Outdoor recreation and conserving biodiversity: Recreational behaviours and capercaillie conservation management in the Cairngorms National Park

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ABSTRACT

Biodiversity loss is a global issue facing humanity at an accelerated rate with the 2019 IPBES reporting over 1 million species at threat of extinction. Conservation sciences have historically been centred around the natural sciences, ecology and genetics. However, given that the overwhelming majority of biodiversity loss is driven by human activity, conservation science invariably must relate to, and look to understand, human behaviour. Within the United Kingdom, the Cairngorms National Park serves to not only be one of the last truly wild landscapes in the UK with rich biodiversity, but is also one of the last refuges for the British population of capercaillie (*Tetrao urogallus*), a large, charismatic, ground-nesting bird species. Capercaillie have been in severe decline within Scotland since the 1970's where the population has dropped from over 200,000, to just over 1,100 in 2016, 80% of which can be found in the Spey Valley in the Cairngorms National Park. Ecological research has found that one of the leading causes of capercaillie decline is disturbance from human sources, particularly outdoor recreation and when visitors recreate off marked trails. Existing studies have struggled to disentangle a number of elements involved in the social dimensions of capercaillie conservation, such as the prevalence of damaging behaviours and the key drivers and motivators behind these behaviours. In order to successfully enact a conservation initiative that involves changing people's behaviours, it is first essential to understand not only how prevalent these behaviours are, but also what influences people to behave as they do. As with much of the wider field of conservation science, there has been little research into the socio-ecological dynamics of capercaillie conservation. Further, little to no research has been carried out into the political and organisational dimensions present between capercaillie conservation managers and landowners, and how these conservation bodies respond, and react, to newly acquired sources of information. By using a rigorous mixed methods approach, including a quantitative survey of 159 park visitors employing randomised response techniques, and a key informant focus group of capercaillie management stakeholders, this thesis provides an original and nuanced understanding into the dynamics surrounding capercaillie conservation within the Cairngorms National Park. The original findings show that the two most prevalent activities were walking off marked trails and letting a dog off the lead. This is a significant contribution suggesting up to 374000 visitors to the national park engage in behaviours likely to be deleterious to capercaillie each year, and potentially causing widespread disturbance to fragile capercaillie populations. Further, this study found that knowledge and awareness of capercaillie conservation issues is relatively low amongst visitors, especially for a flagship species, designated as such to raise awareness for conservation schemes. However, people who were more aware of capercaillie were found to be more likely to venture off marked trails, potentially seeking an interaction with one of the birds, suggesting that increasing awareness alone will likely

not improve people's behaviour. Given this, this thesis provides a number of evidence-based implications. While information and education schemes would be very beneficial for increasing the profile of this rare and charismatic species, any education scheme must be inclusive of sustainable viewing opportunities to reduce the numbers of people seeking wild interactions, and also to provide meaningful and consequential encounters. The way new knowledge and uncertainty is handled by conservation managers was found to be a substantially hindering factor throughout the management process having impacts on several levels, especially on stakeholder engagement and cooperation. However, by involving locals and visitors throughout the management process, and employing expert experiential knowledge, the findings presented in this thesis suggest that the overall impact of this uncertainty may be reduced, allowing for more effective biodiversity conservation initiatives. The implications presented in this thesis have relevance not only to the conservation of capercaillie in Scotland, but to any multi-stakeholder system where the roles, responsibilities, and objectives of stakeholders are complex and diverse. The increased and consistent involvement of these stakeholders throughout the conservation process is essential for biodiversity conservation to succeed.

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1 INTRODUCTION

1.1 BACKGROUND

The loss of biodiversity is a global issue that is occurring at an accelerating rate. As we move into the Anthropocene (Crutzen and Stoermer 2000), it is clear that humans, as a species, are having a profound impact on the environments, ecosystems, and populations that share this planet with us (Lewis and Maslin 2015). The IPBES (2019) has recently estimated that more than 1 million species are at risk of extinction worldwide, and human behaviour, whether directly or indirectly, is the primary driver of this decline (Vitousek 1994). A lesser investigated topic in the decline of biodiversity is outdoor recreation, which is an important factor in the decline of many species and habitats (Young *et al* 2005; Larson *et al* 2016). This focus on the impacts of recreation on species and habitats is becoming more important as engagement in outdoor recreation increases year on year (Mackintosh *et al* 2018), which is especially notable in the case of national parks.

While the most prominent objective of national parks is arguably to conserve biodiversity and natural landscapes, they have always been associated with recreation in the outdoors since the late 19th century (Eagles *et al* 2002). Within Scotland, the Cairngorms National Park, the largest in the UK, has been seeing a marked rise in visitor numbers over recent years (CNPA 2015a), and with the recent work widening the main road into the cairngorms from the south improving access to the highlands, this trend is likely set to only accelerate. If not managed appropriately, this increase in visitor numbers has the potential to have significant impacts upon the habitats and species found within the Cairngorms. One such species that could be particularly susceptible to an increase in visitor numbers is the capercaillie. However, as with many national parks and protected areas around the world (Pouwels 2017), conservation managers within the Cairngorms National Park must balance multiple objectives, which not only include biological conservation, but also the promotion of social and economic development, including recreation.

The western capercaillie (*Tetrao* urogallus) is an iconic ground nesting bird currently resident throughout much of the Palearctic ecozone including areas in Scotland (Picozzi *et al* 1996; Duriez *et al* 2007). While widespread across much of western Eurasia, and with strong populations in pockets of Fennoscandia, the species has been in decline throughout much of its range (Storch 2007). In Scotland in particular, capercaillie populations have seen dramatic declines since the 1970's (Moss *et al* 2001), and now the last remaining populations are almost exclusively found within the Cairngorms National Park (Ewing *et al* 2012). Aside from the intrinsic value of biodiversity, capercaillie are proven to be a useful indicator species for mountainous ecosystems (Bollmann *et al* 2004) and have great potential to increase conservation engagement as a large

and charismatic flagship species (CNPA 2015b). Given the historically mixed success of capercaillie reintroductions (Marshall and Edward-Jones 1998), every effort must be made to conserve this iconic species in its last remaining refuge within the British Isles.

There are a number of causes of this decline, including habitat loss (Klaus 1991; Sangia 2011; Mikoláš *et al* 2015), climate change (Moss *et al* 2001), and collisions with man-made structures such as deer fences (Baines and Summers 1997). However, a factor which is especially pertinent to capercaillie decline in Scotland, and the focus of this thesis, is the impact of anthropogenic sources of disturbance. Capercaillie are thought to be particularly sensitive to recreational disturbance (Thiel *et al* 2007), which is thought to impact upon capercaillie populations by compounding the impact of these other stressors, such as more frequent separation events from disturbance causing higher chick mortality due to colder and wetter breeding seasons (Moss 1986). Although recreation and human disturbance are important factors in the decline of capercaillie, relatively little is known about the intricacies of how capercaillie react specifically to different types of recreation (Moss *et al* 2014). The disturbance of capercaillie from recreational sources is an issue that is present across much of the species range (Storch 2013; Moss *et al* 2014), however, given the highly concentrated nature of the Scottish population, and the high levels of recreation found within the cairngorms (CNPA 2015b), recreational sources of disturbance are arguably more pertinent within the Scottish context than elsewhere in the species range.

In recent decades, conservation science has been focussing increasingly on the social elements of conservation. Authors such as Schultz (2011) and Young *et al* (2005), have argued that, ultimately, given that the majority of environmental damage is caused by humans, conservation initiatives must involve efforts to change human behaviour, and is no longer purely the realm of ecology. In line with the increasing emphasis being placed on the human and social aspects to conservation, paradigmatic shifts have occurred in the framing of why we conserve biodiversity (Mace 2014), and how we feel conservation should be carried out in practice (Vaccaro *et al* 2013). Mace (2014) gives an overview of these historical framings of why we conserve, and how, over time, these shift from being largely dualistic, where nature is seen as separate and largely a resource for extraction, to a more inter-species paradigm where humans and non-human entities are seen as part of the same complex, multi-faceted system. These paradigmatic approaches to conservation influence the way in which we view outdoor recreation. Historically, recreation in the outdoors has been viewed as being either consumptive, such as hunting, or non-consumptive, such as bird watching (Duffus and Dearden 1990). However, these definitions are derived from a primarily economic view of nature centred around resource extraction, and the labelling of non-resource extracting activities as non-consumptive serves to further embed the dualistic idea that humans

and nature are separate (Tremblay 2001). However, the apparent shift towards an inter-species paradigm could provide an opportunity to lessen this separation between humans and non-human species (Mannion 2020) and serves to further highlight the need for nuanced social research in conservation sciences. These arguments are particularly pertinent to the case of capercaillie conservation in Scotland where recreation is thought to have such a profound impact on this particular species. However, considering the importance of the issue of anthropogenic disturbance of capercaillie, relatively little is known about this socio-ecological system.

While we are aware of the general effect that recreation has on capercaillie populations (Storch 2013), these general and overarching impacts have limited use in the context of policy and recreation management. In order to effectively enact a behavioural change within a population, or design a management plan, it is vital that we understand not only what motivates individuals to engage or abstain from these behaviours, but also exactly what behaviours are occurring within the vicinity that require management. These two points have provided conservation managers within the Cairngorms National Park some difficulty. Since these capercaillie populations are most often in very remote areas of the park with widespread and diverse path networks, the monitoring of recreation can be difficult, and given the potentially sensitive nature of these activities, people may not be forthcoming about their participation (CNPA 2015b). Further, given the complex socio-political landscape within the Cairngorms National Park, the effectiveness of any conservation initiative is not only influenced by the design of the initiative itself, but is instead hinged upon cooperation and interaction between the multiple actors and organisations involved. Therefore, understanding the barriers and enablers to effective managerial level cooperation is an important factor in this instance.

1.2 Research objectives

The central aim of this thesis is to gain a better understanding of the dynamics surrounding the conservation of a fragile species, capercaillie, and outdoor recreation within the cairngorms national park. Specifically, I focus on outlining and identifying ways in which capercaillie conservation efforts could be enhanced by investigating conservation related behaviours, how these behaviours are influenced, and through exploring the key barriers and enablers of effective capercaillie conservation from a managerial and landowners' perspective. Findings generated from this thesis look to directly contribute to the delivery of policy recommendations for recreation management and capercaillie conservation within the Cairngorms National Park. Through employing a mixed methodological approach, from the formation of key research questions, through to analysis and interpretation of results and findings, conservation managers have informed and been involved throughout the research process to maximise the utility of this

thesis. By addressing issues on how to reduce anthropogenic disturbance of capercaillie, the research presented in this thesis will directly address priorities and objectives of the Cairngorms National Park Authority and other conservation organisations.

The research questions investigated within this thesis have been identified and formulated through a number of methods. Firstly, research questions 1.a through to 2.b were identified following a systematic literature review and consultation with conservation professionals within the cairngorms national park. It is often derided that conservation research has little to no bearing on policy and practice within conservation organisations (Laurence *et al* 2012; Fabian *et al* 2019). For this reason, the consultation process was seen to be essential for contextualising the research questions and research design to be as applicable and useful for Scottish capercaillie conservation as possible, therefor making substantial efforts to close the science-policy gap that often occurs within conservation science. Following from this, research questions 3.a to 3.c were iteratively defined during the PhD process. As data collection from the survey closed out, it became evident that the most appropriate way of rounding out the doctorate was to present findings to policy makers and conservation managers to ground these results in the reality of capercaillie conservation. This opportunity to provide perspective and refract the empirical findings of this doctorate through the perspective of real life stakeholders, adds further value to the contributions of the doctorate. The development of these research questions is entangled in how the doctorate emerged and changed through its course and reflects how my thinking and approach changed through not only changes to my supervisory team but also as a result of the reflexive process itself.

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The specific research questions addressed in this thesis are as follows:

1.a. *What are the current patterns of behaviour within the Cairngorms National Park in relation to capercaillie conservation?*

1.b. *What are the current levels of awareness and values amongst visitors to the Cairngorms National Park of capercaillie conservation issues?*

2.a. *What are the key predictors of extra-trail behaviours amongst recreationists within the park?*

2.b. *How can these behaviours best be targeted and influenced to reduce anthropogenic disturbance of capercaillie?*

3.a. *How are different sources of information utilised during the policy making and management process, and what are the key difficulties while addressing this?*

3.b. *How are policy and management decisions disseminated and communicated to residents and visitors?*

3.c. *How do conservation managers and policy makers interpret and utilise new empirical information?*

1.3 CHAPTER OVERVIEW

In chapter 2 I outline the literature which underpins the methodological and analytical structure of this thesis. Following on from this literature review, a methodological chapter, chapter 3, will cover the methods of data collection, course of analysis, and lines of enquiry used to investigate these research questions. Additionally, this methodological chapter will outline the philosophical standpoint taken to marry these quantitative and qualitative methods, along with further ethical considerations taken into account. Following on from this methodology chapter will be three analytical chapters, each focussing on specific subsets of research questions. In the first analytical chapter, chapter four, I make use of quantitative survey methods to investigate the current gaps in knowledge surrounding the levels of awareness and patterns of behaviour, relevant to capercaillie conservation issues, amongst members of the public recreating in a reserve in the Cairngorms National Park. Further, chapter four also looks at the specific forms of environmental knowledge that is present amongst recreationists within the park in order to investigate whether levels of awareness match what would be expected from a flagship species. In this chapter, I used a randomised response technique in a novel setting for the estimation of not explicitly illegal recreational behavioural traits. The second analytical chapter makes use of the randomised response estimates of extra-trail activities, and specific psycho-social measures, to look to identify the key determinants in illicit environmental behaviour with regards to a fragile species. The quantitative findings from each of these first two analytical chapters is contextualised with richer and more nuanced qualitative responses given by respondents during the survey. Chapter six, the third and final analytical chapter, looks to investigate and explore the capercaillie conservation landscape from the perspective of conservation and recreation managers. This chapter consists of analysis of data collected through a key informant interview with local conservation and land management professionals, each with their own expertise and speciality. During this chapter, I discuss some of the key difficulties faced by conservation managers with regards to public engagement in capercaillie conservation initiatives, and also, through the presentation of some initial results from chapters four and five, explore how conservation managers interpret and locate these new findings within a wider context. Finally, chapter seven brings together the findings from each of the previous three analytical chapters into a wider discussion around the main themes present throughout this thesis. This chapter will also present both the

methodological and policy implications of the research presented in this thesis, along with limitations, future research directions, and outlining the original contributions made.

2 LITERATURE REVIEW

2.1 THE ECOLOGY AND CURRENT STATUS OF THE WESTERN CAPERCAILLIE (*TETRAO UROGALLUS*)

The western capercaillie (*Tetrao urogallus*) is the largest member of the grouse family currently resident throughout much of the Palearctic ecozone (Picozzi *et al* 1996; Duriez *et al* 2007). The species range is continuous within the boreal forests from eastern Siberia to Scandinavia and more fragmented within the temperate south-western part of its range in Europe, likely due to the species restriction to montane forest habitats (Storch 2007). This species is divided into 12 morphologically and behaviourally differentiated subspecies (de Juana 1994) and what are thought to be 3 distinct genetic clades (Duriez *et al* 2007).

Capercaillie habitat in both boreal and temperate regions is characterised by large areas of mature coniferous forest with a well-developed understory of ericaceous shrubs principally dominated by blaeberry (*Vaccinium myrtillus*) (Summers *et al* 2004). These habitats will typically be interspersed with smaller areas of younger successional stages of forest growth and peatland. Outside of winter when food is more abundant the adults feed on the leaves and fruit of bilberry and other understory plants such as *Calluna vulgaris*, pollen cones from pines, and very occasionally, invertebrates. When chicks hatch in the early summer their diet is entirely comprised of bilberry leaves and fruits and invertebrates such as Lepidoptera larvae, which are often found feeding on bilberry (Summers *et al* 2004). During the winter capercaillie will almost exclusively feed on pine needles and small amounts of bilberry shoots (Picozzi *et al* 1996).

Due to capercaillie being a habitat specialist and the strong association between capercaillie and structurally complex forests the species has become identified as a potential umbrella species for mountainous temperate and boreal forests (Suter *et al* 2002; Mikolas *et al* 2015). Capercaillie have been found to be especially useful as an indicator species for many endangered mountain forest bird species as well as other measures of biodiversity (Bollman *et al* 2004). As a result of the status of capercaillie as an umbrella species many species-specific conservation efforts and research projects directed at capercaillie would likely inadvertently benefit a large number of other sympatric species and not just capercaillie itself.

2.1.1 Capercaillie decline

Capercaillie populations have been in severe decline throughout much of their range especially since the mid-20th century (Storch 2007). Early declines were seen throughout much of temperate Europe in the 1950's (Saniga 2003), in the 1960's in boreal Fennoscandia (Sirkia *et al* 2010) and in

the 1970's in Scotland (Moss *et al* 2001). Although the most pronounced declines are seen within the temperate regions of Europe, and to a lesser extent boreal Fennoscandia, capercaillie still remain in strong numbers throughout the rest of its boreal range from eastern Fennoscandia to Siberia and although there are reports of some local decline in these areas there is little in the way of significant regional declines within the literature (Storch 2007).

In Scotland in particular the abundance of capercaillie has been turbulent and the species has become locally extinct once before. During the 18th century capercaillie were regularly hunted in Scotland and as a result of overexploitation of the natural populations the species became extirpated from this part of its range in 1785 (Moss *et al* 2001). Scotland was then reintroduced in 1837 with capercaillie taken from Swedish stock and quickly re-established itself to the point that they became troublesome for forestry managers and were seen as a pest (Moss *et al* 2001). During the 1970's however the Scottish population started a drastic decline from around 20000 individuals to just over 1200 birds in 2012 (Ewing *et al* 2012) and further still to just over 1100 birds in 2016 (Wilkinson *et al* 2018). This dramatic decline in population size has also been coupled with a contraction in range to the extent that 80% of the current population resides within the Spey valley in the Cairngorms National Park (Ewing *et al* 2012).

These declines in capercaillie populations have resulted in the species becoming red listed in 18 of 32 currently inhabited countries, mostly those in central, western and south-eastern Europe, and all but 6 countries providing legal protection (Storch 2007). Although the species is listed as 'lest concern' on the IUCN Red List (IUCN 2015) this is due to the large range the species still occupies and the local declines in population size are what cause the red list status on a local scale. Capercaillie are also highlighted as a priority species in the EC Birds Directive and categorised in annex 1, rare or vulnerable species (JNCC 2013). Furthermore, capercaillie are afforded additional legal protection in the UK in the form of the Wildlife and Countryside Act 1981 in which the species was included with schedule 1 designation in 2001 (SSI 2001). Following the protected status of capercaillie in Scotland a number of Special Protection Areas (SPA) and Special Areas of Conservation (SAC) were created and are protected by both UK law and EU regulation.

2.1.2 Habitat loss and fragmentation

It is widely accepted that one of the most pressing threats facing biodiversity is habitat loss (Brooks *et al* 2002) and it is estimated that only 2-3% of original old growth forest habitats remain within Europe (WWF report 2001). With this in mind it is not a great stretch to understand why the loss of forested areas and fragmentation of suitable habitat is one of the most influential drivers of capercaillie decline throughout much of the southern and western parts of the species range. Historically much of Europe was heavily forested and the accelerated loss of much of the

old growth mature forest has caused a loss of connectivity and fragmentation between suitable primary habitats. Due to capercaillie being habitat specialists (Suter *et al* 2002) and relatively short mean dispersal distances of 1-2km for adults and 5-6km for juveniles (Storch and Segelbacher 2000) the species is highly susceptible to habitat loss and fragmentation at increasingly greater distances consequentially leading to metapopulation structures. In addition capercaillie are known to exhibit sex biased dispersal with females dispersing further than males (Storch and Segelbacher 2000), with this in mind it is possible that with increasing fragmentation certain areas could potentially exhibit a gender bias as the immigration and emigration dynamics may be disrupted.

