 5 eagles feeding on same bait – parents & offspring of previous 2 seasons. Also buzzards and eagles using same baits at different times at some low elevation sites. Langholm keeper believes DF buzzards won't work because lots of live prey, yet they are taking pheasant poults from midden.
Ideas / suggestions of what should be done	Eagles - once feeding site established in winter, would they continue to come in breeding season? Problem is keeping large bait fresh in summer, but if aim is conflict mitigation may be sufficient to provide smaller bait that they can carry away. Ravens could be drawn away from lowland farms during lambing if carcass put out in nearby area. But not allowed to leave fallen stock which would be natural food for predators so they take newborn instead. Also control of other predators now relaxed by many farmers. White-tailed eagles going to be bigger problem as pop grows & moving into areas where farmers aren't used to them, e.g. lowlands. Golden eagles don't go on lowland farms.
Have any reports, articles or other documentation been produced regarding these mitigation methods?	No documentation or analysis / collation of data. But lot of photos.
Other comments	Can be time consuming to set up & if need to put out bait frequently, but in winter if use large bait little time needed. May need to establish bait site in heart of territory, away from nest sites, e.g. along ridges where eagles soar.

(4) Sector	Government Agency
What do you / your members perceive	Main issues: human-wildlife conflicts of any kind

as the main wildlife conflicts, issues or management practices relevant to conflicts that you deal with?	(crop and forestry damage, infrastructure damage, traffic accidents, diseases, predation on livestock and conservation species, environmental impact on plant and animal species or communities. Species: any overabundant wildlife species. Overabundant defined as those causing intolerable impact on human activities.
What are your specific concerns regarding these?	Population control, damage mitigation, disease control
Are you aware of any mitigation management practices being carried out to resolve these?	Main methods involved with: Immunocontraception & translocation. Translocation really not a good solution, many associated problems, cost, transfer of pathogens and not as good for animal welfare as people imagine. Immunocontraception available for all instances where culling is unfeasible, illegal, unpopular but must be regarded as only one of the many tools in population management
If so, how effective are they? Under what conditions?	Immunocontraception very effective & cheap compared with surgical sterilisation. Population-level effect requires treating a proportion of the population, how large this is depends on population dynamics. Injectable vaccine 'GonaCon' worked on every species tried. Injectable vaccine PZP also effective but need booster doses
What's the evidence?	In the UK: Trials in captive wild boar, on-going trials in captive and free-living badgers, trials in free-living goats and trials in laboratory rats. Elsewhere: Successful trials on horses, elephants, marsupials, deer, cats, seals, prairie dogs, white-tailed deer and other ungulates
And to what extent are they being carried out?	Used increasingly in N. America and explored for wildlife management in UK, Africa and Australia
Ideas / suggestions of what should be done	Need to educate the public about the limitations / disadvantages of translocation. Immunocontraception in hedgehogs: available immediately for research purposes. Currently hedgehog capture season for translocation is very short to avoid moving lactating females. Could catch, vaccinate, release, recapture & then translocate when you know it is infertile. Increases length of capture period. Deer in UK: immunocontraceptives available for research now but need to test impact and cost to manage isolated populations. Currently looking for isolated pops to test in Scotland & develop protocol. Oral vaccine not available. All usual darting issues, although should be able to re-dart if had part dose. So may be easier to administer to trapped individuals – labour intensive. Isolated population has no immigration / emigration, don't know what would happen when expand to non-isolated population e.g. towns - will reducing density by contraception lead to immigration & so not resolve

	over-population problem? Need to trial / model. Badgers: currently being tested in urban badgers Wild boar: need to test on free-living population with low hunting pressure (otherwise vaccinated animals are quickly lost). Seals: ready for testing. In all the above, testing effects of fertility control in isolated populations is better due to no immigration / emigration.
Have any reports, articles or other documentation been produced regarding these mitigation methods?	Sent copies of published papers
Other comments	Nice thing about immunocontraception is that it doesn't use hormones so no contamination of environment and treated animals can potentially safely enter human food chain (treated feral pigs allowed to enter human food chain in USA Humane Society International agreed to use of immune-contraception in wild horses in US – this has given it credibility as a humane technique.

(5) Sector	Independent expert
What do you / your members perceive as the main wildlife conflicts, issues or management practices relevant to conflicts that you deal with?	Ravens – sheep farmers Buzzards at pheasant release pens - big issue in NE Scotland. Cormorants / fish eating birds /otters at put & take fisheries & fish farms.
What are your specific concerns regarding these?	Ravens – no evidence of predation problems, still quite rare in NE Scotland, only 3-4 breeding pairs. Large roosting population /young birds – influx from West, but being killed under licence before pairing. Traditionally no raven nesting sites in NE as occupied by eagles but eagle persecution has opened up territories. Whitetailed eagle – reduction in sheep stocking density on Mull under 'Natural Care' conservation payment scheme has lessened problem. Farmers are given payments for reducing stocking density so many now just keeping sheep on good quality low ground. Better condition sheep less likely to be predated. But as WTE pop grows so Natural Care claims increase across range – have to have birds on your ground or using your ground to be eligible. Saw-billed ducks – licensed shooting continues but otherwise gone quiet. Seems to be an acceptance that salmon problem is at sea.
Are you aware of any mitigation management practices being carried out to resolve these?	Otters at fish farms, like ospreys, put up hide & charge photographers / tourists. Manipulate size of fish in ponds so that ospreys come to hide pond. Use of electric wire on bank around fish farms to stop otters & wires along bank to keep herons from wading in.
If so, how effective are they? Under	

what conditions?	
What's the evidence?	Anecdotal
And to what extent are they being carried out?	
Ideas / suggestions of what should be done	Pheasant release pens need net over to keep buzzards out but that restricts possible pen size
Have any reports, articles or other documentation been produced regarding these mitigation methods?	
Other comments	Game bird industry demands something that can't be delivered within the law – keepers being harassed by peers. Persecution in NE seems worst it's been for decades. Lot of meetings but stakeholders not sticking to rules & end up tit-for-tat point scoring. SNH personnel not getting out to the field enough so in meetings show themselves up. Need central independent mediator, SNH is govt conservation body so not independent.