Modern clear-felling techniques have been shown to be one of the most influential factors in the decline of capercaillie through habitat loss in temperate Europe (Klaus 1991; Sangia 2003; Mikoláš *et al* 2015). This observation however is less clear in boreal Russia and Fennoscandia with some studies indicating marked negative impacts (Wegge *et al* 1992; Kurki *et al* 2000) and others more recently suggesting no significant impact (Wegge and Rolstad 2011). These varying results may be due to the largely more continuous population and structure of boreal forests when compared to the mountainous forests of temperate Europe (Storch 2007). Also due to the nonlinear effect of fragmentation on biodiversity (Fahrig 2003) many of the boreal forests in question may not have reached a point where fragmentation becomes a significant driver of biodiversity loss.

Suggestions of alternative Low Impact Silviculture Strategies (LISS), such as selective logging, have been made for Scottish woodlands where clear-felling is the norm (Kortland 2003). These LISS usually create habitat with more continuous canopy cover and composed of stratified ages, this results in less impact of local wildlife during harvest and provides a more resilient and resistant community structure. Not only do these strategies benefit local systems but also on the landscape scale by reducing the acidity on watersheds and greater water retention during periods of high rainfall. LISS have been shown to not only be less detrimental capercaillie but in some cases can have a positive effect on capercaillie numbers (Mikoláš *et al* 2015)

2.1.2.1 Increased predation

Increasing fragmentation does not only reduce capercaillies fundamental niche but can also introduce higher pressure from generalist edge predators (Malt and Lank 2009). Andrén (1992) showed that as forest habitats become more fragmented corvid density increases and therefor in areas of greater fragmentation capercaillie will likely be under greater predation from one of their main predators the carrion crow (*Corvus corone*) (Storch 2001; Baines *et al* 2004); the same has also been found for foxes (*Vulpes vulpes*) (Kurki *et al* 1998). Greater fragmentation is also known to result in disrupted population dynamics (Wiegand *et al* 2005) and so the effects of greater

predator presence and top down pressure may be compounded by capercaillie in these areas being unable to effectively recover from a decline in population size.

2.1.2.2 Collisions with fences

Bird collision with manmade structures has also been observed as a potentially significant factor in the decline of capercaillie populations in certain areas. This is largely thought to be a result of the species short wings and large body, leading to poor flight capabilities, and low acuity resulting in failure to identify difficult to resolve manmade objects such as wires (Bevanger 1995). Both of these traits are shared by other tetraonid species to varying degrees (Bevanger 1995). In the early 1990's it was estimated that of Norway's predicted population size of >150000 (Storch 2001), collision with high tension power lines resulted in around 20000 capercaillie mortalities annually (Catt *et al* 1994; Bevanger 1995). Another case where collision mortalities have significantly impacted local capercaillie populations is collisions with deer fences as evidenced in Scotland (Baines and Summers 1997, Moss *et al* 2001) and Slovakia (Saniga 2011). Moss *et al* (2001) highlighted that collisions with deer fences resulting in mortalities were one of the most pressing causes of local capercaillie decline in Scotland in the early 1990's. They identified that at the time of the study the capercaillie population was in decline by a rate of 18%year^{-1}, however if fatalities related to fence collisions are not taken into account then the population would have increased by 6%year^{-1}. They also suggested that with the number of fence deaths at the time in order for the population to sustain itself each hen would need a breeding success rate of 1.1 chicks/year whereas in the absence of fence deaths the required success rate would drop to 0.6 chicks/year. In addition to this Moss *et al* (2001) predicted that if the rate of decline at the time remained as it was then the probable hen population would have declined to around 40 individuals by 2014 and thus likely to have led to extinction. However, as a result many deer fences were either taken down or removed entirely from key capercaillie habitat. Baines and Andrew (2003) estimated found that by marking the fences with highly visible orange netting the number of collisions with fences reduce by 64%. Alongside marking, the removal of many deer fences has shown further reductions in population decline in a number of areas in Scotland (Summers *et al* 2010; Ewing *et al* 2012).

2.1.2.3 Climate change

The role of climate change on biodiversity loss is known to be profound and is thought to be one of the main distal causes of species decline (Bellard *et al* 2012). The current evidence regarding the impact of climate change on capercaillie numbers however is mixed and varies with locality (Storch 2007). Moss *et al* (2001) found that as spring warming became progressively later in the year capercaillie reproductive success fell. This can possibly be somewhat attributed to the phenological changes that occur throughout the community's present in these habitats and

ecosystems. An argument put forward by Moss *et al* (2001) is that as adaptive behaviours in many grouse species are not as flexible as in many other species in that they often either over or under adapt according to the changing phenologies of their food sources, blaeberry and invertebrate larvae in the case of capercaillie. As such this inability to effectively adapt to a change in phenology would cause a lower abundance of food sources at critical times of the year such as when females are preparing for the lekking season and just after chicks hatch when they require a high quantity of invertebrates for optimal development. However, these trends are not seen in all capercaillie populations and a study focusing on southern Norwegian capercaillie populations found no relationship between chick survival and climate indicators (Wegge and Rolstad 2011). However as stated earlier boreal community structures are predominantly much less fragmented and more continuous than those in temperate regions and so with the increased resilience that comes with this the boreal capercaillie populations may not be as greatly influenced by climatic change.

2.1.3 Disturbance

Increasing human disturbance such as outdoor recreation, is another area of concern for many conservationists and is known to contribute to the decline of many species (Czech *et al* 2000). One of the reasons for this is likely to be that many free roaming species perceive humans in the same way as natural predators and so exhibit the same anti-predator behaviours as a response (Beale and Monaghan 2004; Frid and Dill 2002). This is certainly the case with many grouse species and particularly capercaillie, which are known to be especially sensitive to human activity (Storch 2013). Capercaillie may be more sensitive as there is strong evidence suggesting that larger bird species, and larger individuals, show greater alertness and flushing distances in response to the presence of a perceived predator (Blumstein *et al* 2005).

There are a number of likely sources of anthropogenic disturbance, however outdoor recreation is one of the most pressing problems facing conservation initiatives (Czech 2000). Off track recreation and tourism is a major problem facing capercaillie populations, perhaps largely due to the attractiveness of prime capercaillie habitat for activities such as skiing, snow shoeing and hiking (Summers *et al* 2007; Thiel *et al* 2011). There has also been an evident increase in the amount of tourism occurring in these mountainous forest regions (Cas 2010) and further anecdotal accounts suggests that walkers with dogs may be detrimental to the capercaillie populations when staying on well-defined paths due to the dogs roaming further into the woods when off the lead (CNPA 2015b). Including recreation disturbance there is also the added pressure of industrial disturbance in the form of construction activity for features such as roads (Cas 2010) and windfarms (González *et al* 2014). Due to the stochastic nature of many of these sources of disturbance, particularly those related to recreation, capercaillie may be unable to

effectively become accustomed to the increases in human activity (Miller *et al* 2001; Theil *et al* 2007). Sterl *et al* (2010) highlighted that many outdoor recreationists, in this case especially back country skiers, partake in outdoor pursuits to experience a connectedness with nature, to relax, and for a feeling of solitude or silence. With this in mind, due to capercaillie habitat often being structurally complex old growth forest, people may find themselves more attracted to areas where capercaillie just so happen to be.

2.1.3.1 Physiological and behavioural responses to disturbance

The frequency of disturbance events can influence the response elicited from the Capercaillie and high frequency, predictable disturbance can often have a very different impact than low frequency and unpredictable events. When the disturbance events are predictable and frequent, such as on-trail walking, it is possible for wild animals to adapt to the stressors in a number of ways (Whittaker and Knight 1998). When predictable disturbance occurs in capercaillie habitat the birds will often respond by altering their habitat use patterns by avoiding areas where there is a high level of disturbance (Theil *et al* 2008). In southern Germany capercaillie showed avoidance of areas with higher skiing and snow sports activity, preferring the less disturbed areas in the centre of woodlands (Thiel *et al* 2008). In Scotland in particular, capercaillie have been found to avoid woodland tracks, a surrogate of human activity, which as a consequence of the high density of tracks in many Scottish woods has resulted in an estimated reduction of 21-41% of useable habitat in the Abernethy and Glenmore forests (Summers *et al* 2007). Moss *et al* (2014) also found that capercaillie avoided heavily used woodland entrances and forest tracks and the capercaillie were more reliant on woodland bogs as a refuge. The avoidance of certain areas of high disturbance will likely lead to a reduction in realised niche and as a result a lower carrying capacity for an area of otherwise suitable habitat and so a decline in population. Although this does not necessarily lead to a reduction in breeding success it can lead to disrupted sex ratios in metapopulations which in turn could cause issues with genetic impoverishment (Moss *et al* 2014). The reasoning behind this being that because male capercaillie are locally recruited and females recruited from other areas, some highly disturbed areas may be less able to recruit females from less disturbed woodland and so a male biased sex ratio would occur and has been observed in disturbed woodland within the Cairngorms National Park (Moss *et al* 2014).

An increase in disturbance can also lead to greater flushing distances for capercaillie (Thiel *et al* 2011). This can be especially problematic during the winter when food sources are not necessarily scarce as with some other species, but the diet is low in energy provision and restricted to conifer needles (Picozzi *et al* 1996). As a result of possible overexertion during the winter unnecessary flushing may affect a decline in overall fitness (Thiel *et al* 2008).

Differences in flushing distances have been observed between sexes where males flush more readily and to a greater distance than females (Catt *et al* 1994; Thiel *et al* 2007). This may be due to the larger size of males and the relationship described earlier between bird size and alertness and flushing distance (Blumstein *et al* 2005), but also may be in part due to capercaillie hens having a higher base metabolic rate than cocks (Rintamäki *et al* 1984) and so have a more conservative predator avoidance strategy that more effectively implements camouflage.

During the lekking season the species is known to be highly sensitive to disturbance and the displacement of an active lek can readily occur (Cas 2010; Mikolas 2015). The disturbance and abandonment of a lek not only causes a short-term impact but often if a lek site is abandoned it may not become readily reoccupied (Cas 2010). However, in areas with a higher vegetation density lek sites are less likely to be abandoned and avoidance behaviours appear to be less profound (Theil *et al* 2007). This is thought to be due to the denser vegetation reducing or blocking visual contact between a person and capercaillie and consequentially reducing the sensitivity of the capercaillie to disturbance and human presence (de Boer *et al* 2004; Theil *et al* 2007)

Capercaillie chicks are thought to be self-sufficient feeders in that their mother, although providing protection and shelter, does not provide their food (Marshall and Edward-Jones 1998). It may be possible that this could further compound any other stressors on the chicks, for instance if the chicks have an already reduced foraging time due to higher rainfall (Moss 1986), when they will be sheltering with the mother, any additional disturbance from humans will aggregate to further reduce foraging time. This in turn will likely mean that the chicks will get less food and possibly are more likely to be affected by the cold (Moss 1986) and less able to respond to predators.

Responses to disturbance in capercaillie are not purely behavioural and there are strong physiological responses that coincide with acute disturbance. The physiological response to disturbance and acute stress manifests in the form of increased levels of glucocorticoid stress hormones, namely corticosterone (Thiel *et al* 2008) and can often be more apparent than the equivalent behavioural response, especially during the winter (Thiel *et al* 2011). These physiological responses have the potential to be detrimental to individual birds if the chronic levels of corticosterone are maintained through regular disturbance and can lead to a loss of overall fitness through repressed immune function, inhibited development of younger birds and a reduction in fertility (Sapolsky *et al* 2000).

When considering the impact of disturbance on capercaillie it is important to note that some authors have found no negative effect and in fact in some instances a higher number of chicks per

hen in more disturbed areas (Wegge and Rolstad 2011; Moss *et al* 2014). There are often a large number of anecdotal reports suggesting a strong link between some anthropogenic disturbance events and the decline in capercaillie numbers. For instance, there have been arguments made that dogs off the lead will kill capercaillie in the surrounding woodland and are a significant cause of population decline and low reproduction rates. However there has been no evidence that disturbances such as these are a direct cause of low reproduction rates (Moss *et al* 2014), but instead it is more likely that these types of disturbance have larger impacts in the reduction of realised niche.

The reason for some capercaillie producing more offspring in disturbed areas is disputed and cannot be identified to a single factor (Moss *et al* 2014). However, a possible explanation may be that an increased human presence can often deter some species of predator from an area (Wegge and Rolstad 2011) leading to reduced predation of capercaillie chicks. However, this is not the case for all predators, such as many corvids, whose numbers often increase with rising human presence (Marzluff and Neatherlin 2006). Another explanation may just be that outdoor recreationists prefer to spend time in woodland that just so happens to be good habitat for rearing chicks. It is possible that this may be the case in a number of areas where capercaillie live such as in Scotland where there is less old growth forest than other parts of the capercaillie's range.

In the Cairngorms National Park, there is now another potential source of disturbance on a different scale to local recreational disturbance. Over the next few years, the main road through the park will be in the process of being duelled and so there will be a lot of industrial activity. Capercaillie are known to respond to distant sources of disturbance as well as immediate sources by through an increase in stress hormone levels and changes in habitat use (Gonzalez *et al* 2014). The response of capercaillie to disturbance in surrounding areas could mean that the current work on the A9 could be a novel source of disturbance to core capercaillie populations (Suarez-Seoane and Garcia-Roves 2004).

2.1.4 Capercaillie as a flagship species and ecological surrogate

Within conservation sciences, both research and in practice, species are often given potentially abstract statuses such as "flagship species" or "umbrella species", "Indicator" or "keystone", or assigned characteristics such as where a species is recognised as being "charismatic" or "iconic" (Lindenmayer et al 2020). While to the lay person, the meaning or definition behind these terminologies may not be immediately obvious, each has been becoming more and more heavily utilised within the conservation literature since the turn of the millennium, with often conflicting definitions (Ducarme et al 2013). Species are often given these labels to highlight their

importance within the ecosystem, conservation policy landscape, or within conservation research, and highlights how the species may be strategically important within each context. These phraseologies and approaches to conservation, which are often used in conjunction with one another, can be misused within different contexts but all can provide significant and specific benefits if employed correctly (Bowen-Jones and Entwistle 2002; Verissimo et al 2013). Firstly, the term flagship species refers to species that play an important socio-political role for many conservation organisations in that they act as rallying points and fulfil an ambassadorial role in encouraging public engagement in either a specific conservation project, or organisation (Lundberg et al 2020). Some examples of particularly well known flagship species are Asian elephants (Epps et al 2011), tigers (Rayan et al 2016), and perhaps the most well-known, being the flagship species for the World Wildlife Fund, the giant panda (WWF 2006). In a similar vein, umbrella species are also often used by conservation organisations in a strategic manner, and often as an ecological surrogate, and are employed when the range and heterogeneity of the habitat occupied by the species is sufficient to provide protection and benefits to other species as an indirect result of conservation efforts focussed on them (Lindemnayer et al 2020). As with flagship status, giant pandas can be identified, and are used as, umbrella species providing protection to bamboo forest ecosystems and sympatric species in china (Shen *et al* 2020). Umbrella species, however, need not be well known flagship species, for instance the humphead wrasse is an umbrella species particularly effective for the protection of coral reef biodiversity in the indo-pacific, and is often used when making decisions on designating marine protected areas (Weng *et al* 2015). Further increasing the complexity of these species labelling systems, when a species' ecological status and success can be used as a suitable proxy for the overall health, status, or processes within, the wider ecosystem, it is often given the term of indicator species (Lindenmayer et al 2000). Linked with this concept is that of a keystone species whereby this status can be assigned to species that are essential to the structure, function, and stability of an ecosystem, and that if their influence on the ecosystem was removed then community structures and ecological processes would become very unstable (Simberloff 1998). These keystone species effect ecosystems through various mechanisms such as predatory effects, for instance apex predators like grey wolves in yellowstone (Ripple and Beschta 2007) or ochre starfish (Sanford 1999), or the via the effects of ecosystem engineer species such as beavers (Hale and Koprowski 2018). While statuses like flagship are more linked to conservation policy, strategy, and social engagement, and umbrella, indicator, and keystone species more relevant ecologically, they are not mutually exclusive from one another. For instance, a flagship species can also hold the status of being an indicator species.

Flagship species are particularly important when considering engaging members of the public with conservation initiatives, with some of the species mentioned above such as giant pandas, tigers and elephants, being at the forefront of the public's mind (Albert *et al* 2018). These species are known for their ability to draw support and funding for conservation through marketing with conservation organisations seeing benefits of increased funding after the adoption of a suitable flagship species (Lundberg et al 2020). However, therein lies the crux of the flagship species paradigm which is selecting a suitable species. It is often cited that a flagship species should be charismatic (Albert et al 2018) or iconic (Horsley et al 2020), however there is little consensus as to what these terms actually mean in practice. While the term charismatic has been used alongside the term flagship species since the flagship species paradigm was first introduced into the academic literature (Heywood 1995), there is no widely accepted, operationalised definition for this characteristic (Ducarme et al 2013). For instance, Lormier (2007), conceptualised non-human charisma as being determined by a number of interrelated factors, these being how distinctive and detectable the species is, biases held by society towards the species, aesthetics, and how likely is the species to generate intellectual satisfaction. While Lomiers (2007) definition highlights the complex, and highly subjective, human-animal relations that determine the charisma of a species, Albert et al (2018) determined six characteristics, across three categories, that could help to identify not only which species are charismatic, but what makes them charismatic. Albert et al (2018) note that the characteristics that make one species charismatic may not be the same as those of another. As part of a survey, Albert et al (2018) asked survey respondents to suggest a species they thought was charismatic, and then assign any matching traits to this species. The traits highlighted in this study, two in each category, were either aesthetic (beautiful and cute), related to human-animal relations (impressive and dangerous), or related to the species conservation status (rare and endangered). However, the majority of definitions for species charisma found within the body of literature are ad-hoc and open to interpretation highlighting the highly subjective nature of charisma. In spite of the subjective and often inconsistent definitions of species charisma, this trait has proven to be a very beneficial asset for any prospective flagship species increasing its ability to generate an emotional response from members of the public driving up engagement (Verissimo et al 2011; Skibins et al 2016; Courchamp et al 2018). The charisma of a species is, however, not the only trait required of a flagship species and some authors have criticised the often subjective, haphazard selection processes for flagship species and instead proposed systematic methods for flagship selection (Verissimo et al 2014; Qian et al 2020). For example, the method employed by Verissimo et al (2014) identified that when selecting a flagship species geographic distribution, population size, visibility, attractiveness, and survival in captivity were all important influencing traits possessed by a species indicating its suitability as a flagship.

The term umbrella species has often been conflated with flagship species leading to the two terms sometimes being used interchangeably as synonyms of one another (Ducarme et al 2012). However, this is not the case, the important difference being that a flagship species is intended to garner public support but whose conservation does not necessarily imply the conservation of the species that share its ecosystem, and vice versa for umbrella species. As stated above, it is more than possible, and often is the case, for species to be both flagship and umbrella, they are not synonymous terms and holding the status as one does not imply the other. For instance, tigers, an often-used flagship species, also holds a status as an umbrella species due to its role as an apex predator requiring a healthy and complex food chain in order to maintain a stable population. However, it can be the case that a conservation organisation adopts a species as its flagship species to act purely as a mascot without necessarily having the ecological or conservation oriented traits that would make it a suitable umbrella specie. For example, the greater sedge grouse, a flagship species for sagebrush habitat in Wyoming, is not an appropriate umbrella species for this habitat as Carlisle et al (2018) found that although conservation of the greater sage grouse benefited local invertebrate populations, sympatric songbird populations declined as a result of the targeted habitat management. While the two different terms, flagship and umbrella, are not synonymous with one another, as stated above, there is often overlap where flagship species are suitable umbrella species which has led to an increasing use of the term flagship umbrella species within the academic literature to describe species that play both roles effectively (Ducarme et al 2012; Kalinkat et al 2017; Lindenmayer and Westgate 2020).

Capercaillie, the focal species of this research, are identified as a charismatic flagship species, not only for European conservation (Suter et al 2002; Mikolas et al 2015; Kortmann et al 2018), but also iconic of highland pine forest habitats in the Cairngorms National Park (Summers 2007; CNPA 2015b). Capercaillie, within the context of the Cairngorms National Park, are seen as a flagship species (CNPA 2015b) and certainly hold many of the traits that make flagship species successful. Capercaillie are certainly charismatic and fit with most definitions such as that given by Albert et al (2018), being beautiful, rare, endangered, and sometimes seen as dangerous (BBC 2019), especially males during lekking season (Milonoff et al 1992). Further, based on the criteria employed by Verissimo et al (2014), capercaillie would make a very suitable flagship species. Congruous with the findings of Verissimo et al (2014), capercaillie have a small geographic distribution in Scotland, they have a small population size, can be highly visible at certain times of the year, especially if a lek is occurring, are attractive, and while individuals can survive in captivity, they cannot breed since a lek cannot take place. These traits would seem to make capercaillie an ideal flagship species for highland pine forest conservation within the Cairngorms National Park. Furthering their suitability is the argument that the capercaillie would also make an

extremely valuable and effective umbrella species (Suter et al 2002; Bollmann et al 2004; Mikolas et al 2015). However, as with likely the majority of umbrella species, conservation benefits are not necessarily seen for all sympatric species, Suter et al (2002) found that while capercaillie are effective umbrella species for other mountainous red listed bird species, such as black grouse, woodcock and hazel grouse, habitat management for the requirements of capercaillie was, while not associated with a decline in species richness, was found to not have an effect. However, this does not mean that capercaillie are an unsuitable umbrella species, instead that for some objectives, capercaillie would not be an appropriate choice.

Commented [WS2]: Flagship and charismatic species

While capercaillie have been identified as a suitable flagship species, not only for the Cairngorms National Park (CNPA 2015b) but also for many European conservation schemes (Suter et al 2002; Mikolas et al 2015; Kortmann et al 2018), there has been little to no research investigating the extent to which members of the public are aware of this species. This poses an interesting question, as awareness of a species is often perceived to be an important trait of a successful flagship species (Bowen-Jones and Entwistle 2002). This research will look to further explore these issues, in particular, in this thesis, I will investigate the extent to which visitors to the Cairngorms National Park are aware of capercaillie in the surrounding areas and the understandings these visitors have of the ecological fragility of the species. More specifically, these aspects of capercaillie conservation will be addressed in chapter 4 through research question 1.b.

Commented [WS3]: Linking research questions

2.1.5 Mitigation

Capercaillie are not only a useful umbrella species for a number of habitats and their conservation would likely involve the conservation of a large area and a number of other species (Mikolas *et al* 2015), but also due to the charismatic nature of capercaillie they have potential to become a flagship species for temperate and boreal mountainous forest conservation. As discussed earlier there are different conservation programmes and designations in place to conserve declining capercaillie populations although, depending on the most pressing issue in the area, each will have a different strategy.

In terms of mitigating against disturbance, one method could be to establish refuges and utilise screens next to paths (Theil *et al* 2007; Moss *et al* 2014). By adding a screen of some description at the edge of a track will reduce line of sight between capercaillie and people there for allowing the capercaillie to utilise more of the adjacent habitat. The addition of a screen at the edge of paths is not only intended to block line of sight but also intended to discourage people from walking off the track along desire lines and by doing so preventing the further reduction and fragmentation of useable habitat. However, in order for this type of mitigation to be effective people must be further encouraged to stay on the paths and avoid extra-trail activities. Further

mitigation may come in the form of enforced exclusions from capercaillie habitat, in certain areas or at sensitive times of the year. However, creating restrictions and excluding people from these sanctuaries can often create conflicts between conservation managers, and residents and tourists looking to use the spaces. This is especially likely to be the case in Western Europe where capercaillie populations mostly inhabit forest areas that are easily accessed by people (Thiel *et al* 2011; Moss *et al* 2014).

However, in order to implement efficient and effective mitigation of anthropogenic disturbance of capercaillie, it is essential to understand what behaviours and subsequent impacts are to be mitigated. There are a number of methods for gaining an understanding of visitor and recreational behaviour within national parks, such as people counters, GPS, or static cameras (Ziesler and Pettebone 2018). However, there has been little to no research that has been carried out investigating the prevalence of behaviours specific to capercaillie conservation, especially within the context of Scotland and the Cairngorms National Park, which is an area I will address and investigate in this thesis. This gap in current knowledge will be addressed specifically in chapter 4 through research question 1.a.

The true impact of recreation and disturbance on capercaillie is often difficult to interpret with so many factors influencing vital rates (Moss *et al* 2014). However, it is likely the case that one of the foremost causes of capercaillie decline, certainly in Western Europe, is due to a loss of useable habitat caused by behavioural responses to disturbance (Moss *et al* 2014). Capercaillie conservation, especially so in the Cairngorms National Park, plays host to a number of complex aspects, both ecological and social. Capercaillie decline is not only driven by ecological factors, such as habitat loss, fragmentation, climate change, and fence collisions, but also this ecologically driven decline is further added to, and compounded by, anthropogenic disturbance and other human behaviours. For these reasons, I surmise that capercaillie are an ideal species to play the focus of an in depth study and put these aspects to its conservation in relation to social theories, and the human behaviour that puts the species at risk.

Commented [WS4]: Linking research questions

2.2 DETERMINANTS OF PRO-ENVIRONMENTAL BEHAVIOURS

2.2.1 Models of predicting behaviours

In the past it has been a common trend in conservation sciences to think that attitudes towards a particular environmental or conservation concept will in turn highlight an individual's likelihood of carrying out pro-conservation behaviours (Holmes 2003; Heberlein 2012). However, many of these studies found that while some people hold positive views towards conservation, it is often the case that they will not engage in pro-conservation behaviours or will continue in their damaging behaviours (St John *et al* 2010). Part of the reason for this discrepancy between attitudes and resulting behaviour is thought to be due to mismatches between the general attitudes and specific conservation or environmental problems that were the focus of many of these studies (Azjen 1991). In addition, the sole focus on attitudes is seen to be a fundamental oversight when looking to study any kind of human behaviour (Heberlin 2012) and more complex models have been developed from other fields such as economics (Hardin 1968) and social psychology (Fishbein and Ajzen 1975), all of which have their strengths and weaknesses and will often be more or less suitable for different situations.

2.2.2 Socio-psychological models of behaviour

In understanding the predictors of behaviour or behavioural intent, we are better equipped when designing and implementing intervention schemes to either discourage deleterious or encourage pro-environmental behaviours (St John *et al* 2010). As such it is imperative that we not only look to understand the relevant individuals' current environmental awareness, be it general or specific to a particular problem, but all aspects and facets that could influence their behaviour in one way or another. With this in mind, conservationists and policy makers have recently begun utilising a plethora of socio-psychological models, each with their own nuances and caveats that go some way to highlighting each of these predictors of behaviour.

2.2.3 TPB

One of the most widely used and successful models of behaviour that has been applied to environmental and conservation behaviour is the theory of planned behaviour (TPB) (Ajzen 1991), an adaptation of the earlier model of reasoned action (Fishbein and Ajzen 1975). These models have been used in many areas where the outcome is to understand and influence people's behaviour in one direction or another, for instance in health research (Armitage *et al* 1999; Albarracin *et al* 2001; Johnston and White 2003; French and Cooke 2012), illegal or irresponsible driving behaviours (Connor *et al* 2007; Elliott and Armitage 2009) and individual involvement in volunteering and the 3rd sector (Okun and Sloane 2002; Greenslade and White 2005).

2.2.3.1 Model overview and uses

In the original theory of reasoned action an individual's behavioural intent was outlined as directly following from the individual's attitudes towards the specific behaviour in question and also the subjective norms surrounding the behaviour (Fishbein and Ajzen 1975). The additive effect of both attitudes and subjective norms are thought to predict behavioural intent which will then, according to Fishbein and Ajzen (1975), in turn predict actual behaviour. Each of these predictors are influenced and formed by different beliefs. An individual's attitude towards a specific behaviour is influenced by their beliefs surrounding the probable outcomes should they carry out that behaviour, these are known as behavioural beliefs. Subjective norms are influenced by what are known as normative beliefs, or more explicitly, the beliefs that an individual holds surrounding the *perceived* societal or peer group pressure to perform, or abstain from, a given behaviour (Fishbein and Ajzen 1975).

The formation of this behavioural framework was a response to early to mid-20th century socio-psychological research and postulation that attitudes alone are not universal predictors of behaviour but instead behaviour is a complex multifaceted construct (Wicker 1969; Fishbein and Ajzen 1975). As the theory of reasoned action became more prolifically utilised in social and psychological sciences a number of limitations and caveats were highlighted, specifically one being the failure to address individuals who have, or perceive themselves to have, very little control over their behaviours (Sheppard *et al* 1988; Ajzen 1991). As a result, Ajzen (1991) included an additional element, perceived behavioural control, in a new theory of planned behaviour. In the TBP perceived behavioural control is a predictor of behavioural intent, just as attitudes and subjective norms are in TRA, which refers to the perceived ease of carrying out a specific behaviour. Perceived behavioural control is based on a person's control beliefs which are described as the perceived ease of carrying out a given action regardless of that individual's general locus of control, weather it is internal or external (Ajzen 1991). As a result, the idea is that attitudes, subjective norms and perceived behavioural control are all predictors of behavioural intent, at which point behavioural intent and perceived behavioural control influence an individual's actual behaviour (Fig 2.1).

One of the key aspects of the theories of reasoned action and planned behaviour is that each predictor does not have a set and locked influence over behavioural intent or actual behaviour, but instead each predictor is weighted differently for different and specific behaviours and situations (Ajzen 1991). This allows the theory of planned behaviour to be particularly flexible and adept at highlighting the most influential predictors of certain behaviours and so will allow researchers to more accurately identify specific targets for intervention schemes, of which there has been recent success in the fields of pro-environmental behaviours and conservation (St John

et al 2010; Chao 2012). The application of the theories of reasoned action and planned behaviour has been applied to many studies investigating behaviours surrounding recycling (Tonglet *et al* 2004; Do Valle *et al* 2005; Mahmud and Osman 2010), sustainable resource use such as water (Lam 2006) and food consumption (Vermeir and Verbeke 2008), and consumer choice of low energy impact hotels (Chen and Tung 2014).

Although still relatively few in number, when compared with more established fields such as health sciences, there have been growing applications of the theory of planned behaviour to planning and intervention in conservation biology (St John *et al* 2010; Gallagher and Updegraff 2012). A number of these studies involve the application of the theory in encouraging the uptake of pro-environmental methods or agri-environment schemes with farmers using otherwise modern yield-centric techniques (Beedell and Rehmen 2000; Zubair and Garforth 2006; de Snoo *et al* 2013). These theories have also been used in assessing people's behavioural intent and acceptance surrounding recreational restriction in nature reserves (Seeland *et al* 2002), willingness to pay for biological conservation within parks (Lopez-Mosquera *et al* 2014) and behaviours of boaters and anglers surrounding both the spread of invasive species (Howell *et al* 2015) and the conservation of manatees (*Tichechus manatus latirostris*) (Aipanjiguly *et al* 2003).

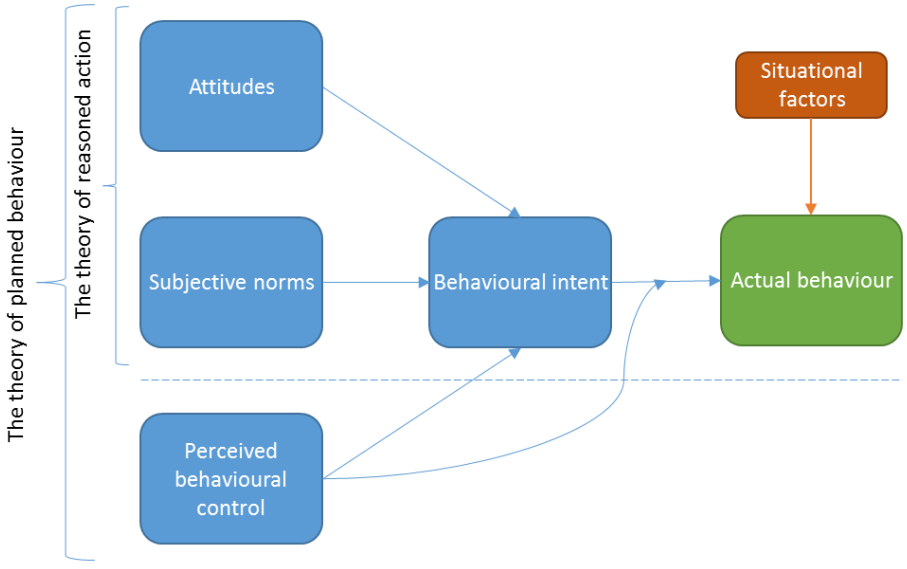


Fig 2.1 The theory of reasoned action (Fishbein and Ajzen 1975) and the theory of planned behaviour (Ajzen 1991)

2.2.3.2 Efficacy, caveats, and alternatives

It appears from much of the current literature that the use of models such as the theories of reasoned action and planned behaviour is not only useful, but perhaps necessary when informing intervention schemes. For instance, out of 11 conservation focused studies reviewed by St John *et al* (2010) the four that employed a psycho-social framework, namely either the theory of reasoned action or planned behaviour, were able to suggest intervention schemes specific to the behaviour in question, conversely those that simply looked at general or specific stakeholder attitudes towards conservation were unable to do so. In addition, when policy or intervention schemes are informed by the theory of planned behaviour, they are able to significantly change the actual behaviour within the target population, as highlighted by Hardeman *et al* (2002) in their review of such interventions. They found that two thirds of planned behaviour intervention schemes produced behavioural changes in the desired direction within the target population.

However, with respect to those studies that focus on conservation related behaviours, with the exception of Howell *et al* (2015), few have looked at longitudinal behavioural changes, instead the majority have studied the predictors and their impact on behavioural intent, or a similar surrogate such as willingness to pay. This prediction of behavioural intent is potentially a major shortfall in some of these studies because one of the key issues surrounding the theory of planned behaviour is the often problematic link between behavioural intent and actual behaviour, and the occurrence of individuals known as 'inclined abstainers', people whose intentions may be strong but do not carry out the behaviour (Ajzen 1991; Armitage and Connor 2001; Bamberg and Möser 2007; Chao 2012). Highlighting this fact Bamberg and Möser (2007) found that even though 52% of variance in intent could be described using the predictors, behavioural intent was in turn only able to describe 27% of variance in actual behaviour when they performed meta-analytic structural equation models based on secondary data collated from 57 studies researching the socio-psychological determinants of pro-environmental behaviours. In addition to this, other studies have found varying results using similar methods, for instance an early analysis found that planned behaviour explained around 45% of intent and between 19-38% of actual behaviour (Sutton 1998), whereas Kaiser *et al* (2005) reported 76% of explained intention and intention explaining 95% of actual behaviour. These variations could be a result of a number of factors. For instance, the study carried out by Bamberg and Möser (2007) was a meta-analysis of 57 previous studies of pro-environmental behaviours using theory of planned behaviour or another similar psycho-social model. This in itself may pose some problems as by conducting a meta-analysis any specificity that has been integrated into the initial models is lost during the meta-analysis and specificity is an essential component of the theory of planned behaviour (Ajzen 1991). Similar criticisms can be made of Suttons (1998) earlier study. The study by Kaiser *et al* (2005) yielded

much higher explanation of behaviour by behavioural intent. However, the focus of this study was much more general and used a wide range of environmentally friendly predictors such as attitudes towards leaving the light on and using a tumble dryer to explain other general environmental behaviours. In this study the participants were directly asked about their environmental behaviours and so would likely have encountered some social desirability bias (Fischer 1993).

Highlighting Bamberg and Möser's (2007) meta-analysis it is apparent that the majority of studies analysed used self-reported measures of behaviour, which in itself can introduce a number of potential biases into the data (Sniehotta *et al* 2014). Self-reported measures of behaviour are liable to under estimation of action or inaction, for instance if the behaviour in question doesn't fit with social norms, is seen as taboo or accepted to be illicit, conversely socially desirable behaviours are at risk of over estimation (McEachen *et al* 2011; Chao 2012). As such it is the case that in many studies the theory of planned behaviour can struggle when dealing with to accurately predict behaviour especially when self-reported (Sniehotta *et al* 2014). With this in mind however, in defence of the theory the original author has stated that it is possible that one reason for these low predictive abilities in some studies could be largely due to poorly constructed questionnaires that lack a degree of specificity and rigour (Ajzen 2015).

Due to the specific nature of the interplay between attitudes, norms, control and behaviour it can be seen how important thoroughly designed methods of interview are when using a model that necessitates a high level of specificity (Ajzen 2015). It can also be said that another potential source of some of the disparity between behavioural intent and actual behaviour in some of these studies could be due to long delays between the recording of intent and the consequent decision making event, in this case many external and internal effects have the potential to yet again change an individual's intent to carry out a given behaviour. With this in mind it seems logical that in order to maximise the efficacy of using such a behavioural framework, the assessment of intentions must be carried out as close to the time when the individual will be carrying out the behaviour. Also, often it may be the case that the beliefs accessible to the individual at the time of measuring intent may not be the same as those accessible when they are at the decision-making stage (Ajzen 2015). This may take shape in a number of ways and for a number of reasons such as the difference in environments, differentiation between a real and hypothetical situation and even the time of day (Ajzen 2015).

On the topic of beliefs, another often stated criticism of the theory of planned behaviour is that it makes the assumption that people's behavioural decision making is based on rational and calculated processes (St John *et al* 2010; Sniehotta *et al* 2014). However, this is not necessarily the case and this assumption may be due to a lack of understanding of how the model works in that

although the three proximate predictors of intent may seem to be inherently rational, the beliefs that underpin them may not be and have the potential to have unconscious or superstitious origins (Ajzen 2015). If researchers are forming their enquiry methods around the assumption that these beliefs are inherently rational then there will be potential for further error in their results.