(6) Sector	Government Agency
What do you / your members perceive as the main wildlife conflicts, issues or management practices relevant to conflicts that you deal with?	WT Eagles (WTE), ravens– agricultural losses; Raptors (especially buzzards) – game birds
What are your specific concerns regarding these?	Predation that leads to significant impact
Are you aware of any mitigation management practices being carried out to resolve these?	SNH National WTE management scheme pays for improved sheep welfare / condition, increased shepherding, animal health, putting up nesting platforms, eco-tourism development e.g. cameras. Based on paired birds but some provision for non-breeding/immature birds. East coast release problems generally more perceived than actual, SNH & RSPB paid to put up fences around geese pens on some small holdings. Long-standing idea that WTE eat sheep & lambs & that's why we got rid of them. In west, relatively relaxed about giving licences for ravens causing agricultural losses as pop. there is healthy & ravens are known to cause problems. Young ravens in large flocks previously fed at landfill but now denied access so hanging around farms (specific to west coast, mainly islands). No licence given yet for raven damage to wild bird pops., e.g. black grouse & waders - difficult to gather sufficient appropriate evidence. Pheasant-release pens: Need cover/ shelter in pens, net over top at vulnerable times. Owners often need to do more to minimise or mitigate the risk of predation. During lambing, changing management or bringing ewes in should be done wherever practical to

	minimise predation risks
If so, how effective are they? Under what conditions?	Bringing ewes in to lamb & for long enough period that lambs gain immunity against various diseases (passed on from mothers that have been dosed) really helps against WTE through improved condition. Licensing seems to deal with raven problem, but process perceived by some as too slow. Speeding up the process would require more applications to be taken on trust that there was a problem.
What's the evidence?	BASC & ADAS studies show low predation /overall impact by buzzards at pheasant release pens but game keepers still perceive a problem.
And to what extent are they being carried out?	No buzzard licences ever given – would be perceived as setting a precedent.
Ideas / suggestions of what should be done	
Have any reports, articles or other documentation been produced regarding these mitigation methods?	BASC & ADAS report on pheasant release in Birds of Prey in changing environment Moorland Forum report (Park <i>et. al.</i>)
Other comments	

(7) Sector	Conservation Body
What do you / your members perceive as the main wildlife conflicts, issues or management practices relevant to conflicts that you deal with?	Members from across land use spectrum including members of BASC, SLE & NFU. But not representing membership so not driven by their views - interested in how game management influences conservation. Conflict issues - Once rare predators, now protected and relatively common, possibly affecting formerly abundant but now rare prey and economically important game. How to collect evidence (through experiment & monitoring), inform policy and design management needed for balanced modern conservation. Geese not an issue for members. Legislation conflicts - lack of contemporary relevance (new law a missed opportunity). Protection based ethos based on species status from long time ago, when lapwings were abundant & ravens were rare; adaptive management possible in current legislation but great caution in adopting this approach Process conflicts – monitoring detail does not match need; for game bags there is no point in having mandatory cull returns if you don't know number of individuals out there. If mandatory, risk returns being falsified. For adaptive management, better monitoring of populations by managers and agencies is needed.
What are your specific concerns regarding these?	Ravens - large flocks of sub-adults believed by managers to be causing losses of waders & wild birds. Raven pop has inc. by 150%. Does raven

	control for sheep protection positively affect wader population performance? Pine Martens – climate and predation affect Capercaillie survival in Scotland; to keep Caper we need to use all effective tools now; is control of pine marten predation pressure an effective tool? Needs experimental research. Hares, eagles, ticks, grouse – different stakeholders at interface of each pair of species. Number of hares we're used to is result of red grouse management. So what is sustainable management of hares? Depends on management on neighbouring estates, dispersal and species resilience, which is still poorly known. Keepers say that they are continuing to cull hares after considerable pressure so appears that hares are quite resilient. Black grouse - bird of moorland/woodland edge & as woodland expands, relative area of edge decreases. Open land habitat connectivity must be part of forest planning. Grey partridge predation – at demonstration site in Lothian, has monitored high raptor predation on females & poults; is this due to unusually high raptor pop. and/or the weather altering partridge behaviour? Have all the reasonable habitat management alternatives been tried?
Are you aware of any mitigation management practices being carried out to resolve these?	Legal predator control, disease control & habitat management for red grouse, waders, caper, black grouse and grey partridge reduce some impacts of protected predators - diversionary feeding for harriers, Strongyle worm control for red grouse important in maintaining populations, sheep mops and development of tick control collars for sheep. Agri-environ. and private financed cover and food supply for partridges Licensed control – General Licences for corvids are essential and sawbilled ducks licence on Spey where they give detailed returns.
If so, how effective are they? Under what conditions?	Success of mitigation often seems locally compromised. Legal predator control can be very effective in enhancing many small game and other animal populations. But increasingly is weather and predation pressure acting synergistically to increase impacts? Diversionary feeding appears to work when harriers and grouse are few in number and harrier nests are accessible; but outside these parameters? Hare control in Angus Glens seems effective when combined with removing / excluding deer & using sheep mops. But still don't know how many deer & hares are too many & how many sheep is enough. Novel anti-tick treatment of sheep collars may be important in future

What's the evidence?	Scientific evidence on impacts that cause conflicts being collected as part of future mitigation at a number of projects. Experimental evidence of hare conflicts from Lochindorb and Angus Glens, raptors at Langholm Moor Demonstration Project & Whitburgh Farms Grey Partridge Project. Large scale black grouse radio-tracking project Tummel. Monitoring data: GWCT bag data at landholding level, BASC at individual shooter level, esp. on foreshore.
And to what extent are they being carried out?	Standard management is commonplace across country; legal predator control notably in small game areas; novel mitigation less common
Ideas / suggestions of what should be done	An ethical approach- Intensify management for conservation; resilience in-built by active management Target orientated conservation – what do we want from the countryside? Need to be pragmatic – can't do anything about weather, what can we do something about? Conservation needs to mitigate where it will be effective & it maybe that in certain years / circumstances it may be appropriate to manage predators – possibility for adaptive management licence, i.e. licence with obligation to report returns so allowing opportunity to gather data on consequences of removal under certain set of circumstances. Right thing to do is not easiest thing – give greater independence to managers to manage on condition that they monitor. Experimental research which may involve e.g. predator removal to gather evidence – but policy doesn't allow. Put a research proposal to capercaillie BAP group for backing, then would apply for licence. Licences - should be available for research and adaptive management; monitor affects of licence & decide whether to continue / withdraw – i.e. licence issued with obligation to monitor effects, e.g. of predator removal.
Have any reports, articles or other documentation been produced regarding these mitigation methods?	Annual reviews – sent together with list of literature
Other comments	Concerned about the differentiation between wildlife & land management / habitat – e.g. harrier problem is as much about maintaining moorland habitat quality & extent. Distinction between 'wildlife' conflicts & other conservation issues is artificial & unhelpful. Managers can be tempted to look for easy option – i.e. controlling hares rather than deer, shooting