2.2.3.3 Norms

Perhaps partially due to the 'hybrid' origin of the theory of planned behaviour, it lends itself well to additional or alternative predictors being used for specific behaviours (Ajzen 2015). As a result, many studies that have included additional, or more appropriate alternative, predictors have in fact been able to increase the efficacy in the model if chosen carefully with due consideration (Head and Noar 2014). One of the areas that is often altered is surrounding the norms involved, due to subjective norms being what an individual believes others will think of a certain behaviour, in essence 'other' based norms, the original theory appears to miss out the possibility of including 'self' based norms such as moral or personal norms (St John *et al* 2010). The additions of these 'self' based norms have been found to be effective in a number of circumstances, especially with regards to pro-environmental or pro-conservation behaviours (Bamberg and Möser 2007), such as recycling behaviours (Tonglet *et al* 2004), responsible water use (Lam 1999), and in predicting people's willingness to pay for conservation schemes in parks (Lopez-Mosquera *et al* 2014). In these cases, the addition inclusion of moral norms, an individual's own perceptions of what is seen to be 'correct' or 'incorrect' behaviour, can add significant explanatory power to the model that would otherwise not be there. This may be particularly relevant when considering in-situ pro-conservation behaviours as it may be the case that an individual may only act on their subjective norms if there is another party present to observe the behaviour. The relationship of norms and pro-environmental behaviours in many instances appears to be complex and the traditional use of subjective norms in the theory of planned behaviour can provide mixed results in different situations varying in significance from non-significant to the most influential predictor (Armitage and Connor 2001). These varying results may in fact highlight the necessity of including a 'self' based norm such as moral norms as where some behaviours will be more strongly influenced by perceived societal pressure others will more strongly linked with the internal norms that an individual holds (St John *et al* 2010). In fact, it has been noted by several authors that there is something inherent about pro-environmental behaviours that means that a moral component in a behavioural model is necessary (Kaiser 2006; Bamberg and Möser 2007; Han and Hansen 2012). Additionally, it may be interesting to look into the extent to which an individual's self-efficacy, the extent to which an individual believes in their abilities to carry out a given action, affects the respective strength of their subjective or personal norms. For instance, will someone with very

strong self-efficacy be more heavily influenced by personal norms than subjective norms and vice versa?

One consideration that must be accounted for when using social norms as a predictor, and consequentially designing intervention schemes around subjective norms, is the potential for counteractive effects resulting from the intervention (Schultz *et al* 2007). The main issue when using normative messages in intervention schemes is that some studies have in fact shown boomerang effects in the desired behaviour and although a change does in fact occur, it does not occur in the desired direction (Schultz *et al* 2007). For instance, attempts to reduce the level of drinking in US universities used social norms by highlighting the average amount that is drunk by most students, this had the effect of increasing the consumption of individuals who previously consumed below the average (Wechsler *et al* 2003; Perkins *et al* 2005). This is thought to be due to normative messages in fact being a 'behavioural magnet' instead of a benchmark (Schultz *et al* 2007) in the sense that individuals who already perform the desired behaviour may reduce their participation to fit the norm. However, it has been found that including an injunctive message, one that communicates approval or disapproval, along with a descriptive normative message, helps to alleviate this 'magnet' effect (Cialdini and Goldstein 2004).

2.2.3.4 Behavioural intent

Another alteration to the theory of planned behaviour is to substitute behavioural intent for a measure of willingness to pay instead of adding or replacing a predictor of behavioural intent (Lopez Mosquera *et al* 2014). In their study looking into conservation in an urban Spanish park, Lopez-Mosquera *et al* (2014) used an extension in the form of moral norms as well as using these predictors to explain an individual's willingness to pay for conservation services within the park itself. When determining people's conservation intentions it has been noted that willingness to pay can be used as a valuable indicator for people's conservation behaviours or intentions that gives a tangible capital based result that is more easily translated for policy making purposes (Christie *et al* 2006). However, the use of willingness to pay in environmental valuation has a number of caveats associated with it (Hanley *et al* 2013). Especially when not looking at anthropocentric valuations of the environment, individuals making the valuations will often either over or underestimate the value which they would place on a certain aspect due to distinctions between hypothetical and real situations (Murphy *et al* 2005).

An alternative to the theory of planned behaviour is the model of responsible environmental behaviour (Hines *et al* 1987) which is a model of behaviour specifically designed for environmentally orientated behaviours. The model was created through a meta-analysis of 128 studies researching environmental behaviour, following which the predictors that most strongly

influenced behaviour were incorporated into a framework (Fig 2.2). Hines *et al* (1987) found that the most influential predictors of environmental behaviour were a combination of personality factors, namely attitudes, locus of control, and personal responsibility, skills and knowledge in the form of action skills, knowledge of action strategies, and knowledge of issues. Personality factors, skills and knowledge then predict intent, which in turn combines with situational factors to predict actual behaviour. However, this model has rarely been used to any great effect (Chao 2012) and has mostly been applied to general environmental behaviours (Hwang *et al* 2000; Hsu 2004). In most cases the theory of planned behaviour outperforms the model of responsible environmental behaviour in its predictive ability and is likely due to the higher level of specificity required in the theory of planned behaviour both in target behaviour and measurement of predictors (Chao 2012).

2.2.4 Environmental knowledge

One further potential problem with the theory of planned behaviour is that it assumes complete knowledge about a system in order to make a decision (Ajzen 1991). Yet in many cases this may not be the case when individuals are making decisions regarding environmental behaviours, especially with people such as tourists in potentially new environments.

Many environmentalists suggest that knowledge of a system is essential for successful conservation action and knowledge-based interventions are there for historically popular (Boerschig and De Young 1993). However, many of these cases only look at one or sometimes two forms of knowledge that do not adequately address the problem (Frick *et al* 2004) and the link between the knowledge investigated and behaviour change is often weak (Schultz 2011). As a result, Frick *et al* (2004) defined three different types of knowledge that are appropriate to investigate with regards to environmental or conservation related behaviours. They argued that a combination of three forms of knowledge are essential in the decision making process when regarding environmental behaviours, system knowledge relating to the ecology of the species or ecosystem in question, action-related knowledge where individuals would understand different methods used for conservation benefit, and effectiveness knowledge where the individuals will understand the extent to which different behaviours will impact conservation efforts (*Ibid*). In their analysis, Frick *et al* (2004) found that all three types of knowledge were significantly related to the behaviour in question. However, while action-related knowledge and effectiveness knowledge both directly influenced behaviour, system knowledge was not a directly significant factor but was significant by influencing both action related knowledge and effectiveness knowledge. Further studies have found differing results where the three types of knowledge have different influences (Diaz-Siefer *et al* 2015). However, the amount that relevant knowledge

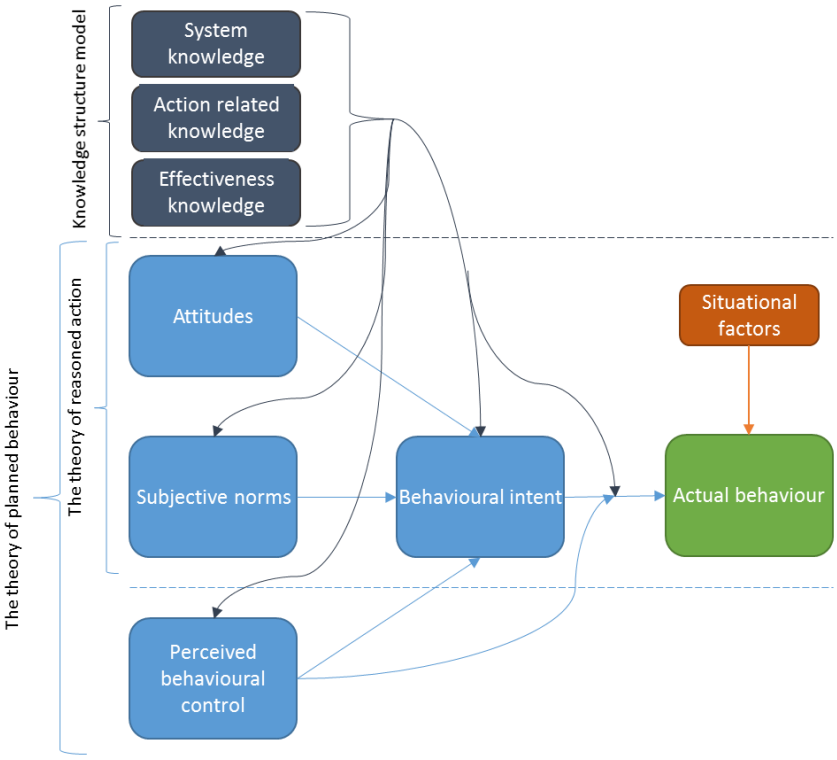


Fig 2.2 A combined model based on the theory of planned behaviour (Ajzen 1995) and forms of environmental knowledge (Frick *et al* 2004)

actually contributes to behavioural changes is low, especially when compared to other models of behaviour (Schultz 2011). In many cases, knowledge-based intervention schemes fail to bring about a desired change of behaviour (McKenzie-Mohr *et al* 2012). However, this is not to say that knowledge is an unnecessary component to behavioural change. While increasing individual's knowledge of a problem may not have directly the most effect on a target behaviour, it may instead be a useful facilitator to alter other predictors of behaviour that may have a more direct link to the behaviour in question (Schultz 2011) and has been found to be more significant in studies using other predictors such as norms (Aipanjiguly *et al* 2002) than those looking as knowledge alone.

With this in mind, I will incorporate these forms of knowledge into the theory of planned behaviour (Fig 2.2) in order to overcome this potential issue. An integrated model may be more complex but captures both the previously highlighted importance of the components of the theory of planned behaviour while investigating the effect of the different forms of knowledge on each of these components.

3 METHODOLOGY

3.1 INTRODUCTION

The focus of this thesis is on ways to improve capercaillie conservation efforts within the Cairngorms National Park by investigating conservation related behaviours, both beneficial and detrimental. In particular, the thesis aims to inform and address the priorities of the Cairngorms National Park Authority as outlined in the capercaillie framework (CNPA 2015b), namely reducing disturbance of capercaillie from recreational activities, and improving the awareness and ownership of a flagship species. This research has broader scope with potential to inform further research into fragile species management and conservation.

In this chapter I will firstly outline the philosophical ideology I employed throughout the mixed methods techniques employed. I will then discuss in more detail the quantitative and qualitative aspects of this research and how each will address specific research questions. Finally, I will discuss the ethical considerations involved with this research and the complex legal nature of the behaviours in question.

3.1.1 Philosophical standpoint for mixed methods research

The research questions which this thesis seeks to address are varied in the breadth and depth in which social phenomena are explored. As such the most appropriate line of enquiry would to be employ a mixed methodological strategy.

While, in the past, there have been a wide variety of definitions for what exactly makes some research methodologies inherently mixed, Johnson *et al*. (2007) define the term mixed methods as:

> *"Research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches for the purposes of breadth and depth of understanding and corroboration."*

While mixed methods research has been carried out for centuries where qualitative and quantitative lines of enquiry are employed (Maxwell 2016), there have often been disputes as to the compatibility of the respective traditional theoretical approaches, both in terms of epistemology and ontology (Bazeley 2018). While quantitative research has often been inherently tied to positivism, whereby the observable world is seen as having objective truths which can only be described through logic and mathematical proofs (Kitchin 2014), qualitative research is often associated with constructivist ideologies whereby social phenomena can only be understood through the experience of the individual (Lincoln and Guba 2013). However, this thesis uses a

pragmatic ideology which allows for these two seemly disparate theoretical stand points to be utilised in a harmonious and effective manner.

This pragmatic approach, similar to that outlined by Johnson and Onwuegbuzie (2004), allows for mixed methods to be used for a more complete and nuanced understanding of social systems by recognising that while, on an individual level, there are nuances governing people's behaviour that is not always directly measurable in a quantitative way, there are measurable patterns that are observable at a population level. This rejection of traditional dualisms allows for the research questions in this thesis to be addressed both quantitatively, by finding patterns amongst data, and qualitatively, further contextualising these patterns through the individuals lived experience.

3.2 VISITOR SURVEY

In this section I will outline the methods used in the first two analytical chapters, which address the current gaps in knowledge around the levels of potentially deleterious behaviours occurring within the park, levels of awareness of capercaillie conservation amongst recreationists, and how these potentially deleterious behaviours can be influenced. These chapters employ the use of primary surveys of visitors recreating within the park. These surveys are primarily quantitative in nature with some open-ended questions where context or clarification may be needed.

3.2.1 Data collection and pilot

Prior to survey design, initial interviews were carried out on the 8th and 9th of December 2016 with key informants involved with capercaillie conservation in the Cairngorms National Park. These interviews were done to gain a better understanding of the current state of capercaillie conservation within the park, and to direct and inform the content and structure of surveys and data collection. The key informants were from; the Cairngorms National Park Authority, the RSPB, Forestry Commission, the capercaillie Conservation Advisory Board, and a large local outdoor recreation centre. Along with direction of survey design, these interviews also helped to inform when and where data collection should be carried out.

The survey was piloted over two days on the 7th and 8th of April 2017 at key 'pour points' within the park, as advised by park staff, in two key reserves within the Cairngorms National Park, noted here as reserve A and reserve B to maintain anonymity. These pour points are locations where visitors recreating within the park will gather at the start or end of their recreational activity, for example large car parks where visitors will disperse from. Over this period 32 pilot surveys were completed, 16 at each reserve. Following the pilot survey, the structure and design was altered slightly, and some questions were re-worded after feedback from participants. Although both sites provided the same number of surveys, the sampling effort to collect surveys at reserve B

took substantially longer and yielded a much lower response rate than at reserve A. In addition, many of the respondents at reserve B, as it appeared to the researcher, were not of the demographic suitable for completion of the survey, in that they did not appear to be recreating within the woodland but were instead stopping in the carpark to briefly stay for a refreshment break to then carry on along the road. Additionally, car parking within reserve B is much more spread out with a higher number of smaller capacity parking spots. In contrast, due to reserve A being less commonly frequented by general tourists meant that the demographic there was much more likely to be recreating in some capacity within the local forest. For this reason, only reserve A was carried forwards to being used in the main study and as a result became a focus of this thesis. From this point forward in the thesis, reserve A will be referred to as "Gannochy Forest Park", or simply as "Gannochy".

As is often the case in conservation research, the origin and formation of a conservation research project has its roots in requests from conservation practitioners and/or managers of a specific area or site (Newing *et al* 2011). In these instances, the researchers site of interest is already pre-determined, as was the case with this research. The Cairngorms National Park Authority, being major gatekeepers to the areas and communities involved in this research, outlined the scope of the study area, being within the national park, but excluding a number of areas within the park for concerns of research fatigue and troubled ongoing relational issues with specific communities. These gatekeeping issues are discussed in more depth later on in section 3.4.4 but represent the reality of conducting research in partnership with a large organisation. As I have stated above, of the two locations that were available to the research project, only one proved to be appropriate for study during the pilot meaning that the visitor survey would be carried out within a single reserve. However, gatekeeping aside, a single location, or case study approach, comes with some assumptions and caveats, but also benefits.

One common criticism of case studies is a perceived lack of objectivity and rigor (Bryman 2012; Farquhar 2012), however this critique often assumes a lack of methodological clarity and structure alongside a perceived lack of reflexive practices observed throughout the research process. In this regard, I have made every possible effort to ensure the research presented within this thesis is not only as objective as possible, for further discussion see reflections in section 3.4.4, but also rigorous by following and presenting clear and standardised methodological structures.

Another critique that is commonly associated with case study research is that there is a lack of generalisability to wider areas (Bryman 2012). The argument here comes in the form of a lack of

representation of the broader picture when only sampling in one area and that any interpretation of the resulting findings cannot be more broadly relevant to other similar situations.

Whereas this argument that case study research is not generalizable is one of the most common arguments detracting case studies, it is also closely linked to one of the greatest benefits of carrying out research in this manner. One of the greatest benefits afforded to researchers carrying out case study research is that the data are collected, examined, and disseminated within the context to which they are immediately relevant (Farquhar 2012). This can provide much greater contextual insight and allows findings and insights to be directly applicable to the situation, area, or phenomena being studied. It is often lamented within conservation literature that there is a large amount of conservation research that has little to no bearing on the policy and practice landscape (Laurence *et al* 2012; Fabian *et al* 2019). However, the location and context specific approach of this research has allowed practitioners and policy makers to immediately engage with findings and implications as will be discussed later in this thesis.

Yin (2009) highlights a number of situations where case study approaches to research design are preferable over some alternatives. One of these examples is when the research is thought to have little influence or control over current events. As highlighted above, this could be seen to be the case within the context of this research where the delicate socio-political situation within and between different stakeholders within the national park meant that access to some communities was out with the control of the project. Yin (2009) further asserts that case study methodologies are best implemented when contemporary events and phenomena are being studied. For instance, with the complexity of the current ecological and socio-political landscape of capercaillie conservation, a case study approach may well be an appropriate direction to take this research.

As stated above, the initial scope of this project was to carry out data collection across two separate reserves within the cairngorms national park that had been cleared as being suitable for research by the park authority. However, given the lack of good quality data at one of the sites the decision to move forward using one study location in a case study capacity was made. While there are some drawbacks to this approach, as discussed above, the study site used was the largest reserve within the cairngorms national park, is home to one of the largest populations of capercaillie, and one of the most visited areas for recreation. For these reasons, the location as a case study may well work as an advantage as the site could be seen as emblematic of the issues faced by reserves across the cairngorms national park while still allowing for efficient data collection.

Commented [WS5]: Case study and single location justification

Surveys were carried out between June and August 2017 to coincide with when capercaillie are most susceptible to disturbance events and also when the national park receives the highest numbers of visitors (CNPA 2015a). Respondents were approached opportunistically at specific sites in the Gannochy Forest Park, either at a visitor centre car park, or at a popular stopping point on a walking path entering the reserve, on varying days during the week to attempt to gain a more representative demographic. These sites were chosen due to being main pour points for visitors entering the forest to recreate. Respondents were given an information sheet and asked if they would like to complete the survey estimated to take between 10-15 minutes. If they agreed, then a consent form was signed, and each respondent was given an ID number in case they wanted to withdraw their response at a later date while maintaining a high level of anonymity. Both the pilot and final surveys are available in appendices I and III.

3.2.2 Survey design

To gain information on the levels of knowledge held by users of the Cairngorms National Park on capercaillie conservation issues it is important to understand the different types of knowledge that can play a critical role in influencing pro-conservation behaviours (Frick *et al*. 2004). Frick *et al*. (2004) highlighted three different types of knowledge that are influential in an individual's decision-making process; system knowledge, action-related knowledge, and effectiveness (Frick *et al* 2004). In their 2004 study Frick *et al* (2004) used 20 questions for each type of knowledge, however their study was investigating general environmental issues, which is not the case for this research where questions will be more specific to capercaillie conservation issues which is essential when looking at their impact on specific behaviours (Azjen 1991). In order to make the questionnaire as concise as possible the survey questions were designed to be specific and so likely result in a higher response rate (White *et al* 2005).

In addition, a number of psycho-social concepts of behaviour such as norms and attitudes were investigated. When determining the most influential predictors of behaviour it is important to investigate the roll of different norms and attitudes (Schultz 2011). When looking into the influence of these psycho-social constructs on behaviour it is essential for the leading questions to be highly specific in order to produce reliable results (Ajzen 1991). The questions in the survey relating to these concepts have been designed to be situationally specific to behaviours relating to capercaillie conservation and recreation. These attitude and normative predictors were measured using a five-point scale in response to directional questions. For instance participants were given a number of statements relating to their attitude towards capercaillie conservation and the potentially deleterious behaviours such as 'It is important to me that individuals act in a pro-environmental manner', or 'Witnessing others recreating off marked trails in the woods would make me feel more comfortable to do the same'. The participants would then mark the

appropriate box as to the extent to which they agree or disagree where 1 would denote strongly disagree and 5 would denote strongly agree. Information was also gathered on respondent's demographics, recreational habits, and activities they engaged in on the day.

3.2.2.1 Randomised response technique

In order to investigate patterns of behaviour within the park, indirect questioning techniques were used to investigate those behaviours deemed more sensitive, such as extra-trail activity or activities that may have an impact on capercaillie populations. Indirect questioning techniques, more specifically randomised response techniques, have been shown to provide more accurate estimates of the prevalence of certain behaviours or attributes and has often provided higher estimates for sensitive behaviours (St John *et al* 2010). Randomised response techniques also provide greater protection and anonymity to the respondent due to the fact that the researcher is unaware of whether the response is truthful or not (Sudman *et al* 1977). Although there are many indirect questioning techniques that can be used to assess the prevalence of illicit or undesirable behaviours, this study utilised a specific randomised response technique called forced response (Warner 1965), which is statistically one of the most robust and efficient methods available (Lensvelt-Mulders *et al* 2005). This method involves the respondent using a randomisation device to inform them as to how to answer the question without telling the interviewer the result. In this case a dice was used with three options depending on what number the respondent rolled. These options are that they either respond truthfully or they give a prescribed response, weather it is the truth or not, depending on the outcome of the dice roll. Due to the enhanced privacy the respondents will be more likely to respond truthfully should they roll the corresponding number.

When designing the indirect questioning section of a survey, care must be taken to ensure the proportion of forced responses would not be so large that the method would become inefficient, while still maximising respondent protection. When deciding on the probability of a forced response a researcher must decide between a more efficient design, having a lower probability of a forced response, and a design where the respondents will still feel comfortable telling the truth if they do not have a forced response. For this reason, this study used a probability of a truthful response at 0.83, or 10 in 12, with a 12-sided dice as a randomisation device. It has been suggested that, in a forced response method when assessing some illegal behaviours, the probability of a truthful response should be between 0.75 and 0.8 in order to achieve maximum efficiency (Lensvelt-Mulders *et al* 2005). However, as the behaviours in question for this study are not explicitly illegal and respondents may be less concerned with full anonymity, the probability of a truthful response was chosen to be 0.83 to further increase the efficiency of the method while still providing respondents with some anonymity, and also allowing for a practical randomisation device, a 12 sided dice. In this instance if a respondent rolled a 1 then they were

prescribed to answer 'no', a 12 would elicit a 'yes' response, and anything from 2-11 elicits a truthful response. The dice was handed to respondents inside an opaque cup to minimise the chances of the researcher seeing what value was rolled. Some of the forced response questions were filtered to exclude respondents to whom the question was not relevant, such as those who do not own a dog or mountain bike.

3.2.3 Analysis

3.2.3.1 PCA

All data analysis was carried out using R Studio v. 1.1.456 (RStudio Team 2016). Principal component analysis (PCA) was performed on nine norms related variables using the psych package for R (Revelle 2018). This was done for factor reduction and to produce values relating to different types of norms in a more meaningful and theoretically sound manner. A KMO test of sampling adequacy was carried out on the 9 variables with no variables falling below a KMO score of 0.5 and so all 9 were carried forwards for use in the PCA. A KMO value of 0.5 is considered to be the lowest value that is considered to be adequate for variables used in PCA (Budaev 2010). A scree plot suggested that after 3 components little additional explanatory power was added. Analysis was carried out using a varimax rotation for 3 components. Scores for each component were extracted as individual variables. The variables used for creating these principal components

Table 3.1

Variables used for principal component analysis. Each variable is based on a five-point likert scale for agreement to given statements where 1=strongly disagree and 5=strongly agree.

Variable label	Likert statements
PerceptionET	The majority of people who visit the Cairngorms National Park will often venture off the marked trails
PerceptionDoL	The majority of people who visit the Cairngorms National Park with a dog will walk with it off the lead
PerceptionOthersValues	The majority of people who visit the Cairngorms National Park would want others to behave in a pro-environmental manner
InfluenceNormsET	Witnessing others recreating off marked trails in the woods would make me feel more comfortable to do the same
InfluenceNormsDoL	Witnessing others walking a dog off the lead would make me feel more comfortable to do the same
Expectations	There are expectations placed on me as a user of the park to behave in a certain way
ExpectationsParkUsers	These expectations are from other park users
ExpectationsFriendsFam	These expectations are from friends and family
ExpectationsParkStaff	These expectations are from park staff

were based on likert scale questions in the survey where respondents were asked to report how strongly they agreed with a given normative statement. These variables and corresponding survey questions are outlined in Table 3.1.

3.2.3.2 Forced response estimations

Due to the nature of the forced response design used in this research, proportions of respondents possessing sensitive traits must be estimated in a specific way to account for the 1/12 error on either end. Here we use a method specific for this forced response design (Hox and Lensvelt-Mulders 2004). In this equation π is the estimated prevalence of the sensitive trait within a given population, λ is the total proportion of 'yes' responses, θ is the probability of a 'forced yes' in this case 1/12, and P^{true} is the probability of the respondent being instructed to answer truthfully in this case 10/12.

$$\pi = \frac{\lambda - \theta}{P^{true}}$$

3.2.3.3 Modelling

Generalized linear mixed effects models were used for model building, however, due to the additional known error around the response variables introduced by the forced response design, it is not appropriate to use a standard logistic function (van den Hout *et al* 2007). Any models with forced response dependant variables must therefore be adapted to account for the known probabilities of both a forced response and a truthful response. In this case a constrained logistic function, employed by St John *et al* (2012), was used for all models. This function allows the user to constrain a logistic regression to the known probabilities of their data, in this case between 0.083 and 0.83, instead of the usual 0 and 1 for standard logistic regressions. While there are packages available for use with R that contain functions for building models with forced response data, such as RRreg (Heck and Moshagen 2019) and RRTCS (Rodríguez *et al* 2015), at the time of analysis it was often either unclear which method of estimation was being used and so a user defined link function was deemed to be the most appropriate method. Because of the use of a user defined link function the glmmPQL function available in the MASS package for R was used (Venables and Ripley 2002). This function for building GLMMs accepts user defined link functions more easily than the base R function 'glmer'. While using this function does allow for greater flexibility in link customisation, it does create some difficulties when model building due to the nature of penalised quasi-likelihood regressions not being compatible with more traditional model selection methods such as AIC and BIC. For this reason, as with St John *et al* (2012), models were initially built in a blockwise manner using GLMs and selected using AIC, then built into a GLMM. Predictors for these models were grouped into theory informed blocks (table 3.2). For these models the response variables used were with regards to individual's behaviour and their

Table 3.2

Summary of variables used in modelling. Predictor variables are grouped into theory informed categories for blockwise model building and selection. Knowledge and awareness variables (Frick et al 2004), norms and attitudes as per the theory of planned behaviour (Fishbein and Ajzen 1975; Ajzen 1991), age and gender as demographic control variables.

Variable label	Description	Grouping	Type
Off Trail Important	FR for if respondent finds extra-trail activity important		Response
Walked Off Trails	FR for if respondent had walked off marked trails		Response
Age	Age of respondent in years	Demographic	Predictor (fixed)
Gender	Respondents identified gender, 0=female 1=male	Demographic	Predictor (fixed)
Aware rare spp	Respondents awareness of rare species in the area	Knowledge and awareness	Predictor (fixed)
Aware caper	Respondents awareness of the presence of capercaillie in the area	Knowledge and awareness	Predictor (fixed)
Aware law	Respondents awareness of any laws surrounding capercaillie disturbance	Knowledge and awareness	Predictor (fixed)
Important others behave	Do respondents feel it is important for visitors to behave in an environmentally friendly manner	Norms and attitudes	Predictor (fixed)
SubNorms	Principal component showing subjective norms of feeling pressure to behave in certain ways	Norms and attitudes	Predictor (fixed)
DescNorms	Principal component showing respondents self-reported influence of descriptive norms	Norms and attitudes	Predictor (fixed)
PeerBehaviourEst	Principal component showing respondents estimate of extra-trail behaviours of others	Norms and attitudes	Predictor (fixed)
GroupID	ID number of respondents who were recreating in a group together		Predictor (random)

behavioural intent. Due to the filters applied to the forced response questions, variables on dog walking and mountain biking had lower responses than walking related variables. For this reason, the variables on walking off marked trails and finding walking off marked trails important were used as proxies for extra-trail behaviour and behavioural intent, respectively. Fixed effect predictors were age and gender, female being the contrast category for gender, different types of environmental awareness, and norm and attitude indices (table 3.2). GroupID, indicating which respondents were in a group together, was included as a random effect in order to disentangle any effects where individuals who spend more time together are more likely to share certain traits and characteristics (McPherson *et al* 2001).

3.3 KEY INFORMANT FOCUS GROUP

This section outlines the methods used in the final analytical chapter of this thesis, which concerns how conservation organisations utilise different sources of information in the planning and implementation of capercaillie conservation initiatives. This chapter employed the use of a face to face semi-structured focus group with key informants from different conservation

organisations operating within the park. The design, data collection, analysis and reporting of this focus group followed a methodological structure similar to that set out by Young *et al* (2018).

Due to the small numbers of people working at a policy level in capercaillie conservation, a focus group was deemed to be the most effective approach for gaining rich qualitative data on the processes, and difficulties, involved in the conservation of capercaillie populations. Since there are multiple dimensions to capercaillie conservation, ecologically and socially, a qualitative focus group would be most effective at teasing apart the complexity involved within the system, allowing for, and encouraging, participant interaction (Bryman 2012). For this reason, individual interviews were quickly dismissed for this phase of the research process since individual interviews would not highlight the synergies and conflicts present between different disciplines and organisations. This focus group, taking part after initial analysis of the visitor survey, had also presented an opportunity for findings and interpretations from the previous two chapters to be discussed and contextualised within the context of capercaillie management.

3.3.1 Participant recruitment and data collection

As has been stated above, the pool of individuals who work directly within capercaillie conservation within the area is relatively low and as a result a single focus group with a diverse group of individuals was the most appropriate route. Due to the sensitive natures of capercaillie conservation and the location of capercaillie within the park, the identities of all participants, their organisations, and reserves are anonymised to protect the identity of participants and the location of the reserves in question.

Participants were identified from organisations working with capercaillie conservation within the park, and as individuals who are directly involved with capercaillie conservation schemes. Since much of the capercaillie conservation work involves anthropogenic sources of disturbance, such as from recreation, a spread of both ecologists and social science practitioners were approached. A group size of 4-5 was determined to be sufficient to encourage rich discussion without having participants who contribute little due to a larger group size. Although it is commonly suggested that the optimal size for a focus group is between 5 and 8, Bryman (2012) suggest that for situations where participants have a great deal of personal experience and information to share, a smaller size can be more beneficial.

In these situations, where the pool of potential participants is small and highly knowledgeable, smaller focus groups, known as key informant, elite, or mini focus groups, are often the most appropriate method and can yield high quality data (Bruman 2012; Krueger 2014). Smaller focus groups are often criticised for not providing diverse and rich experiences (Carlsen and Glenton

2011), therefore calling into question the validity and reliability of the data and resulting findings. However, research methods, whether quantitative or qualitative, must be contextually appropriate and informed by several factors. As previously stated, Bryman (2012) suggests that smaller focus groups can be more effective in cases where there is a great deal of in depth knowledge and experience held by each member. The focus group carried out in this thesis was comprised only of individuals who were very experienced practitioners in capercaillie conservation management and so a smaller focus group size would allow for the depth of each individuals experience to be expressed. This approach of hosting a small focus group comprising only of experts working within the relevant area has further benefits to the overall research design, this kind of place responsive research, as posited by Lynch and Mannion (2016), can have a number of benefits for further contextualising research in the area of focus and attenuating participants to the more-than-human. Another benefit of a smaller focus group size is that it allows members to feel more comfortable when engaging in the conversation, therefore allowing them to communicate their thoughts and feelings more effectively without feeling either embarrassed or overshadowed by a larger group size (Carey 1994).

As stated by (Sandelowski 1995), the success of qualitative research often relies on not only getting the most out of your participants, but perhaps more importantly, getting the right participants. They argue that it is often more important to get good quality data out of fewer individuals who are closer and more informed in the area. While not the case within this research, there are situations where this argument is taken to the extreme. Krause *et al* (2017) for example make the case that in their very specific area of supply chain management research, it can be the case that a single key informant is not only adequate for the purposes of their research focus, but is in fact the most optimal and efficient method for collecting valid and high quality data. In this instance, their reasoning is that by involving more actors in the data collection process, the quality of data would likely decrease as there is only a single person who has sufficient knowledge and experience to engage meaningfully with the research questions. This example is indeed extreme for likely the vast majority of situations, and is certainly not the case for the methodological approach employed by this thesis even with the smaller pool of potential highly expert participants. As stated above, there are very few individuals who have such a breadth and wealth of knowledge and experience of capercaillie management that not only is the potential pool of participants very small, but also, that by involving others in this stage of the research process may either not add anything beneficial to the overall data and findings, or may well in fact reduce the overall quality by hindering interactions during the focus group itself.

Another reason for hosting small focus groups is if the participants involved are extremely passionate about the topic (Krueger 2014). Krueger (2014) suggests that participants who are

more passionate about the subject of the focus group are more likely to engage in complex conversation instead of sitting quietly in the background allowing others to carry the conversation, instead, more passionate individuals want to have their own thoughts and feelings heard and so are more vocal. Because of this, smaller focus groups provide the space for these individuals to converse more freely without anyone being pushed out of the conversation due to the dominance of others, which in some fields of research is an essential part of the methodological design, such as in social work research (Toner 2009). This also allows the researcher to investigate the relationships and interactions between the different actors much more effectively as each relationship will be uncovered in more detail as a result of more frequent direct interactions and discourse between participants (Krueger 2014).

For the reasons stated above, these kinds of key informant focus groups have become methodological staples in some fields of research where the smaller and more intimate setting allow for more interaction between all participants and richer resulting data.

Commented [WS6]: Focus group justification

A list of potential participants was drafted noting individuals' involvement with capercaillie conservation, affiliated organisation, and the extent to which their expertise is based in natural or social sciences. The focus group took place at Forest Lodge, a convenient location for all participants, within the national park, at a date and time that suited everyone. Four participants were recruited during this process, representing two organisations and spanning a range of disciplines, all in powerful decision making roles across the conservation policy landscape. The backgrounds and characteristics of these participants will be outlined in more detail in the third analytical chapter. It should be noted however, that while the participants taking part in this focus group make up some of the most informed and expert conservation professionals working within capercaillie conservation, there were a number of voices that were not present in these discussions. Within this research, and as discussed in section 3.4.4 of this chapter, there were some compromises that must be met when working on collaborative projects with funders who have a direct presence in the area of study. In this instance, due to both the concern of research fatigue and ongoing socio-political tensions, there were some groups who I was encouraged not to involve heavily in the research process by the funders. It was highlighted to me that, at the time of fieldwork, there was considerable tension between the Cairngorms National Park Authority, local residents and recreation organisations, and the CNPA were working to repair these relationships. As a result of this, and ongoing social research in local communities, the CNPA encouraged me not to contact these communities for fear of worsening the situation. These communities would of course provide highly valuable insights if involved in the focus group process, especially those of the local outdoor recreation organisations, whose livelihoods rely on access to wild spaces, such as Glenmore Lodge. Glenmore Lodge for instance would have

provided a much welcomed insight into how these spaces are not only utilised buy recreationists and professional outdoor instructors, but would have provided a perspective from individuals who may not have had a conservation centric background. However, due to the dynamic of the focus group and the line of questioning being focussed around conservation, these individuals would not have been able to fully participate and so they were not invited to take part in this research but would provide highly beneficial insight for future research.

While Krueger (2014), highlights that one practical advantage of smaller key informant focus groups over larger group sizes is that participant recruitment is made much easier, recruitment for this key informant focus group was a challenge for a number of reasons. Some of these participants proved to be difficult to recruit as a result of their incredibly busy schedules and so there were who could not attend due to their time constraints. In addition, there was a further problem with organising a suitable time that was convenient for all participants who had agreed to take part. As a result, recruiting and organising the focus group took a great deal more time than was initially expected.

Commented [WS7]: Focus group justification

The focus group was researcher mediated and followed a pre-determined topic guide, which was designed to encourage participants to engage with each other's responses and facilitate discussion. This topic guide followed four main phases for the focus group. Firstly, a general introduction to the structure of the session and topics involved, followed by introductions of each participant and their disciplinary background and relevant recent work. This also included gaining informed consent from the participants for their taking part and each participant was given a consent form to sign prior to the start of the session. Following this, the second phase looked to generate discussion on the current status of capercaillie conservation efforts within the park. For the third phase, participants were presented with initial findings, from the first and second analytical chapters of this thesis, to gain a more nuanced insight into the implications of these findings with regards to current capercaillie conservation efforts. This third phase also aimed to further investigate how conservation practitioners view and utilise newly acquired information. The final phase of the focus group aimed to encourage a wider discussion and debate on the dynamics surrounding capercaillie conservation, anthropogenic disturbance, and how paradigmatic differences may lead to difficulties and potential conflict. Framing of these paradigms was aided by using those outlined by Mace (2014), where she describes historic stances taken on how nature and the natural environment are predominantly viewed.

The focus group, with permission from the participants, was recorded on two recording devices, and the researcher made some notes throughout the focus group and for some post-hoc reflections. Audio recordings were sent to a professional service for transcription and were stored in a secure manner in line with the ethical guidelines.

While it is commonly suggested to carry out multiple rounds of focus groups (Bryman 2012), due to the focus group element emerging as an important part of the research late on in the PhD process, and the time and funding constraints that entails, it was only practical to carry out a single focus group session. However, if further focus groups were to be carried out then involving other local publics such as outdoor recreation organisations, would be a valuable addition in post-doctoral research or further studies.

Commented [WS8]: Focus group justification

3.3.2 Analysis

Following transcription, data were imported into Nvivo, a software package designed for the management and analysis of qualitative data. The transcript was analysed by employing a two-phase coding method to explore common themes and construct a narrative (Miles *et al* 2014). The first phase is to summarise the data and highlight common themes and subjects by utilising codes to explore descriptive themes, processes, and emotions and values associated with the data. These codes were predefined through themes surrounding the research questions following a review of the transcript, and further codes were developed during analysis of the data allowing for new codes and themes to arise in a grounded approach (Miles *et al* 2014). Following this initial coding phase, all codes and potential relationships between codes were identified and condensed into themes to create more meaningful units for analysis and to allow for a narrative to be created (Miles *et al* 2014). The second phase of analysis involved focused coding using this condensed group of codes and themes to draw out more meaningful groupings and orderings of quotes.

3.4 ETHICAL CONSIDERATIONS

3.4.1 Informed consent

Informed consent was gained in the surveys in the form of a signed consent form detailing the conditions of consent with an information sheet attached. Each survey was assigned a unique ID number so that the respondent could get in touch at a later date and request that their data be erased. This is highlighted in the consent form, of which there are two, one for the researcher to keep a record of consent and one for the respondent to take away, including researcher and project supervisor contact information.

For the key Informant focus group, participants were presented with an information sheet and confidentiality form, prior to commencement of the session, which the respondents were required to sign if the focus group was to go ahead. Again, they were informed that all participation is voluntary, and their data can be erased at a later date.

All information sheets contain information regarding the research aims, details of research funders, researcher and project supervisor contact details, conditions of consent, and how the data will be stored. They all state how participation is voluntary, and that data can be withdrawn at a later date to be erased.

3.4.2 Confidentiality and anonymity

Survey respondents and focus group participants were given written and verbal assurances of strict confidentiality and informed of how anonymity would be maintained throughout the research and dissemination process. The aggregation of the survey data provided full anonymity in any results as all identifying information, such as names or places of work, was removed from the data before analysis. In addition, the nature of the indirect questioning techniques used assured further confidentiality and anonymity. Further, the surveys did not intend to collect identifying information but instead, as stated above, each survey was assigned a unique id number which respondents could later use as a reference to have their data erased by contacting the researcher *via* email or telephone.

The data from the focus group was processed so that no identifying information was present in the working dataset. All raw data, audio recording and raw transcriptions, were kept in a secure and locked cabinet in the researcher's office at the University of Stirling in line with the ethical guidelines. No individuals or organisations are referred to by their name but instead are given a pseudonym.

Data will be stored by the researcher for as long as is necessary for research purposes and will be suitably and effectively erased at the end of the study.