	buzzards rather than removing last stoat, because they perceive smart, balanced options are unavailable to them for policy reasons.
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(8) Sector	Conservation Body
What do you / your members perceive as the main wildlife conflicts, issues or management practices relevant to conflicts that you deal with?	pine woods – lack of quality native habitat for crested tits, capercaillie, crossbills etc, biodiversity associated with old growth woods & pines - understory blueberry in open canopy of pine forest necessary for capercaillie. Spruce plantations don't allow same understory to survive. Slovenian grebe vs. pike, & otters – even martens can swim out to diver islands
What are your specific concerns regarding these?	older trees produce smaller cones- better for crossbills in autumn & winter Forestry Commission switching to continuous cover forestry - fell 90% & leave seed trees - ok for crossbill, but no good for caper. Recreation along tracks making approx. 20% of pine wood area unavailable to capercaillie. Attempt to remove tracks but opposition from access groups, national park. Difficult to find evidence that birds can simply relocate, but reduces availability & therefore pop size that can be supported. Grebe numbers declining due to poor productivity - & in lochs with introduced pike young grebe survival reduced. Pike fisherman stock lochs & release caught big fish. Also pike eat other fish which removes prey base for ospreys & other fish eating birds. Also increasingly stocking with trout (including rainbows).
Are you aware of any mitigation management practices being carried out to resolve these?	Not really. On continent have found high stress levels in birds around tracks – no mitigation methods found.
If so, how effective are they? Under what conditions?	
What's the evidence?	Camera trap evidence of pine marten predation. No evidence regarding mitigation.
And to what extent are they being carried out?	
Ideas / suggestions of what should be done	Taste aversion in otters but didn't get funding also maybe try scent marking round nests? electric fencing around nest sites On-going research into otter predation of grebes, adult young & eggs. Now analysing data from 3 seasons. Habitat use by pine martens in relation to vole densities – modify grassland to make them less attractive to martens. Long term project - no data at present on habitat modification. 'Present natural woodland', bring back deciduous forest component, especially in areas currently under grassland.
Have any reports, articles or other	Bill Mason (2004) Managing Pinewoods of

documentation been produced regarding these mitigation methods?	Scotland, FC Published articles on pike predation Unpublished reports on scoter by Hancock
Other comments	Pine marten removal – would prefer non-lethal methods. PhD student is monitoring pine marten pop dens but no time to carry out diversionary feeding experiments.

(9) Sector	Government Agency
What do you / your members perceive as the main wildlife conflicts, issues or management practices relevant to conflicts that you deal with?	Deer management: biggest conflict issues are attitudes & perceptions within deer management groups (DMGs). DMGs need to demonstrate that they can manage their deer populations sustainably – proof of competency currently voluntary but will be reviewed in 2015.
What are your specific concerns regarding these?	As conservation interests become bigger players, increased diversity within DMG leads to differences of opinion within groups. Not all traditional managers respect conservation managers & some may not perceive their objectives as equally legitimate.
Are you aware of any mitigation management practices being carried out to resolve these?	DMGs are main forum allowing stakeholder dialogue. DMGs need the skills / tools to manage their deer pops. sustainably. Capacity building within DMGs, training of chairman & secretary – coaching for role of managing diverse groups. New Code of Sustainable Deer Management sets out guidelines – may ultimately be useful as evidence if conflict arises. Collaborative management - thinking about how to make DMG members see the benefits of membership. Technological modelling & mapping tools useful to show what's actually realistic. Map current deer densities & aspirational densities & see where neighbouring properties have very marked differences – flags up potential conflicts and allows informed debate.
If so, how effective are they? Under what conditions?	Code is only just being implemented. Within protected areas, legislation means implementation is generally easier as stakeholders accept certain actions are required. No real test of Code in other areas yet and as Code is only advisory its effectiveness may be limited. Grey area when it comes to delivering public benefits – e.g. if deer numbers should be reduced to reduce conflict with neighbouring interests / public benefits in the form of conservation or protection of natural heritage, but this would result in reduced local employment, would this be considered a loss of public benefits? Changing format of DMG meetings may improve opportunities for constructive dialogue, e.g. seating

	around a table & reconciliatory approach of chairman.
What's the evidence?	Anecdotal.
And to what extent are they being carried out?	Modelling & mapping only being carried out in small areas – requires high-level of expertise so is expensive. Time & skills need to be bought in.
Ideas / suggestions of what should be done	Reducing pop size can have wide range of benefits, including benefits to sporting interests – need really good evidence to show that it works. A good case study would give landowners confidence that reducing numbers is beneficial to sporting interests.
Have any reports, articles or other documentation been produced regarding these mitigation methods?	No
Other comments	Personalities involved play big part in success of DMG. Who should mediate? SNH, ADMG or some other party? Future changes in deer spatial movements likely, e.g. reductions in wintering areas due to fencing. Also reduction in sheep numbers likely to have major effect on deer movements – may lose deer if neighbour takes sheep away.

(10) Sector	Government Agency
What do you / your members perceive as the main wildlife conflicts, issues or management practices relevant to conflicts that you deal with?	Mountain hares - ticks Pine marten - capercaillie Badgers - agriculture and other land uses Otters – fisheries
What are your specific concerns regarding these?	Concerns about sustainability of hare cull – expecting increase in applications for shooting out of season following change in legislation. But we need better information on hare abundance when setting bag limits for licences. Pine martens / capercaillie: 2 comparatively scarce and protected species in which martens are known to predate the eggs of capercaillie, although it unknown whether this predation has a negative impact at the population level – should SNH intervene or not? The wildlife Management Framework is being developed to provide guidance on when to intervene in this kind of situation. Badgers & agriculture – main problem is with setts e.g. in field due for ploughing or farmers ploughing right up to edge of sett (should be 30m exclusion). Farmers either unaware of or ignoring this guideline but not enforced. What is it reasonable to ask farmers to do whilst staying within the law? Otters & fisheries less of an issue in Scotland than in England & Wales where conflict with put & take fisheries in areas where otters were previously not present but have now recovered. Seems to be

	greater tolerance to otters in Scotland as have always been there.
Are you aware of any mitigation management practices being carried out to resolve these?	Hare mitigation – unclear at present; the priority is to develop a reliable and cost effective monitoring method to determine population level effects of culling. Trials of one potential monitoring method unfortunately were disappointing and so we need to consider an alternative approach. Licensing – guidelines on website e.g. raptors. Anti-predator nets at fish farms seem sufficient to deal with otters.
If so, how effective are they? Under what conditions?	Badger legislation covers most situations
What's the evidence?	GWCT hare distribution survey showed no overall change in distribution but not looking at actual numbers. Bag data suggest stable situation but have limitations and only give broad national trend information. It is unclear whether current levels of culling are sustainable in some parts of the country.
And to what extent are they being carried out?	
Ideas / suggestions of what should be done	No immediate solution to hare monitoring issue and so further work is needed here. Seems increasing effort in fox & crow control would be beneficial for capercaillie.
Have any reports, articles or other documentation been produced regarding these mitigation methods?	Pine martens: SNH commissioned reports 415 & 435 – correlational, based on indices. Pine marten expansion zone survey (with Vincent Wildlife Trust) – report to be published soon.
Other comments	Alternative hare counting methods may need to be used – need discussion with researchers, to determine the best way forward. Don't currently have the data to show that the level of culling is sustainable.