3.4.3 The potentially illegal nature of respondents' behaviours

Although human disturbance is not thought to directly impact capercaillie productivity, it is thought to affect their movement within the habitat showing preference for quiet, undisturbed areas and avoiding heavily used tracks. With this in mind, the Cairngorms National Park has previously issued a number of signs to encourage individuals to keep dogs on leads and stay on marked trails in certain areas of sensitive woodland. As such, some behaviours, such as recreating off marked trails and letting a dog off the lead in some areas, may be seen by conservationists and some members of the outdoor community as undesirable. In addition, it is stated in section 5 of the Wildlife and Countryside Act (1981) that:

> *"If any person intentionally or recklessly – (a) disturbs any wild bird included in schedule 1 while it is building a nest or is in, on or near a nest containing eggs or young; or (b) disturbs dependent young of such a bird, he shall be guilty of an offence and liable to a special penalty."*

In this instance capercaillie are in schedule 1. Although this states that disturbing a schedule 1 bird is an offence it is only so if the individual has done so either recklessly or with intent. In addition, the data received on visitor behaviour is not in itself indicative of capercaillie disturbance and only provides information on the behaviours undertaken. Therefore, these data will provide no evidence of whether a disturbance event (accidental or not) actually occurred at any point.

These data are also fully anonymous with no identifying information being collected at any time in the survey. Because these data have been collected using a randomised response technique the respondent is offered extra security in that the researcher does not know whether their responses are in fact true or not but will gain a more reliable result from the aggregate.

With this in mind however, if a respondent reported that they were concerned that they had committed an offence of this regard, as happened on one occasion following completion of a survey, then their response was to be kept confidential and anonymous, as with the rest of the data, so long as no harm was being done or due to be done to the individual or the local endangered species. There was also the concern of future intent, in which case the local ranger service would be informed of a potential threat to capercaillie without giving any identifiable information as to who the respondent is. This would allow the ranger service to be aware, and expectant, of any potentially damaging behaviour and react in the way that they deem to be most appropriate, without incriminating the respondent to something that they may not carry out.

While intentional or reckless disturbance of capercaillie is against the law, there is, in all actuality, little to no risk of the data collected in this survey being incriminating for the respondents. Firstly, the nature of the randomised response design means that participants are afforded extra anonymity. Also, the behaviour would need to be identified as both causing a disturbance event, and being intentional or reckless in nature, neither of which are likely nor recorded in the survey.

3.4.4 Positionality and reflexivity

Holmes (2020) posits that research into matters involving social phenomena and human actors is never, or rarely, value free. In other words, the positionality of the researcher brings with it additional baggage into the realm of social research where each researcher has their own past experiences, educational background, and preconceptions that shape the way they see and understand the world around them (Beck *et al* 2021). Being reflexive of one's own positionality, and potential subsequent impact on the research in question, is not only an analytical practice to ensure the rigour of any analysis and findings, but it is also an essential ethical practice (Brittan *et al* 2020).

As the field of conservation sciences becomes more aligned with mixed methods and interdisciplinary research, researchers are encouraged more often to engage in reflexive practices, and in particular, to identify and make known how their positionality, within the context of the research, may influence their decision making, interpretation of findings, or ethical outlook (Sultana 2007). This is particularly so in conservation research that involves social elements to the process, as is becoming more prominent (Brittan *et al* 2020). In this regard, there are several aspects to my own positionality that should be noted and the potential influence on this research explored.

Firstly, I should note that my academic background in natural sciences and conservation will undoubtedly influence my approach to conducting research into issues related to conservation. Given that my academic background in natural sciences provided a substantially greater influence on quantitative lines of inquiry it is understandable that I was more aligned with a positivist ontology, which in turn influenced the initial research design of this project. Initially, I was more comfortable with quantitative research and so the broad majority of my methodology was focussed around gathering quantitative surveys as opposed to interviews and focus groups. However, being situated within a social sciences department, and peers with backgrounds in sociology and social theory, soon encouraged me to think more critically about my chosen methodological approach. This move away from positivism towards a more pragmatic ontological outlook gave space for me to view social research as a more nuanced practice leading to more qualitative elements being incorporated into the methodology.

I think it is also important to highlight that my understanding of the ethical duties of conservation research has also somewhat changed since the outset of this thesis. As highlighted by Mace (2014), the outlook of conservation has undergone numerous shifts. In some regards my own positionality on nature can be broadly aligned with some of the positionalities, or framings, outlined by Mace (2014). In a similar vein to what Mace (2014) describes as a "nature despite people" framing, I had, for a long time, believed that the best way to conserve nature was to exclude humans from key biodiversity areas and that conservation efforts should be prioritised before human needs or requirements. It is likely that the cause of this line of thinking for me came from multiple sources with my upbringing in a heavily industrialised area of north-west England in the 1990's being one. During the 90's, awareness of environmental degradation from anthropogenic sources was becoming more mainstream and living, at the time, in an area with many oil refineries made these messages particularly pertinent to my younger self. However, I am also a keen outdoor recreationist having been brought up hill walking and mountain biking, and so I have another perspective on wild spaces and nature as being spaces for recreation. For this reason, I feel as though my role in this research, and how I am seen by those participating, is likely

that of both an insider and outsider as my perspectives may be both harmonious and discordant with those of this researches participants.

3.4.4.1 Insider/ outsider

When discussing positionality one of the debates that often arises is what is known as the insider-outsider debate, or dichotomy, which has multiple definitions with each stating how and why it may be more beneficial to be one as opposed to the other (Holmes 2020). For context, a researcher involved in social research can be categorised as an insider or an outsider with regards to their chosen area of study, the participants they are engaging with, and the relevant culture of those participants. This insider-outsider categorisation of researchers is intrinsically linked to their positionality, and how the positionality of the researcher relates to that of the actors and environments that are the focus of the research, this in turn is thought to be a fundamental characteristic that defines an individual's ability to truthfully and accurately collect, interpret and communicate information (Holmes 2020). As defined by Merton (1972), one can be identified as an insider if they are a member of a specific group or collective whereas outsiders are not. Another way to define this is that the assignment of insider status occurs when an individual has a "lived familiarity" with the group being researched and as such has a theoretical understanding and knowledge of the group (Mercer 2007). However, these definitions appear to rest of a dualistic definition of what it means to be an insider or an outsider, whereas in actuality these positions are along a spectrum and individuals can hold both insider and outsider status at the same time (Holmes 2020). This is particularly relevant to how I was situated within the context of this research, sharing lived experiences with the participants of the focus group as conservation professionals, and also shared experiences as an outdoor recreationist with many of the survey respondents.

Having been trained in natural sciences and conservation it could be argued that I share insider status with the conservation professionals involved in this research. Having similar education backgrounds, similar views on nature and conservation, and even sharing similar demographic characteristics, being white British, will undoubtedly lead to some likeminded thinking around conservation issues. However, while I may be an insider in a disciplinary and academic context, I was very much an outsider when it came to the socio-political dynamics surrounding conservation organisations, and as such my "lived familiarity" was not shared in this regard. This mixed insider/ outsider dualism I held with these research participants will have arguably proved to be both beneficial and disadvantageous in some scenarios, and in fact the pros and cons of such positionalities have been widely debated (Holmes 2020). One such advantage of sharing an insider position in this instance is that I was more able to recognise and hold a more nuanced discourse with other capercaillie conservation experts without prior explanation or clarification of

what could be considered more basic concepts. However, as stated, the outsider position with regards to the socio-political landscape of capercaillie conservation meant that I was making more inquiry into the different individual and organisational actors in the field. While in some ways this could be seen as a disadvantage it could also be argued that my lack of preconceived ideas surrounding this socio-political landscape allowed me to become more detached from any predetermined biases when gathering and analysing data (Merton 1972).

Within the focus group setting with conservation professionals my situatedness as an insider was also apparent through how these individuals perceived me as being equally expert in the field, albeit from a slightly different angle. I believe that this proved to be a significant asset. As already stated, my own perception of myself as an insider gives me greater familiarity with the field in question, but also, being perceived as an insider by the participants may have meant that they were more comfortable in having open discussion with me in the room in a manner that may not have been the case if I didn't have these shared experiences and backgrounds (Mercer 2007). For example, having already discussed our shared conservation background, my own being with the Scottish Wildlife Trust, prior to the focus group commencing I had developed a relationship and understanding with the participants, establishing myself as having some very similar professional experiences. For instance, I feel as though one such example would be that we had casually discussed many of the challenged faced when carrying out conservation work, especially involving people, and the issues that are often faced when coordinating volunteers. These experiences are often shared amongst the majority of conservation professionals and proved to be a unifying common ground that, I believe, lead to more open discussion where the participants felt more open to being critical of the public side of conservation work.

However, there were more publics involved in this research than just the conservation professionals participating in the focus group. The other key group involved in this research was the outdoor recreationists who completed surveys within the national park. My positionality with relation to these outdoor recreationists is complex and, as with the conservation professionals, not likely to be easily identified as either insider or outsider, and in reality is probably a mix of both and somewhere in between. As with many of the individuals who completed these surveys, I am also a keen outdoor recreationist and regularly go hill walking, mountain biking and walking in woodland areas. For this reason, I feel as though I can relate to, and understand, the desires of some of these individuals to immerse themselves in wild areas and to seek out more than human encounters. In this regard, I could relate to their experiences and drivers, for example, I would often have conversations with many of my participants about where they were going walking, other walks in the area, interesting wildlife that we had each seen, or good bike rides in the National Park, which may have gone some way to showing that I also shared the same

experiences as my participants. However, it was clear that I was often not seen as such by the participants themselves, who, despite our shared lived familiarity in relation of recreation, enjoyment of the outdoors, and familiarity with the surrounding area, saw me very much as a figure of authority within the national park setting. My position as what they perceived as a conservation expert and researcher placed me in a position where I was not seen as being the same as them. This was particularly notable while collecting data with some individuals becoming notable less open about their activities once they understood why I was in the area. However, I addressed my outsider status in this regard, and looked to mediate the lack of openness with rigorous survey design, ensuring confidentiality, and introducing a data collection method that seeks to minimise the influence of social desirability bias (Fischer 1993).

I must also note that the relationships between myself and the participants of this research were not the only relationships at play. As this research was, in part, funded by the Cairngorms National Park Authority, the relationship I had with this stakeholder, and any commitments to them, were different to that of almost anyone else within the research landscape. When research is funded by a highly invested partner, it is not uncommon for finding to be brought into questions (St John *et al* 2016). In the past, and likely still today, lobbying groups commission research with an agenda to attaining specific findings that are seen to be sympathetic to their cause or enterprise, such as the tobacco industry (Bero 2005) and the fossil fuel industry (Franta and Supran 2017). For this reason, it is highly important that researchers working with funding partners who are highly invested in the research landscape reflect upon the relationship between themselves, the funding body, and other actors within the landscape. My relationship with the Cairngorms National Park Authority was not simply that of researcher/funder, but they also played a further role as gatekeeper to communities within the national park. This was particularly evident during initial discussions with my contact at the park authority when negotiating access to different populations. Initially, my thoughts were to involve local residents directly in the research process as their voices would be highly valuable. However, due to ongoing tensions between the park authority, researchers, and local residents, I was strongly advised not to directly engage with these communities. In some ways, this could be seen as a funding body limiting access to important communities within the research context. However, while involving local communities within the research would have provided a beneficial insight, the integrity of the research was not impacted by their exclusion. Gatekeeping is a practice that happens a lot in funded research (McFadyen and Rankin 2016), and in this instance, the limiting of access is in some aspects acting in a safeguarding capacity as local communities in the cairngorms national park are often highly involved with research and consultation with other organisations and conservation bodies. In this respect, it is understandable that the CNPA looked to reduce the impact of further research

efforts within this community to not only protect their deteriorating relationship but also to protect the communities themselves from research fatigue. For this reason, abstaining from involving these communities in the research process may in fact be the ethical choice (Ashley 2020).

It is important to express that, as a researcher, I was never asked to alter my approach to this research project with the exception of not directly engaging with local communities, and so my relationship with the CNPA was entirely ethical. The findings of my research were not downplayed at any point in time and I was never encouraged to exaggerate or downplay any of these findings in a way that would benefit the CNPA. Further, the objectives of the CNPA are very much in line with objective research driven decision making and there are no organisational benefits, either financial or political, that could be derived from manipulating this research. However, there is also a desire to provide the CNPA, not only as a funding body but also as a conservation organisation with values that align with my own, with findings that are ethically sound, objective and impactful. However, I feel as though this desire to provide this enabled my capacity to be critical and reflexive around what my role as a funded researcher should be, and that by providing findings that the funding body wants to see would be counterproductive to their conservation efforts.

While my positionality will have changed somewhat throughout the process, I took every step to be reflexive of how this may influence my research and to remain as impartial as possible. In summation, my positionality, in many regards, was an enabler for improved access due to the connections I was able to make with key individuals due to our shared experiences. In a similar vein, my shared experiences with many of the participants of this study may very well have led to more rich data and, in many ways, better analysis.

Commented [WS9]: Reflexivity and positionality

3.5 Conclusion

Upon reflection, the social systems surrounding the conservation of capercaillie are both diverse and complex and so require a pragmatic theoretical ideology and a diverse methodological approach. In this thesis, by using pragmatism as a research philosophy allows for the rejection of traditional theoretical dichotomies that would otherwise hinder mixed methods research. The utilisation of this pragmatic approach allows for patterns to be examined through quantitative analysis while still permitting for nuances in social behaviour and decision making that can be explored through qualitative lines of enquiry.

Given the potentially sensitive nature of individuals conservation related behaviour, especially considering the legal ambiguity relating to these behaviours and capercaillie disturbance, indirect questioning methods are the most appropriate tool for exploring the prevalence of these

behaviours alongside a more traditional survey style. The use of indirect questioning, specifically the forced response technique, allows for not only greater accuracy of estimates for these sensitive behaviours, but also affords respondents greater protection and anonymity. However, as I have outlined above, these methods require non-conventional analytical techniques, due to the known error introduced through the use of a randomisation device and pre-prescribed responses. While these methods of analysis may introduce some limitations with regards to model building, these limitations are not thought to outweigh the benefits of affording greater anonymity to respondents, resulting in more truthful responses.

While findings from a more quantitative visitor survey will shed light on previous gaps in knowledge such as understandings of visitor awareness and interaction with capercaillie conservation initiatives, and the prevalence of certain behaviours that could be detrimental to capercaillie, the use of a qualitative line of enquiry will allow for contextualisation and corroboration of these results with regards to management and policy making processes. For this reason, a focus group, involving key informants who are directly involved with policy and management decisions, is seen to be the most effective method for investigating the issues presented in findings of chapter 3.

4 ASSESSING THE LEVELS OF AWARENESS AND UNDERSTANDING OF CAPERCAILLIE CONSERVATION ISSUES AND DETERMINING THE CURRENT PATTERNS OF BEHAVIOUR OF VISITORS.

4.1 INTRODUCTION

This first analytical chapter aims to investigate the current gaps in knowledge surrounding the levels of awareness and patterns of behaviour, relevant to capercaillie conservation issues, amongst members of the public recreating in a reserve in the Cairngorms National Park. This chapter will look to address two main research questions in relation to these gaps in knowledge:

> ***1.a.*** *What are the current patterns of behaviour within the Cairngorms National Park in relation to capercaillie conservation?*
> ***1.b.*** *What are the current levels of awareness and values amongst visitors to CNP of capercaillie conservation issues?*

In order to investigate patterns of behaviour within the park indirect questioning techniques will be used to explore those behaviours deemed more sensitive such as extra-trail activity or activities that may have an impact on capercaillie populations. Indirect questioning techniques, more specifically randomised response techniques, have been shown to provide more accurate estimates of the prevalence of certain behaviours or attributes and has often provided higher estimates for sensitive behaviours (St John *et al* 2010). Randomised response techniques also provide greater protection and anonymity to the respondent due to the fact that the researcher is unaware of whether the response is truthful or not (Sudman *et al* 1977). Although there are many indirect questioning techniques that can be used to assess the prevalence of illicit or undesirable behaviours, this study utilised the forced response technique, which is statistically one of the most robust and efficient methods available (Lensvelt-Mulders *et al* 2005). This method involves the respondent using a randomisation device to inform them as to how to answer the question without telling the interviewer the result.

Levels of awareness and values, however, are more easily ascertained through traditional direct questioning methods. Frick *et al* (2004) highlighted three different types of knowledge that are influential in an individual's decision-making process, system knowledge, action-related knowledge, and effectiveness (Frick *et al* 2004). In their 2004 study Frick *et al* (2004) used 20 questions for each type of knowledge, however their study was investigating general environmental issues, which is not the case for this research where questions will be more specific

to capercaillie conservation issues, which is essential when looking at their impact on specific behaviours (Azjen 1991).

4.2 RESULTS

4.2.1 Survey demographics

Overall 159 respondents completed the survey at two key pour points within the reserve, 150 surveys were completed at the main carpark in the busier side of the reserve and 9 were completed at a bothy situated on a frequently travelled footpath entering the less busy side of the reserve. 122 respondents answered as part of a group, with 57 groups in total, and 37 respondents answered alone. The gender split of respondents was relatively even with 78 female and 81 male respondents, with a mean age of 47 years of age and an age range of 14 to 78. 54% (n=86) of respondents said that they were a member of a conservation or outdoor sports organisation, 45.2% (n=72) of respondents reported that they were a member of a conservation organisation while only 11% (n=19) reported that they were a member of an outdoor sports group.

The most common activities respondents stated for coming to the area were those that appear to be more reserved and lower tempo, such as watching wildlife (n=149), Low level walking (n=130), and sightseeing and relaxing (n=130). Activities that are more adventurous, on the other hand, were less commonly reported as being a reason for visiting the area, such as mountain biking (n=27), climbing and mountaineering (n=24), and wild camping (n=18).

4.2.2 Current levels of awareness and understanding of capercaillie conservation.

4.2.2.1 System based knowledge.

Although 80% (n=124) of respondents said that they were aware of capercaillie within the park, fewer reported that they were aware of any specific rare species (73.5%, n=116). The proportion of respondents who were aware of the threatened status of capercaillie was 64.7% (n=103), a markedly lower proportion than those who were aware of capercaillie within the park. When asked where respondents learned about capercaillie conservation the most reported source was from a conservation organisation (n=26) followed by television programmes (n=20), such as spring watch. Signage within the park and learning from friends and family were both reported at the same rate (n=15). Online sources were the 5th most common category (n=8), followed by local non-conservation sources (n=6), nature literature (n=5), and prior formal education (n=2).

29% (n=46) of respondents reported that they were aware of when they were in sensitive capercaillie habitat. The two categories most often reported for how individuals know when they

are in this habitat were signage (n=18) and habitat characteristics (n=18). Awareness through visiting with a conservation organisation was lower at 3 responses and one respondent reported that they were aware because of their prior education.

Respondents understanding of when capercaillie are most sensitive was relatively accurate with most responses falling between march and July. This monthly range closely mirrors the breeding season for capercaillie which typically begins in April and ends in August (fig 4.1). Of those who answered the section of the survey regarding their perceptions of the rarity of capercaillie, 93% (n=115) perceive capercaillie to be either in the rare (n=51) or very rare (n=64) categories. The respondents had a tendency to underestimate the number of capercaillie within the park, the median response was 200, with a range from 6-20000, while the predicted population size at the time of the survey was 1285. However, 61% (n=76) of those who responded to this section of the survey said that they didn't know how many capercaillie there were.