(11) Sector	Land/ Fisheries Management
What do you / your members perceive as the main wildlife conflicts, issues or management practices relevant to conflicts that you deal with?	Predation – badger, raptors (esp. buzzards & harriers), ravens Deer
What are your specific concerns regarding these?	Badgers increasing in numbers & moving onto open hill – can't control them. Taking lambs (dead or alive), hens, ground nesting birds & eggs. Raptors, especially buzzards which now very numerous. Deer - trying to regenerate woodland without fencing.
Are you aware of any mitigation management practices being carried out to resolve these?	Tried providing cover, scaring, diversionary feeding for buzzards.
If so, how effective are they? Under what conditions?	Scaring doesn't work – birds are so bold, especially buzzards, know you can't harm them! Diversionary feeding makes birds stronger, teaches

	them to associate vehicle with food so increasing problems at pheasant release pens, increases boldness of birds. Meetings are all talk & no action, used as a delaying tactic - not effective
What's the evidence?	Personal observations / anecdotal
And to what extent are they being carried out?	
Ideas / suggestions of what should be done	Should be a target population size for predators and as numbers rise, licences should become available. Estates should be required to monitor & report wildlife numbers. Raptor quotas – independent expert should determine how many pairs a property should support. Once that number reached, licence issued to disturb additional birds to prevent nesting. Culled individuals can be post-mortemed for evidence of diet. Zonation – some moors allocated as conservation areas, others for driven grouse, could be implemented within quota system. Get politicians / ministers involved. Education of school children about wildlife & wildlife management. Listen to people on the ground (farmers, keepers, etc).
Have any reports, articles or other documentation been produced regarding these mitigation methods?	
Other comments	

(12) Sector	Land/ Fisheries Management
What do you / your members perceive as the main wildlife conflicts, issues or management practices relevant to conflicts that you deal with?	1. Deer Management Groups (DMGs) - differences in management objectives between neighbours 2. Differences within communities (e.g. keepers) due to difference in opinion about methods implemented e.g. for grouse, remove deer.
What are your specific concerns regarding these?	Multi- rather than single objective management is easier to explain and justify.
Are you aware of any mitigation management practices being carried out to resolve these?	1. DMGs, DM Plans, dialogue, training of DMG chairs. 2. For grouse Sheep mops for tick control & complete removal of other tick hosts. 3. ADMG/FCS protocol whereby if deer break into forest block during winter FCS should notify neighbour and give a certain time period before starting to shoot.
If so, how effective are they? Under what conditions?	1. Mediation can be effective if good mediator & both sides prepared to make compromises. 2. Sheep mops seem effective but very intensive & expensive management & not compatible with some other land uses.
What's the evidence?	1. Case studies where mediation has been helpful

	2.GWCT Tick research project in progress
And to what extent are they being carried out?	Sheep mops being used intensively in Angus Glens and elsewhere.
Ideas / suggestions of what should be done	DM plan should include section on conflict resolution – needs to be formalised & for structures to be in place.
Have any reports, articles or other documentation been produced regarding these mitigation methods?	1. No, but the deer management sector will be working on Best Practice Guides covering conflict resolution. 2. Well reported by GWCT.
Other comments	

(13) Sector	Conservation Body
What do you / your members perceive as the main wildlife conflicts, issues or management practices relevant to conflicts that you deal with?	Raptor persecution – largely because it obstructs many other issues
What are your specific concerns regarding these?	Illegal killing and disturbance of raptors. Most prominent with high profile poisoning/trapping of eagles, more widespread and difficult in terms of harrier killing.
Are you aware of any mitigation management practices being carried out to resolve these?	Law enforcement. Media and public opinion. Also estates working in formal and informal partnership with other estates and with the police and conservation bodies to demonstrate good practice by all involved, e.g. Operation Countrywatch in South-west Perthshire, Raptorwatch in Aberdeenshire and the forthcoming Wildlife Estates initiative.
If so, how effective are they? Under what conditions?	Enforcement alone unsustainable with a sporting community in which defiance of the law is socially acceptable, however arrogant and disingenuous their justification. Public opinion alone will not change this, reached limits of its effectiveness years ago. Partnership success is mixed. Operation Countrywatch, for conservation, is very successful at local level. Raptorwatch much less so. Countrywatch involves a smaller number of estates who see the wider value of publicly demonstrating good/legal practice, allowing attendant raptor monitoring to be a more positive exercise. Transparent raptor monitoring, an essential basis for Partnership credibility, is not likely to be acceptable to estates if it is a negative surveillance exercise. By working on smaller scale with willing estates Countrywatch was able to produce an exemplar of good practice. Right approach is likely to be important for success of Wildlife Estates. Clear role for this kind of partnership
What's the evidence?	Monitoring - no significant raptor persecution in 10 seasons. 4 harrier pairs breeding successfully at Glen Turret (driven grouse moor), other 8 kept

	partner estates have walked-up grouse and harriers also breeding successfully – a peak of 20+ pairs. Can't be definitive about absence of persecution but over years can make fairly sound judgements based on consistent monitoring of local populations and comparisons with other areas. Countrywatch did not make any claims until after 4 years and this timescale was accepted by all partners at the outset. Important also to note that good practice is required of all partners e.g. monitoring protocols, liaison etc.
And to what extent are they being carried out?	Partnerships so far confined to 3 above. Limited by prejudices of both sides. Instead of acting as an exemplar, Countrywatch held up a mirror to these prejudices. Conservation, for example, has institutionalised the conflict and appears to see partnership as a threat, looking for crime on the partner estates, suggesting the Partnership was soft on keepers, discounting the partner estates because they were not driven estates, seeing the monitoring as raptor protection, etc.
Ideas / suggestions of what should be done	The tone of the conflict is set at the national level and in national enforcement initiatives. This polarises the conflict, perpetuating a monolithic view of both sides and a crude confrontational view of issues. Constructive local dialogue is needed to mediate this. It is the unwillingness to find locally appropriate solutions that is the obstacle. Some trust and tolerance of initial problems, including persecution incidents within Partnerships, is needed together with a long-term view. Would be naive to believe that there will be agreement on raptors – that did not exist in Countrywatch – but the current extreme polarisation is not necessary or inevitable.
Have any reports, articles or other documentation been produced regarding these mitigation methods?	Partnership brief – annual reports document results in terms of no. breeding raptors, black grouse & other species counts
Other comments	There is a focus on technical solutions (diversionary feeding, raptor quotas/translocation/brood management, satellite tagging eagles to publicise poisoning) to a non technical problem. Technical solutions are necessary but many sporting interests will not accept them, however effective they are. Raptors are a conveniently polarising focus for a wider political/cultural conflict over who controls land. The sustainable solution for raptors is to reduce the polarisation by, among other things, a more sophisticated media approach which recognises some diversity in the sporting community, attempts greater local dialogue and fosters positive peer-pressure among responsible sporting interests. Currently even responsible sporting interests will close ranks behind

	outrageous illegal activity practised by others. Grouse managers have not earned the right to manage raptors, even if there was a legal loophole for that to happen. It is clear that the law will not be changed, so where are they taking the conflict – permanent reputational disaster? One outcome of dialogue and good practice for them might be greater credibility for their arguments.
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(14) Sector	Land/ Fisheries Management
What do you / your members perceive as the main wildlife conflicts, issues or management practices relevant to conflicts that you deal with?	Policy conflict with aquaculture; Saw-billed ducks; Seals; Tay beavers
What are your specific concerns regarding these?	Predation by saw-billed ducks – overall not significant impact, although depends on development stage & time of year. Most juvenile salmon taken are replaceable loss, but juvenile salmon taken during spring movement to sea are irreplaceable. Conflict arises with licensing authority as evidence required for licences can be considered to be disproportionate to licence issued. Conditions for issuing a licence are becoming increasingly more stringent. Now some fisheries boards and trusts are able to provide fairly robust evidence in support of licence applications but are advised that the burden of evidence required has increased. Seal predation – has been big issue in Moray Firth but elsewhere licence applications on the wane. And competency requirements of people to shoot seals now tighter, so reducing no. seals shot. Beavers in Tay – very polarised views, perceived to be almost socially unacceptable to say that beavers may cause problems despite legitimate concerns from fisheries sector. Most issues actually probably manageable but poor handling means that legitimate concerns are now difficult to raise without standing accused of being unreasonable. Tay animals illegally released & of unknown origins so should not be tolerated, regardless of impacts.
Are you aware of any mitigation management practices being carried out to resolve these?	Lethal control, but increasingly difficult to get licences. Moray Firth Seal Management Plan: by providing good evidence base stakeholders now more reasonable – good model.
If so, how effective are they? Under what conditions?	Moray Firth strategy has been successful in changing people's attitudes through recognising the evidence & agreeing what's reasonable & what's not. Does project need to continue once attitudes changed? Scaring short-term, with practical limitations.
What's the evidence?	Moray Firth scheme based on good science,

	evidence gathering. Saw-billed duck licences require monitoring evidence, available from some rivers.
And to what extent are they being carried out?	
Ideas / suggestions of what should be done	Needs to be decision of whether or not saw-billed ducks can be killed – currently it's a legitimate management option but perceived to be being removed by stealth due to increasing evidence requirements. All parties need to agree a standard or common level of what information & level of evidence is required for a licence to be issued. Currently goal posts are perceived to be being moved & the effort required to secure evidence has become, on occasion, disproportionate to the licence being sought.
Have any reports, articles or other documentation been produced regarding these mitigation methods?	
Other comments	Successful mitigation requires finding common ground – a good evidence base makes this easier.

(15) Sector	Conservation Body
What do you / your members perceive as the main wildlife conflicts, issues or management practices relevant to conflicts that you deal with?	1. Raptors – grouse (biggest, always on desk, now including pheasant-rearing / buzzards but latter is highest profile in England) 2. White-tailed eagles (WTE) & lamb predation 3. Wintering geese & agriculture (recently re-emerging) 4. Pine marten vs. capercaillie (recently emerging) Others: Buzzards in general, may be bigger issue from perspective of wildlife crime Ravens - likely to go up agenda if agricultural damage license applications increase Racing pigeons - periodically re-emerges but science showing lack of significant impact of raptors on racing pigeon interests is solid Deer management & impact on woodland grouse International example: impact of fishing methods (e.g. gill netting & long-lining on seabirds)
What are your specific concerns regarding these?	Raptor persecution Geese conflict depends on funding situation – as money restricted, issues rise up agenda again. Deer management - want low deer densities for woodland grouse & pine forest regeneration
Are you aware of any mitigation management practices being carried out to resolve these?	Raptors: Diversionary feeding – key part of Langholm Moor Demonstration project but no major uptake elsewhere on grouse moors that I am aware of. Population modelling to establish level at which impact on grouse informed Environment Council discussions of harrier-grouse conflict. WTE: payment programme & tourism benefits

	Goose: payments also successful. Goose fencing pilot trial RSPB / SASA – needs further study. Adaptive harvest management now being promoted by SNH/Scottish Government and trialled for greylag geese on Orkney. Deer management: removing or marking fences - successful Pine marten: diversionary feeding trial in Trossachs, potential for manipulating small mammal numbers by habitat management
If so, how effective are they? Under what conditions?	WTE payments successful. Also positive element as incentive to attract eagles. Eagle tourism has had economic benefits on Mull. Active discussions about raptor/grouse issues through Environment Council but broke down due to high background level of persecution (hen harriers now almost extinct as a breeding bird in England), despite evidence that modest hen harrier breeding densities are unlikely to affect ability to manage driven grouse shoots.
What's the evidence?	Population modelling shows that in many cases a few pairs of hen harriers will have little impact on shootable surpluses of grouse.
And to what extent are they being carried out?	Diversionary feeding shown to be highly effective whenever and wherever trialled, but still virtually no uptake by grouse moors
Ideas / suggestions of what should be done	Adaptive management of geese: using pop models & strong scientific basis for agreeing ceiling & then controlling numbers – but no commercial exploitation. Also reasonable evidence that biodiversity value of machair may be compromised by high goose density & subsequent changes to farming practices – a good argument for adaptive harvest management. Grouse management: need a shift in attitudes & management of driven grouse towards more sustainable approach. All discussions focus on raptor management & more or less no discussion on intensive management of grouse.
Have any reports, articles or other documentation been produced regarding these mitigation methods?	Evidence of effectiveness of many mitigation methods is in peer reviewed literature (e.g. marking of deer fences for woodland grouse; modifications of long liens & gill nets; diversionary feeding of hen harriers, and many others). Goose fencing trial study in Uists exists as an informal report.
Other comments	Is high buzzard pop due to intensive pheasant rearing? Langholm – diversionary feeding of harriers & predatory impact of buzzards on grouse (hardly taking any) No current research on WTE or geese Research on pine martens at Abernethy, phd student at Stirling, proposal for marking individuals at Abernethy. Plan to follow up pine marten work –