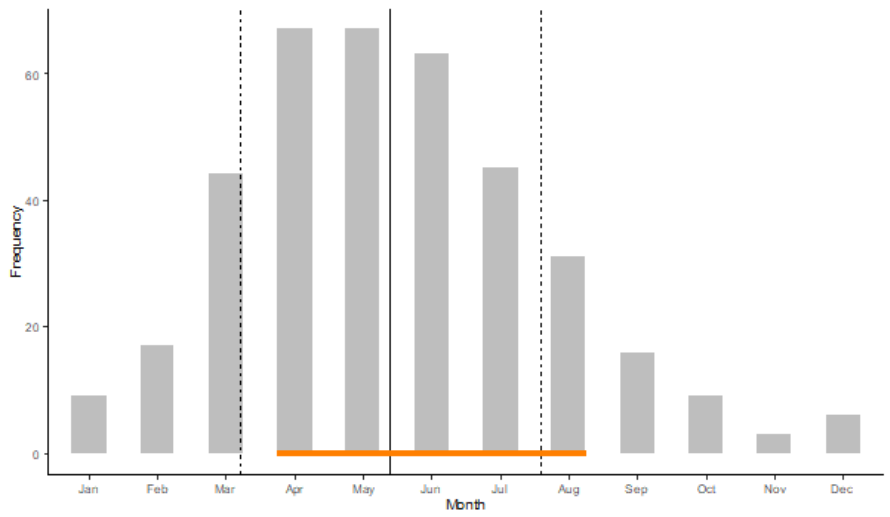


Fig 4.1 Estimates made by respondents as to when capercaillie are at their most sensitive to disturbance. The orange bar at the bottom shows the capercaillie breeding season ranging from April through to August (Gilbert *et al* 1998). The breeding season is often cited as when capercaillie are most susceptible to disturbance events (Moss *et al* 2001; Summers *et al* 2010). The solid vertical line indicates the mean of the distribution and the two dashed lines show 1 standard deviation from the mean.

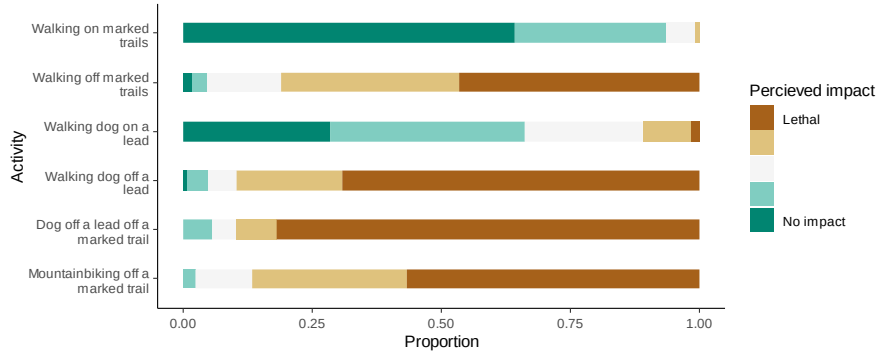


Fig 4.2 Respondents perceptions of the impact of different behaviours on capercaillie populations.

4.2.2.2 Action related and effectiveness knowledge.

Behaviours that were seen to be the most damaging to capercaillie populations were walking dogs off the lead off marked trails, where 82% of respondents said that this behaviour would be life threatening for capercaillie. This dropped to 69% for walking dogs off the lead but on marked trails, while walking a cumulative 81% of respondents reported this behaviour as being a 4 or 5 on the scale of how damaging the behaviour is. Walking on marked trails was seen to be very innocuous by comparison, where no one responded in the most extreme case at the upper end of the scale. Finally, mountain biking off marked trails shows a similar distribution of perceived impact to walking off marked trails, where the majority of respondents felt as though there would be a very serious impact on capercaillie (fig 4.2). When asked why these behaviours might be harmful to capercaillie populations the 51.5% (n=82) of respondents included disturbance in their answer. The number of responses that identified why disturbance was harmful to capercaillie, such as brood abandonment or habitat loss, was 12.5% (n=20). Respondents perceptions of the

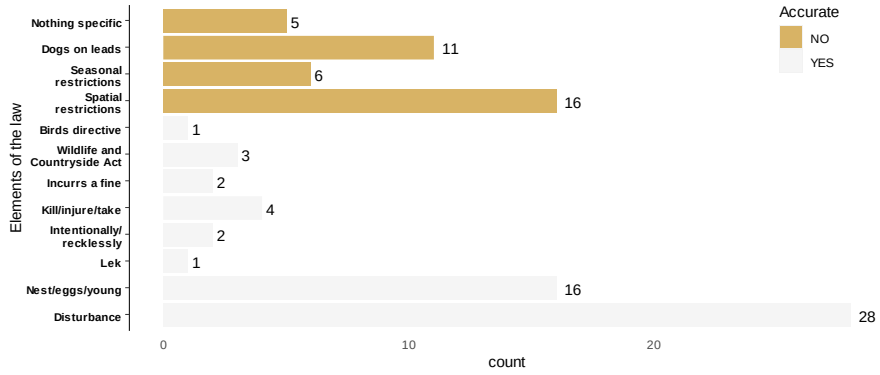


Fig 4.3 Perceptions of the law surrounding capercaillie conservation and recreation, and how accurate these perceptions are.

effectiveness of different potential conservation interventions was relatively homogenous between the different possible interventions where all options were mostly identified as being moderately or highly effective.

35.8% (n=57) of respondents self-reported as being aware of the law surrounding the protection of capercaillie. However, when asked about specific elements of legislation the number of respondents who accurately identified an element of the legislation dropped to 22.6% (n=36). Disturbance was the most commonly reported element of legislation (n=28), followed by a mention of nesting birds, eggs or chicks (n=16). The next four most reported categories were all elements that are not explicitly stated within the legislation, 16 respondents reported some form of spatial restrictions within the park where certain areas, such as off marked paths, were restricted. Another misconception, that letting dogs off the lead was an illegal behaviour in these areas, was reported as being within the legislation by 11 respondents. More specific elements within the legislation were reported far less suggesting a more general understanding of disturbance without the nuances, such as intent or recklessness, ramifications, or lekking (Fig 4.3).

4.2.3 Estimates of, and attitudes towards, undesirable behaviours.

Following analysis of data collected through the forced response technique, the proportions of visitors who possess the potentially sensitive trait, or have engaged in the specific extra-trail activity, could be estimated. Each of the traits in question were identified, during an initial

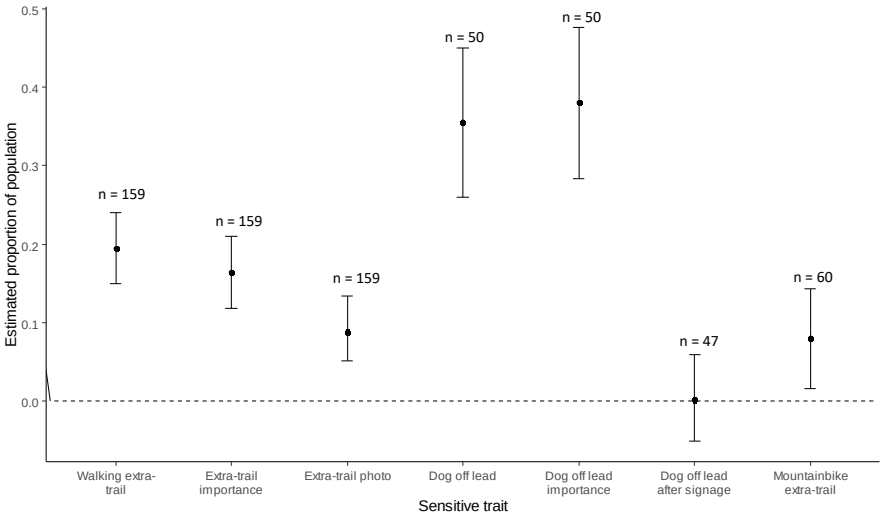


Fig 4.4 Estimates of extra-trail behaviours and traits amongst respondents. Questions were filtered depending on if the respondents had the means to engage in the specific activity, such as owning a mountain bike or a dog, resulting in different sample sizes for each variable. Points show the estimated proportion of t he population who possess each sensitive trait, derived from the forced response design (Hox and Lensvelt-Mulders 2004), error bars show 95% confidence intervals around these estimates. Estimates were made for each of the 7 randomised response variables.

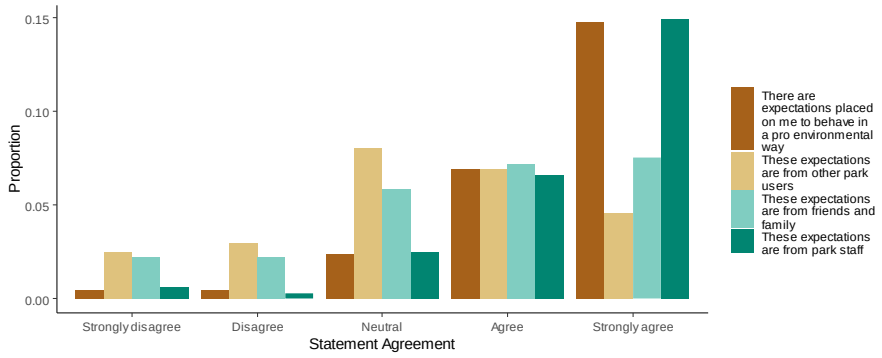


Fig 4.5 How much respondents agree to feeling pressure to behave in a certain way and who they feel these pressures mostly come from.

sensitisation, by key informants working in capercaillie conservation. The estimated proportion of respondents who walked off trails was 19.5% (n=159), who find extra-trail activity important was 16.4% (n=159), walked off trails to photograph wildlife was 8.8% (n=159). For individuals who go walking with a dog the proportion of those who walked their dogs off the lead was 35.6% (n=50) with 38% (n=50) of respondents with dogs finding walking their dog off the lead an important part of their recreation. However, the proportion of individuals who walk their dog off the lead, after seeing informative signage asking to keep dogs on a short leash, was much lower at 2.1% (n=47). Finally, the proportion of mountain bikers who bike off marked trails in the area was 8% (n=60) (fig 4.4).

Attitudes towards other visitors behaving in an environmentally friendly manner were very high where 78% (n=126) of respondents said that this was very important to them. However, the perceived environmental attitudes of others were lower; 33% (n=53) of respondents agreed and 46% (n=73) strongly agreed with the statement 'The majority of people visiting would want others to behave in a pro-environmental manner'.

Most respondents felt as though there were expectations for them to behave in a certain way when in the park. While these expectations were reported to be often from other park users or friends and family, park staff were seen to be the most highly influencing group (fig 4.5).

4.3 Discussion

4.3.1 Current perceptions, attitudes, and levels of awareness

Many people are not aware of either capercaillie being a rare species, or often even that capercaillie exist within the park. This would suggest that, for many people, a major barrier to behaving in an environmentally sensitive way is that they are simply not aware of the problem.

While previous research has found that by simply increasing the public's understanding of conservation issues does not always result in a change in behaviour (McKenzie-Mohr *et al* 2012; Bolderdijk *et al* 2013), knowledge and understanding are key factors to consider when designing initiatives for conservation or environmental change (Schultz 2002). While increasing knowledge of a conservation issue amongst the public may not result in a desired behaviour change, a lack of understanding may well become a significant barrier (Schultz *et al* 2002). If members of the public are not aware of capercaillie conservation efforts, and the impact of their own behaviours, then it would be unreasonable to expect them to behave in a certain way without any prior knowledge. With this in mind it is essential for managers and policy makers to have an understanding of the public's current levels of awareness in order to design an effective and efficient intervention scheme.

We found that levels of system related knowledge amongst the population to be very low. While respondents were, in general, aware of the presence of capercaillie, and fewer aware of their threatened status, their understanding of capercaillie behaviour and habitat were much lower. Considering status of capercaillie as a flagship species within the Cairngorms National Park (CNPA 2015b), and its charismatic nature, it is somewhat surprising that the levels of basic knowledge and awareness of capercaillie are not higher. It may be that of the members of the public who have not heard of capercaillie, or were not aware of its threatened status, were passing through the area and opportunistically took some time to recreate within the reserve without engaging with any sources of information before, or during, their visit.

It is also the case, as will be discussed in analysis chapter 3, that there are a number of different intervention and education strategies between different reserves within the park. Some reserves and land managers feel that it is best to not advertise the fact that there are even capercaillie present within the area in an attempt to not draw any undesirable attention from people who would attempt to seek them out. However, arguably the socio-economic role of a flagship species is to increase engagement with, and understanding of, conservation initiatives (Walpole and Leader-Williams 2002), and that by guarding the presence of such a species is counter-productive.

The publics action-related knowledge, in contrast to system knowledge, appeared to be surprisingly high. Activities taking place off marked trails were reported as being more dangerous to capercaillie populations than those that take place on marked trails. Additionally, it appears to be the case that the general public sees these activities as being more harmful when done with dogs. However, due to the elusive nature of capercaillie, the impact of each of these behaviours is subject to some debate with anecdote being more heavily relied upon than empirical evidence. With this in mind it would be difficult to assess the accuracy of these responses in real terms. However, there does appear to be a general consensus amongst the public as to specific

behaviours that are much more damaging than others, namely those which involve an extra-trail component. Why these specific behaviours are damaging was generally seen to be as a result of disturbance. However, the large proportion of responses where disturbance of birds, nests or chicks was mentioned, may be a result of a flaw in the survey design where this question may have been influenced from an order effect (Van de Walle and Van Ryzin 2011) from an earlier question regarding the law. This earlier question asked respondents:

"Are you aware of any British or European laws that relate to the disturbance of some ground nesting birds such as capercaillie?"

This question appearing in the survey, before one that asks about why some behaviours may be harmful, could have primed respondents to answer in a specific way (Van de Walle and Van Ryzin 2011). This does not invalidate the results from this question, however, as several respondents mentioned not only disturbance, but why disturbance may be harmful to capercaillie populations. This would explain why there was such a large proportion of seemingly accurate responses but in fact it is likely that the respondents were predisposed to respond in this way by an earlier question in the survey. In actuality, the number of respondents who are aware of why these behaviours are harmful is very low. Additionally, the homogenous results from how effective respondents feel different conservation initiatives would be would suggest that effectiveness knowledge is also very low.

Frick *et al* (2004) argue that system knowledge is more distant to the related behaviour than action-related and effectiveness knowledge. This being said, the very low levels of system knowledge amongst the visitors in the park may not be an issue when it comes to encouraging environmentally sensitive behaviours. Instead, action-related knowledge and effectiveness knowledge have much more of an influence on the target behaviour (Frick *et al* 2004). However, although many of the respondents showed a level of corroboration for which activities are more harmful to capercaillie, there is a great deal of uncertainty around exactly what impact these activities have on capercaillie populations. Although it is widely accepted that disturbance negatively influences capercaillie populations in a number of ways, such as reducing the species realised niche (Theil *et al* 2008), the impact of each individual activity is unknown and largely reported anecdotally. For this reason, it is difficult to assess the accuracy of statements given by respondents in this context. It is, however, likely that this uncertainty at an organisation and management level could cause confusion and a decline in cooperation amongst individuals recreating within the park (Pollard *et al* 2019). Additionally, is it important to understand that increasing knowledge alone is not sufficient for enacting a behavioural change within a population (Bolderdijk *et al* 2013). The effectiveness of any informative conservation initiative is largely

influenced by the underlying values and attitudes held by the target population. In this case, the target population appears to have relatively strong pro-environmental attitudes, as demonstrated by their feelings towards others behaving in environmentally friendly ways. As highlighted by Schultz (2010), an increase in relevant knowledge in and of itself is not sufficient to enact a change in behaviour, whereas a lack of this knowledge may prove to be a barrier to this change in behaviour. It may then be that an while an information based initiative may not have the desired effect of increasing specific capercaillie friendly behaviours amongst the population, but it would be successful in addressing the lack of knowledge that could be proving to be a barrier to an effective behavioural change when accompanied by an appropriate environmental disposition. This was evidenced by the responses given to the open-ended question at the end of the survey where some individuals expressed that they did not want to behave in a way that was harmful to capercaillie populations, but they were made aware of some of the issues by the survey:

I think most people would want to behave in an environmental way. Like me they might just not know how.

For some respondents this lack of knowledge, and consequent engagement in damaging behaviours, appeared to be a source of regret:

I wasn't aware of the damage my dogs could do. I generally try to behave in a sensitive way. Will keep my dogs on leads and be more observant. Very sorry.

However, by addressing the lack of knowledge of recreationists alone would be to miss opportunities to make structural changes to the way people engage with wildlife and how they recreate within these sensitive areas. As was highlighted by a number of respondents, even if they are aware of the potential damage that could be caused by their activities, they still wish to, for instance, let their dog off the lead, or walk off the marked trails:

I should be allowed to exercise my dog without being reprimanded.

There needs to be opportunities to recreate off the beaten track, while of course preserving the sensitive areas and wildlife as much as possible.

Sometimes you want to step off the path to look at the wildlife better even though you know it is bad for nature.

These statements suggest that alternative ways of engaging with either the wildlife in the reserve, or how they interact with the space, should be provided in order to satisfy the wants and needs of the recreationists visiting the area. These alternative opportunities, such as designated dog

walking areas, guided nature walks, or sustainable wildlife viewing opportunities, will be discussed in more depth in chapter 6 where results from this chapter, and chapter 5, have been contextualised with capercaillie experts and conservation managers.

Since conservation organisations appear to be the main source of knowledge, either directly or through on site signage, it is extremely important that these messages are put across in the correct ways and also uniformly across the entire park to avoid any confusion as to the norms or behaviours that are expected of visitors and being upfront. Since visitors felt the most pressure to behave in specific ways from park staff it seems as though an informative initiative would be most effective when delivered through face to face interaction with park staff, or through more effective signage.

4.3.2 Estimates of extra-trail activity

4.3.2.1 Dog walking

We found that the most common behaviours that could be harmful to capercaillie involved dog walking. Our estimates suggest that 35.6% of respondents who visit the area with a dog will walk it off the lead, the proportion those who find it important to walk their dog off the lead is estimated to be only slightly higher at 38%. This suggests that in the park it would seem that those who find it important to let their dog off the lead will likely do so. This resonates with much of the literature which suggests that dog walking off the lead is seen to be not only important for the dog's health (McNicholas *et al* 2005) but also important for dog-owner relationships and bonding (Cutt *et al* 2008). Although there is anecdotal evidence of dogs chasing and attacking capercaillie, there is no empirical evidence that suggests these events are having a direct impact on capercaillie populations (Moss *et al* 2014). However, this does not belittle the argument that dog walking is an activity that may be negatively affecting capercaillie populations. It is still likely that should dog walking off leads result in a disturbance event, the realised niche of capercaillie could gradually be reduced, or a chick separation event could take place.

The estimated proportion of visitors who walk their dogs off the lead in these areas drops sharply when asked if they have done so after seeing a sign asking for dogs to be kept under close control. It is estimated that only 2.1% of visitors walk their dogs off the lead after seeing signage similar to this. This drop in behaviour may well be as a result of dog walkers reading a sign and feeling a responsibility to behave in a certain way. However, it is also likely that many of these respondents had simply not seen a sign asking them to keep their dog under close control and so are not responding to whether they have walked their dog off the lead but instead responding to whether they have seen such a sign. Within the Cairngorms National Park, reserve managers put up small blue signs asking for people to be aware of ground nesting birds and to keep dogs under close

control during certain months of the year (Fig 4.6). These signs also have a picture of either a capercaillie or a dog inside of a triangle. A number of park staff reported that they believe that although these signs are minimalist and attempt to portray a message in a simple and efficient way, they may not perform the job as well as may be hoped. Often people who are recreating in the outdoors will not stop to read signage word for word and so signage similar to this often relies on an attention-grabbing picture or phrase. In this case the signage shows a picture of a dog or capercaillie and a statement saying, "Take care – Dog walkers", then smaller writing underneath giving information about capercaillie being sensitive to disturbance. To those who understand the conservation status of capercaillie, and the disturbance possibilities, may take note of these signs and walk away with the right message. However, to many of the visitors who are not aware of capercaillie or their conservation status, may see this sign as saying 'beware there are capercaillie/dogs in the area' not because they themselves should seek to be more environmentally responsive. This is particularly important given that signage is seen to be one of the main sources of information for visitors, and thus it is essential that any messages are clear and concise in their meaning to avoid any confusion such as in this instance.