	capercaillie in 5 Strathspey forests, all with pine marten but very different caper breeding success – why?
(16) Sector	Land/ Fisheries Management
What do you / your members perceive as the main wildlife conflicts, issues or management practices relevant to conflicts that you deal with?	(N.B. from west coast perspective only) WTE, Ravens, Geese
What are your specific concerns regarding these?	WTE predation – threat to survival of hefted sheep flocks, Ardnamurchen, 1/3 lamb production lost, no other predators involved. Healthy lambs on Mull also taken, eating heart & livers only. WTE v. bold & intimidating
Are you aware of any mitigation management practices being carried out to resolve these?	Raven licensing Goose management, not working now as geese have become too abundant WTE payments - but not solution for hefted flocks
If so, how effective are they? Under what conditions?	Unintended consequences of goose management – now too many, so people taking into their own hands, illegally killing & dumping geese.
What's the evidence?	Landowners' evidence of WTE predation not in agreement with the scientific evidence. Dumping of geese in reported in newspaper
And to what extent are they being carried out?	
Ideas / suggestions of what should be done	Goose management scheme not effective use of govt. money – sustainable exploitation, business opportunities that could eliminate need for govt. funding
Have any reports, articles or other documentation been produced regarding these mitigation methods?	See input to recent Goose Management review
Other comments	Impasse between land managers & likes of RSPB, need to get independent, new, research evidence to enable everyone to sit round the table

(17) Sector	Conservation Body
What do you / your members perceive as the main wildlife conflicts, issues or management practices relevant to conflicts that you deal with?	Hare - grouse
What are your specific concerns regarding these?	Trying to reduce tick burdens
Are you aware of any mitigation management practices being carried out to resolve these?	Sheep mops, heavily treated with acaracide. Dosed more frequently than required for treatment of louping-ill in sheep. Requires gathering more often so labour intensive.
If so, how effective are they? Under what conditions?	Tick numbers have dropped dramatically & been low for a couple of years. As long as current management maintained should have tick problem under control. But difficult to know how much of effect is due to sheep mops rather than reducing densities of alternative hosts and increase in

	intensity of other management / increase no. keepers – all changed at the same time. Don't know how low alternative host density needs to be for sheep mops to be effective so most estates currently going for extremely low levels. Limitations in estimating alternative host density - no good method for counting hares & deer counts made on winter range rather than where deer are during grouse breeding season. Have to use population indices.
What's the evidence?	Scientific monitoring, correlative data
And to what extent are they being carried out?	Advice to use sheep mops spread across east of Scotland where grouse is main management.
Ideas / suggestions of what should be done	First use sheep mops, if still have lot of ticks, control deer. Controlling hares should be last resort.
Have any reports, articles or other documentation been produced regarding these mitigation methods?	Report to Angus Glens estates due in New Year
Other comments	Despite heavy hare culling in Angus Glens do still see hares but no feeling for whether population is viable.

(18) Sector	Land/ Fisheries Management
What do you / your members perceive as the main wildlife conflicts, issues or management practices relevant to conflicts that you deal with?	Saw-billed ducks Seals
What are your specific concerns regarding these?	Dramatic decline in Beaully Firth & Cromarty Firth saw-billed duck over-wintering populations. SPA designation includes saw bills. Now becoming apparent that birds coming into the rivers are not the same – problem with mobile sp.
Are you aware of any mitigation management practices being carried out to resolve these?	Moray Firth Seal Management Plan. Similar process now started for saw-billed duck management plan including fisheries boards, SASA, Marine Scotland & Pitlochry Freshwater lab. Establishing pop size, monitoring & modelling number that could be culled.
If so, how effective are they? Under what conditions?	Fisheries management through Scottish Fisheries Trusts is very evidence based, following success of seal management plan. That has taken heat out of conflict
What's the evidence?	monitoring data
And to what extent are they being carried out?	Just started process in Moray Firth
Ideas / suggestions of what should be done	
Have any reports, articles or other documentation been produced regarding these mitigation methods?	
Other comments	Anglers are less easy to convince & especially netsman but scientific managers now all on board.

(19) Sector	Conservation Body
What do you / your members perceive as the main wildlife conflicts, issues or management practices relevant to conflicts that you deal with?	Raptors at release pens Also raptor & raven impacts on wild birds. Geese not big conflict for members. Badgers likely to be an increasing problem but not as many licence applications as expected. WTE little impact on game birds. No real complaints about pine martens at release pens.
What are your specific concerns regarding these?	In Scotland buzzards & pheasant most serious issue, but not sure if problem is really serious in terms of economic or numeric impact. Raptors only a minor disturbance on shoot days. Frustration that it is more difficult for keepers to get licence for ravens impacting on wild birds & pheasants than it is for farmers with sheep. Members are happy that numbers of geese increasing but frustrated where populations of protected species have increased but licences are not issued.
Are you aware of any mitigation management practices being carried out to resolve these?	At release pens keepers should follow guidelines regarding use of scarers & pen design. One keeper has reported success with eagle silhouette scarer. Welcome review of goose management scheme, particularly that option of adaptive management is being considered.
If so, how effective are they? Under what conditions?	Keepers say mitigation not effective but not clear whether they have really tried properly
What's the evidence?	Only anecdotal evidence
And to what extent are they being carried out?	Not sure how many keepers really do use mitigation measures at release pens
Ideas / suggestions of what should be done	Small evidence gathering project to be carried out next summer involving 50 keepers from across country. Plan to test various scaring devices (e.g. plastic owls, eagle silhouettes) at release pens of varying sizes. Will also test diversionary feeding starting at least 2-3 weeks before releasing.
Have any reports, articles or other documentation been produced regarding these mitigation methods?	Allen <i>et. al.</i> 2000
Other comments	It is possible that in some summers a lot more poults may be lost to bad weather than to raptors

(20) Sector	Land/ Fisheries Management
What do you / your members perceive as the main wildlife conflicts, issues or management practices relevant to conflicts that you deal with?	Geese WTE Deer Ravens Not badgers as very localised & licensing allows real problems to be dealt with.
What are your specific concerns regarding these?	Concerns differ with species & locality but when hill farming systems are so vulnerable anyway, problems with geese, WTE, ravens or deer

	perceived as the straw that breaks the camel's back. Issue is with numbers e.g. WTE on Mull, high density in concentrated areas where lambing percentages are low & every lamb counts - less able to absorb the losses than where lambing percentages high. Deer: changes due to new WANE act & sustainable management code mean tenant hill farmers on stalking property perceive that they're less able to remove deer in spring – creates tension when farmer's position is already vulnerable. Barnacle geese numbers on Islay have increased from 5,000 to 45,000, now reached a tipping point. Farmers have been working hard to support geese but can't continue to support more & more indefinitely. They may soon go out of business which will have detrimental impacts on geese as well as local social & economic impacts.
Are you aware of any mitigation management practices being carried out to resolve these?	Natural care package / WTE Scaring – narrow legal window, farmers cautious of trying out new methods as don't want to be accused of disturbing birds esp. in breeding season which often coincides with season of impact. Birds Directive constrains activity. Not possible to manage scaring on landscape scale, 24hrs a days as would be needed e.g. with WTE at lambing time. In Norway, small sheep flocks & lamb indoors or confined area – not possible on west coast where lamb on hill. Diversionary feeding - farmers don't like idea as afraid will increase number of predators.
If so, how effective are they? Under what conditions?	Economic benefit of WTE not being felt by those with greatest economic losses. Natural Care package helped to some extent, but current package limited timeframe & limited budget. Not just about money so much as trying to maintain an active hill farming community.
What's the evidence?	None provided
And to what extent are they being carried out?	
Ideas / suggestions of what should be done	Need new contract between farmers / crofters & government for the delivery of public, conservation & environmental benefits. With CAP reform, Rural development plan for Scotland provides opportunity – the social & environmental benefits of sustainable hill farming are huge but need to include minimum activity requirements to unlock payments, e.g. minimum stocking levels. Don't want to have empty hillsides, need farmers to be active & keeping sheep flocks in more vulnerable areas. How to manage impact given that local areas differ – need tailored solution, e.g. problems with greylags in Orkney different from barnacle geese on Islay. Same solution not necessarily appropriate for

	both.
Have any reports, articles or other documentation been produced regarding these mitigation methods?	Couldn't think of any
Other comments	

(21) Sector	Government Agency
What do you / your members perceive as the main wildlife conflicts, issues or management practices relevant to conflicts that you deal with?	Seals & piscivorous birds on fisheries – salmon rivers, fish farms and put & take.
What are your specific concerns regarding these?	Determining whether these predators have a real impact How to deter predators.
Are you aware of any mitigation management practices being carried out to resolve these?	Predator nets at fish farms, underwater & top nets. Put & take fisheries – use gas guns, not in predictable pattern, people scaring. Managing stocking, e.g. trickle stock throughout year rather than large number of naive fish which draws predators in (bird table effect). Stock with larger fish that cormorants can't take, but more expensive.
If so, how effective are they? Under what conditions?	Predator nets effective at fish farms, put & take harder to protect with nets. Scaring more manageable at small sites than large e.g. Loch Leven. Conservation limitation, don't want to disturb at roost sites.
What's the evidence?	Rather than hard scientific evidence it's a case of applying general scientific principles to novel situations. Some case studies
And to what extent are they being carried out?	
Ideas / suggestions of what should be done	
Have any reports, articles or other documentation been produced regarding these mitigation methods?	SMRU – new study on acoustic devices, including using devices to protect marine mammals from pile driving, etc. Ian Russell – MAFF review 1996. McKay et al 1999 MAFF review on effectiveness of management measures. Cowx (ed) 2003: Interactions between fish and birds: implications for management.
Other comments	

(22) Sector	Land/ Fisheries Management
What do you / your members perceive as the main wildlife conflicts, issues or management practices relevant to conflicts that you deal with?	raptors – game birds (suite) raptors – waders & other wild sp., birds & red squirrels raptors – free ranging poultry & racing pigeons sparrow hawks – garden birds ravens – red grouse, black grouse & waders geese – farmland

	white-tailed eagles (WTE) – lambs (west), poultry (east) badgers – lambs, wild sp., digging seals, cormorants & saw-billed ducks – salmon deer – habitat (red on uplands, roe on lowlands) pine marten - capercaillie
What are your specific concerns regarding these?	Predation of red squirrels & garden birds – human element, visible predation of sp. people trying to nurture. Ravens – large flocks of immature birds Badger population increase & spreading onto hill. Badger predation can be worse than foxes, e.g. around lambing pens, nests of waders, bees & hedgerow birds taken. Raptor predation of free-ranging poultry, but also cause stress, increase vigilance & reduce foraging. Birds stay indoors so benefits of free ranging lost. Deer numbers – now accepted that too many in some places. Issue arise when incompatible neighbouring objectives, & large culls in short-time period, rather than gradually bringing pop down in well managed way, taking pop structure into account
Are you aware of any mitigation management practices being carried out to resolve these?	Poultry shelters against raptor predation Cover in pheasant release pens Set-aside for geese, victim of own success WTE – poultry – fencing/ scaring relatively successful Getting licences for saw-billed ducks, cormorants – sensible & pragmatic. Seems to work. Richard Cooke good mediator in deer issues. Ravens – shooting up to 10% of flock increases effectiveness of scaring Deer – fencing. In tick areas, use double electric fence to keep out. Reluctance to introduce diversionary feeding until there is a clear undertaking of what management measures can be used if/when populations of Harriers and other raptors/scavengers escalate as a result.
If so, how effective are they? Under what conditions?	Some evidence that cover in pheasant pens is effective. Lack of political will when it comes to issuing licences for buzzards although legal provisions to protect livestock are there. Natural Care payments for WTE damage – not just about money, morally insulting when you see your livelihood taken. Not interested in farming eagles! Similar issue concerning potential payments for harriers & other sp. Scaring alone doesn't work for ravens – too clever. Electric fencing in Angus Glens has been effective in controlling deer without drastic cull.
What's the evidence?	Has been demonstrated that scaring of ravens not effective. Accepted because enough people tried it

And to what extent are they being carried out?	Fencing young plantations against deer practised widely & is effective.
Ideas / suggestions of what should be done	Decide what number of animals can be supported sustainably & remove excess. Licensed removal or immunocontraception of badgers to reduce pop growth Law should be up-dated now that predatory birds more abundant, so that lethal control can be used if all other methods fail. Need better scientific knowledge of pop sizes of buzzards & ravens in order to estimate no. that can be removed. Ravens – shooting to scare, but licences not given to protect wild birds.
Have any reports, articles or other documentation been produced regarding these mitigation methods?	Draft guidance for licensing control of predatory birds in relation to livestock, where reared game birds can be considered livestock.
Other comments	Re-introduced sp. cause greater conflicts because an active decision has been to impose this species on someone unwilling. Also species that need large range cause greatest conflicts as they move across property boundaries & between properties with different objectives. Conflicts also greater where people have an underlying passion for certain wildlife sp. e.g. public attitudes towards squirrels (including grey squirrels in some urban situations), also for landowners & keepers decline in waders. Get particularly upset watching predation occurring and feeling unable to do anything about it. Potential damage to biodiversity may be greatest in case of predation of wild sp. where no human/ economic interests. SNH has important role in researching & managing these situations. DCS merger with SNH has increased people's confidence in SNH's practical management.

(23) Sector	Land/ Fisheries Management
What do you / your members perceive as the main wildlife conflicts, issues or management practices relevant to conflicts that you deal with?	Fisheries: seal & saw-billed duck predation
What are your specific concerns regarding these?	Seals – predation of adults Saw-bills – predation of smolts
Are you aware of any mitigation management practices being carried out to resolve these?	Seal management plan Seal scarers – they work but are they really cost-effective (10k a piece)? Seals only really up river in winter, probably taking kelts, so little impact on fishery. Lot of work to apply for saw-billed licence – only realistic if have sufficient workforce. For smaller rivers not much return for the effort unless part of a bigger scale licence application, e.g. Moray Firth.
If so, how effective are they? Under what conditions?	Seal management plan works because of 12 month / yr close season. Perceptions among anglers still

	that seals take lot of salmon, despite the scientific evidence. Seal scarers seem generally effective in river mouths – depending on topography may work better than at fish farms.
What's the evidence?	A northern river has data showing saw-bills taking up to equivalent of 1 tributary of smolts. SMRU has evidence that seal scarers on nets & in mouths of rivers seem to work. Also have seal photo ID data & satellite tracking data of marked seals.
And to what extent are they being carried out?	Seal scarers not being used as widely as should be, probably due to cost
Ideas / suggestions of what should be done	Seal-scarers could be part government-funded to encourage up-take. With seals, SMRU do overall counts & get data that no one disputes. With saw-billed ducks evidence is piece-meal from individual river boards so hard to get bigger picture. No over-arching body doing counts – would be good to get independent body e.g. BTO, to do a count that everyone accepts.
Have any reports, articles or other documentation been produced regarding these mitigation methods?	Published papers from SMRU, Marine Scotland (Pitlochry)
Other comments	SPA for saw-billed ducks counts in Moray Firth were high, now low. SNH thinks pop is in decline so not interested in implementing saw-billed management plan. No one at SNH prepared to put head above parapet so default position is 'no'. Frustration for boards is that boards invest lot of effort doing counts, apply for licence for a number of birds & only get licence for 1 – needs to be greater level of trust between SNH & boards. If formal counts showed no scope for removing saw-bills that would be accepted. If SNH makes it too difficult to get licence folk will take law into their own hands. SNH area officers need to be more active in the field and interacting with stakeholders more.

(24) Sector	Government Agency
What do you / your members perceive as the main wildlife conflicts, issues or management practices relevant to conflicts that you deal with?	Level s of trust between different interest groups. The extent to which self-regulation/industry led best practice and accreditation can provide confidence to 'consumers and wider interests' - Wildlife Estates Scotland scheme (WES) as an example
What are your specific concerns regarding these?	Loud voices from more polarised or cynical positions seizing headlines and dominating/distracting from constructive discourse. As a society we need to start from some basic assumptions about the inherent integrity of most individuals if we're really going to get anywhere. This is in line with evidence-based legislation and

	the presumption of innocence until proven otherwise that underpins the legal system. Some organisations and individuals don't always seem to present this view but express views based on their own values, perceptions and beliefs.
Are you aware of any mitigation management practices being carried out to resolve these?	Wildlife Estates Scotland scheme is not intended as a conflict resolution tool but by encouraging best practice may nonetheless be a subtle step towards conflict reduction. Aiming to create positive peer pressure, such that those out of line become isolated and exposed. Initiative has got to come from within landowning community to be taken up. Will give confidence to more cautious land managers. Forcing change on people is difficult and often ineffective or has unintended consequences. Alternative schemes such as Operation Countrywatch seen by some as too focused on raptors & monitoring heavy-handed. Might make for v. big unwieldy organisation/administration to support wide application. Involvement of range of stakeholder interests in development of the scheme through Steering Group – necessarily limited numbers for effective working – and wider stakeholder workshop. Independence of assessment (by SFQC who have established reputation) and robust/transparent protocols for handling clear instances of bad practice. Regular communication/publication of information gathered.
If so, how effective are they? Under what conditions?	New scheme, don't yet know how effective it will be.
What's the evidence?	None yet. Scheme to be launched in 2013 and will take time to establish and prove itself.
And to what extent are they being carried out?	So far >200 businesses signed up to level 1 stating their commitment. The scheme's business plan will fail if there is a very low conversion rate in those seeking to step up to level 2. While the risk cannot be ruled out, feel confident that every effort will be made to ensure this doesn't happen.
Ideas / suggestions of what should be done	WES could be used as means of developing interests & skills of estates to start collecting their own monitoring data in a systematic way, which can then be combined with other data, e.g. from raptor study gps/BTO recording programmes. Will help engagement, as with citizen science.
Have any reports, articles or other documentation been produced regarding these mitigation methods?	WES concept briefing & section on SLE web site with a range of other information. One of case studies in SG-led LUS research currently underway.
Other comments	As membership of WES develops, it becomes mainstream & self-sustaining, & benefits greater. Could ultimately lead to e.g. earned recognition in risk-based approaches to regulation, targeted events for level 2 businesses & other financial

	incentives. Also helps provide evidence of how estates deliver multiple public interest leading to wider understanding and better connection of people with the land.
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(25) Sector	Conservation Body
What do you / your members perceive as the main wildlife conflicts, issues or management practices relevant to conflicts that you deal with?	The biggest conflicts are ideological rather than practical. Most disputed management practices attract more criticism in the abstract, before they start, than once the reality becomes apparent. Deer management is high profile. In practice most problems can be tackled with local management. Where sea eagles present no conflicts.
What are your specific concerns regarding these?	Regeneration of native woodland and deer management.
Are you aware of any mitigation management practices being carried out to resolve these?	Reduce deer populations. Important to manage roe deer as well as red and to ensure that hind cull is carried through. Strategic fencing can be useful; also opening up alternative wintering areas
If so, how effective are they? Under what conditions?	Success of management depends on continued commitment. Population reductions are only effective if you maintain vigilance to ensure that numbers do not build up again. Deer are only one component of grazing – need to consider overall herbivores including sheep, goats and hares which may be having larger impact.
What's the evidence?	Monitoring tree regeneration, deer counts, cull returns, habitat assessment surveys
And to what extent are they being carried out?	Regular monitoring programme
Ideas / suggestions of what should be done	
Have any reports, articles or other documentation been produced regarding these mitigation methods?	Yes
Other comments	Cooperative deer management between estates is most effective where they have similar management objectives. If this isn't the case then local management can be more effective.

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