Fig 4.6 Example signage available in the Cairngorms National Park

4.3.2.2 Walking

Walking off marked trails is thought to be an important factor in the reduction of the capercaillie's realised niche due to continuous and predictable disturbance events (Summers *et al* 2007). Certain areas of the forest that get a higher footfall, such as around western side of the reserve, have seen declines in the capercaillie population as it is thought that the birds avoid these heavily disturbed areas even when visitors stay on well-defined path systems (CNPA 2015b).

We have estimated that 19.5% of visitors walk off marked trails while recreating within the park. While this is a large proportion of people recreating in the area, the majority of these individuals would likely be walking in the more heavily used areas of the forest around the western side of the reserve. The land managers have established a maintained footpath network and have maps available for visitors. However, these maps only include the maintained footpaths in the western section of the reserve around Loch Garten, where there are fewer capercaillie. The eastern area has a much lower footfall, but also larger numbers of capercaillie, perhaps as a result of the fewer numbers of visitors. The western area is seen by some reserve staff somewhat as a 'sacrificial' area in an attempt to reduce disturbance of capercaillie populations in the east. In this instance it would appear that having a 'sacrificial' space for recreation is helping by reducing the stress on healthier capercaillie populations in other areas. However, it may also be the case that some of the individuals who do walk off the trails are actively seeking out a feeling of remoteness and wilderness, which would potentially draw them into the more remote areas in the east. Whereas, it may be that individuals who are recreating in the more heavily used areas around the western part of the reserve are walking off the trails opportunistically instead of planning their whole activity around extra-trail recreation.

Further, given that there is estimated to be 1.92 million visitors to the Cairngorms National Park each year, mostly in the summer months (CNPA 2015a), could mean that as many as 374000 visitors engage in extra-trail activity potentially causing disturbance events with capercaillie. As just a single disturbance event can have a significant deleterious impact on capercaillie, both on an individual and population level, such as the disturbance and subsequent abandonment of a lek (Cas 2010; Mikolas 2015), the potential for widespread disturbance is very high. Given that a trend of increasing visitor numbers is set to only increase in the coming years as a result of improved access to the area, recreation is likely to require greater focus from managers.

4.3.2.3 Mountain biking and photography

Mountain biking on single track routes is a topic that has received some controversy with regards to capercaillie conservation in non-academic circles (Kelbie 2003; Winter 2017). Many of these statements say that unofficial mountain bike trails are a danger to capercaillie populations and

are driving birds away from suitable habitat areas, with reserve mangers encouraging mountain bikers to stay on official purpose-built mountain bike trails. However, as with many other sources of disturbance, the impact that mountain bikers have of wildlife, especially capercaillie, is anecdotal. Some members of the mountain bike community suggest that their sport is in fact one of the least detrimental activities to capercaillie, as they feel that they are usually very quiet and are through the forest relatively quickly resulting in 'less disturbance'. We estimated that around 8% of mountain bikers in the area mountain bike off marked trails or use unofficial trails. However, Abernethy forest is not regarded to be a particularly good single-track mountain bike venue as it is relatively flat and has a well-developed understory. Because of this, many of the mountain bikers in this area may be more likely to use official marked trails, and so the style of mountain biking may be different than other areas, in so far as it would become more bike touring than downhill mountain biking that cuts through understory vegetation.

We estimated that 8.8% of visitors in the park walk off marked trails to take photographs of wildlife. This however is of the whole sample and not just of individuals who identify as being wildlife photographers. Although wildlife photography is thought to be a contributor to capercaillie disturbance, the demographic who would be causing these problems would not necessarily have been captured by this survey. Instead, many of the more enthusiastic wildlife photographers looking to get a photograph of a capercaillie would likely be out in either the very early morning when the birds are lekking or late in the evening when the light conditions are widely considered to be 'better'. Members of staff at the reserve talk about finding trails of reflective tape on trees left by wildlife photographers leading to known lek sites. While individuals who walk off marked trails may be doing so for a number of reasons such as a wanting to feel more adventurous, wildlife photographers are instead actively seeking out capercaillie and so even though the numbers of individuals partaking in these activities may be lower, the overall impact may well be greater.

This impact of wildlife photographers, and also likely bird watchers, is likely to be compounded by the fact that capercaillie are known to have a more pronounced response to sporadic and unpredictable disturbance events (Theil *et al* 2008).These events, for instance, could be where photographers or bird watchers venture off the marked trails into very remote areas of woodland actively seeking out the birds. While these less common but more unpredictable disturbance events may not reduce the realised niche of capercaillie as much as more regular and predictable disturbance (Theil *et al* 2008), unpredictable disturbance, resulting in greater flushing distances and higher stress responses, could cause more brood separation events, nest or lek abandonments (Whittaker and Knight 1998).

4.3.3 Limitations

The use of randomised response designs has been applied to many areas of research when attempting to gain insight into the prevalence of illegal, illicit, or undesirable behaviours (Hoffman *et al* 2017). However, the efficiency of these methods, namely the forced response technique (Warner 1971), is reliant upon specific conditions. Firstly, the behaviours, or characteristics, in question must be sufficiently illicit for the method to be required and more accurate than through a conventional direct questioning line of enquiry (Lensvelt-Mulders *et al* 2005). This requires the respondents to primarily understand that these behaviours would be considered taboo by someone who influences their norms and values. In this instance, the behaviours in question, although potentially illegal, are not as overtly illicit as other behaviours where this method has been used before, such as bush meat hunting (Nuno *et al* 2013). However, there is a great deal of subjectivity when determining how undesirable a behaviour or characteristic is and, thus, there is no objective way of ascertaining weather a randomised response method is appropriate for a given study without performing a comparison of responses given for the same survey through direct questioning. The lack of knowledge surrounding specific elements of the legislation protecting capercaillie, and other ground nesting birds, could be argued to prove that respondents are unaware of the illicit nature of these behaviours. However, respondents were generally found to see the law as being more robust and covering a greater spread of activities without the nuances of any disturbance event being seen to be 'intentional' or 'reckless'. In this case, the lack of understanding around the law may, in fact, increase the necessity for a forced response technique as respondents may see the potential consequences for these behaviours to be greater than they actually are.

It was noted by the researcher during data collection that there appeared to be difficulties when trying to engage some members of the public who seemed to be in the park to take part in more high intensity activities. This was noted from the individuals or group's attire and equipment, for instance, the wearing of running clothing, a heavily laden rucksack, or trail running shoes. It may have been that these individuals were particularly difficult to recruit as they had arrived at the park with a very clear and set objective or activity which may have had a time constraint associated with it. However, sampling bias was minimised by recruiting throughout all times of day in order to approach potential respondents both when they are just beginning or just ending their activity.

4.4 Conclusion

There are seen to be a number of major barriers to enacting and implementing an effective and efficient conservation intervention with regards to the anthropogenic disturbance of capercaillie.

Of those that are seen to be at the fore front of the process are establishing an understanding of not only what the current patterns of behaviour are, but also the levels of knowledge and understanding of capercaillie conservation issues amongst the general public. This chapter has addressed these gaps in knowledge through analysis of survey data and the use of randomised response techniques for estimating the prevalence of certain undesirable behaviours.

Firstly, overall knowledge of capercaillie conservation issues amongst the general public was found to be relatively low. These low levels of awareness could prove to be a substantial barrier to enacting a behavioural change within the target population (Schultz 2002). Although informative conservation initiatives are often not effective in changing behaviours (Bolderdijk *et al* 2013), when the right pro-environmental attitudes are present an increase in knowledge and understanding, especially of action-related and effectiveness knowledge, can provide the right tools in order for a population to behave in a more environmentally friendly manner. This desire to behave in an environmentally friendly way, but not being aware of how to do this, is seen amongst this survey's population. With this in mind, an intervention that looks to increase action-based and effectiveness knowledge would likely be effective with a large proportion of the population.

While walking off marked trails may be predicted at the most commonly occurring behaviour in total, the proportion of individuals within the dog walking community who are walking their dogs off the leads is estimated to be higher. However, due to the unknown impact that each of these behaviours may have on capercaillie populations it would be difficult to identify one behaviour, or user group, that would be most effective to target. Consequentially, as both commonly occurring and less common and sporadic behaviours will impact capercaillie in different ways, an intervention designed to target all behaviours, each in a nuanced and specific manner, would be most beneficial. However, given that we can estimate up to 347000 visitors per year will engage in extra-trail activity, recreation may be a more significant stressor to capercaillie population than is currently thought.

5 PREDICTORS OF EXTRA-TRAIL BEHAVIOURS

5.1 INTRODUCTION

This analytical chapter looks to address the knowledge gaps surrounding drivers of extra-trail activity within the park with regards to capercaillie conservation, and how this may influence the efficacy of available conservation initiatives. The following research questions will be addressed:

> 2.a. What are the key predictors of extra-trail behaviours amongst recreationists within the park?
>
> 2.b. How can these behaviours best be targeted and influenced to reduce anthropogenic disturbance of capercaillie?

When looking to enact a change in behaviour it is vitally important to understand the processes and predictors involved. In doing so makes us much better equipped when it comes to the design and implementation of conservation schemes. Many different models of behaviour have been applied to investigate and understand conservation and environmental related behaviours, ranging from sociological (Kasper 2009) to psychological (St John *et al* 2010) and economic (Ostrom 2015). While each of these approaches have merits, and also drawbacks, key psychosocial concepts were drawn from the theory of planned behaviour (Ajzen 1991), along with knowledge and basic demographics, to be utilised for determining the key predictors of behaviour. Due to the latent nature of norms, principal component analysis is used here to reduce and factorise 9 variables into appropriate normative components. Additionally, due to the forced response method of collection for the behavioural data, a traditional logistic regression is not appropriate. For this reason, a constrained logistic regression is used to account for the known error within the forced response variables. Through using these methods in the exploration of behavioural traits and conservation related recreation, this chapter presents an original contribution by addressing the gap surrounding behaviour, outdoor recreation and fragile species. This chapter highlights not only the key influencing traits for extra-trail activities, but also how varied and nuanced the prospective conservation interventions must be in order to be effective.

5.2 RESULTS

5.2.1 Principal component analysis

The 9 variables used for the principal component analysis (table 3.1, chapter3) were based on norms and attitudes. Two variables regarding respondents perceptions of the prevalence of peer behaviour both walking off the trail and letting dogs off the leash, perceptions of peers

environmental values, two variables regarding self-reported influence of norms, and four variables on perceived expectations to behave in an environmentally sensitive way and who these expectations come from (table 5.1). Results from the KMO test indicated that no variables had a KMO score of below 0.5 so all 9 were carried forward for use in the principal component analysis.

The loadings matrix (table 5.1) shows the specific loading of each variable on the three components. From these loadings the components can be interpreted as follows. The first principal component, "InjNorms", summarises respondents' perceptions of expectations of their behaviour, this can be interpreted as being related to injunctive norms, which shows respondents perceptions of if behaviours are approved or not by others. As can be seen in table 5.1, the primary loading variables for this component are all related to if respondents felt as though there was a pressure to behave in a pro-environmental way, and from various sources. The second component, "InfluenceOthers", indicates respondents self-reported influence of descriptive norms. For each of the two primary loading variables for this component, respondents were asked if witnessing someone else in the park engage in a certain behaviour, would it make them feel more comfortable to do the same. The third component, "DescNorms ", can be related to respondents' perceptions of the prevalence of extra-trail activity, or descriptive norms, in the

Table 5.1

Loadings for varimax principal component analysis of 9 normative variables. Primary loadings, >= 0.4, for each variable is highlighted in green for positive loadings and red for negative loadings.

Variables		Principal components		
Variable label	**Variable description**	**InjNorms**	**InfluenceOthers**	**DescNorms**
PerceptionET	Perceived prevalence of others walking off marked trails.	-0.06	0.16	0.85
PerceptionDoL	Perceived prevalence of others walking dogs off the lead.	-0.15	0.11	-0.51
PerceptionOthersValues	Perceptions of others pro-environmental attitudes.	0.4	-0.13	0.04
InfluenceNormsET	Self-reported influence of witnessing others walking off marked trails.	0.02	0.89	0.02
InfluenceNormsDoL	Self-reported influence of witnessing others walking dogs off the lead.	-0.01	0.92	-0.02
Expectations	Perceptions that there are expectations to behave in a certain way in the park.	0.65	-0.38	-0.06
ExpectationsParkUsers	Expectations to behave come from other park users.	0.8	0.17	-0.06
ExpectationsFriendsFam	Expectations to behave come from friend and family.	0.76	0.2	0.09
ExpectationsParkStaff	Expectations to behave come from park staff.	0.6	0	0.29

area. The estimated proportion of explained variance for each of the three retained components was 24.7% for "InjNorms", 21.5% for "InfluenceOthers", and 11.6% for "DescNorms" which explains a total of 57.8% of variance. For the three components each variable has a loading of higher than 0.4 on their respective primary components, with no cross loading across components. One variable, overall perceived expectations, had a secondary loading of -0.38 but has a relatively strong primary loading of 0.65. Principal component analysis scores were predicted and extracted for each respondent for use in regressions.

5.2.2 Indicators of potentially illicit behaviours

As discussed in the methods chapter, section 3.2.3.3, while final GLMMs would use penalised quasi-likelihood due to the flexible approach which it offers for user defined link functions, initial model selection was made using a series of GLMs. AIC indicated that the models with the best fit out with the null model were those containing all three sets of predictors for the response variable 'OffTrailImportant', and the model containing Knowledge and awareness variables, along with demographics, for the response variable 'WalkedOffTrails' (table 5.2).

The likelihood of respondents finding extra-trail activity important (table 5.3) in the park was significantly related to age with a negative relationship suggesting that respondents are 0.8 times

Table 5.2

Model selection for forced response GLMs. Models were fitted using a blockwise selection process with predictors grouped into theory informed categories as outlined in table 3.2. Final models favoured by AIC are highlighted. X denotes predictors included in the model.

Response	Model	Grouped predictors			AIC	Δ AIC
		Norms and attitudes	Knowledge and awareness	Demographics		
OffTrailImportant	Null	-	-	-	169.6	0
	1	X	-	-	171.09	1.49
	2	-	X	-	175.29	5.69
	3	X	X	-	175.5	5.9
	4	**X**	**X**	**X**	**157.59**	**-12.01**
	5	-	X	X	158.78	-10.82
	6	X	-	X	158.15	-11.45
WalkedOffTrails	Null	-	-	-	179.16	0
	1	X	-	-	184.06	4.9
	2	-	X	-	176.13	-3.03
	3	X	X	-	182.19	3.03
	4	X	X	X	179.98	0.82
	5	**-**	**X**	**X**	**173.02**	**-6.14**
	6	X	-	X	183.18	4.02

less likely to find extra-trail activity an important part of their recreation for every ten years of age gained. Male respondents were 2.4 times more likely to respond saying they find extra-trail activity important. The principal component SubNorms, feeling expectations from peers to behave in a certain way, was significantly positively related to the importance of extra-trail activity. Respondents with a higher score for the component DescNorms, self-reported influence of peer behaviour, were more likely to report that extra-trail activities are an important way in which they recreate. Awareness and attitude variables were non-significant in this model.

Age was again significantly and negatively related to the likelihood of respondents having walked off marked trail in the park (table 5.3) where respondents were roughly twice as likely report having not walk off marked trails for every ten years of age gained. Respondents who are aware of rare species in the park are 2.38 time less likely to engage in extra-trail activity than those who were not aware. Conversely respondents who were aware of capercaillie specifically in the park were 1.87 times more likely to respond saying they had engaged in extra-trail activity in the area.

Table 5.3

Regression results for final models. Constrained logistic GLMMs for two different response variables, if visitors find extra-trail activity important (OffTrailImportant), and if they have walked off marked trails during their time at the reserve (WalkedOffTrails). For an overview of predictors see table 3.2 in chapter 3.

Predictors	**OffTrailImportant**			**WalkedOffTrails**		
	Log-Odds	*std. Error*	*p*	*Log-Odds*	*std. Error*	*p*
(Intercept)	-1.35	5.45	0.18	0.41	0.99	0.68
Age	-3.15	0.02	**0.002**	-2.23	0.01	**0.031**
Gender [Male]	2.76	0.88	**0.007**	-0.47	0.38	0.211
AwareRareSpp	0.36	1.19	0.721	-2.38	0.59	**<0.001**
AwareCaper	0.42	1.27	0.678	1.87	0.91	**0.043**
AwareLaw	1.6	0.9	0.112	-0.83	0.76	0.277
InjNorms	2.26	0.51	**0.026**	-	-	-
InfluenceOthers	2.17	0.45	**0.033**	-	-	-
DescNorms	0.75	0.4	0.456	-	-	-
ImportantOthersBehave	1.05	1.08	0.296	-	-	-
Random Effects						
τ_{00}	$3.23_{GroupID}$			$0.00_{GroupID}$		
N	$49_{GroupID}$			$49_{GroupID}$		

Non-significant variables included gender, awareness of the law surrounding capercaillie, and norm and attitude variables.

5.3 DISCUSSION

Disturbance of capercaillie in the Cairngorms National Park is thought to be one of the key compounding factors leading to the species decline (Storch 2013). Much of this disturbance is thought to be from tourist and recreationists visiting the park engaging in various extra-trail activities, such as mountain biking, walking, and walking dogs off the lead (CNPA 2015b), however these assumptions are largely anecdotal. Disturbance events can lead to flushing of birds, chick separation events, lek abandonment or in some cases death caused by roaming dogs (Moss *et al* 2014). Gaining an understanding of the prevalence of these potentially damaging behaviours within the park can have important consequences for management strategies, where park managers can then identify user groups who would be most likely to engage in extra-trail activity. When inquiring about these kinds of behaviours, which could be seen by some to be undesirable, traditional direct questioning methods may not provide truthful estimates of behaviour prevalence. This could be due to social desirability bias (Fischer 1993); therefore, it can be beneficial to employ indirect questioning techniques that give the respondent sufficient anonymity for them to feel comfortable telling the truth when they are asked to do so.

5.3.1.1 Age and gender

The findings presented in this chapter suggest that as people age, they not only find extra-trail activity important, but they also engage in extra-trail activity less. This could be a result of mobility becoming more problematic as people become older (Crespo *et al* 2000) and so walking off well maintained marked trails may become more difficult. Previous research in this area has stated that age does not influence individuals' recreational activity preferences but does appear to influence whether the underlying driver of recreation is physically driven, or nature based (Payne *et al* 2002, Arnberger and Eder 2011). What is more pertinent in this study is whether these activities took place in a certain manner or setting that could have been detrimental to capercaillie populations. Another explanation for this may be that perhaps younger people are more likely to engage in extra trail activity because they are seeking out a more 'wild' experience their outdoor recreation, while older people look for more managed natural experiences. Previous research has found that younger individuals place high importance on natural and wild settings for their outdoor recreation (Arnberger and Eder 2011). These preferences were seen to shift with age to preferring cleaner more managed outdoor settings such as urban parks.

When looking at the effect of gender, these results suggest that males are more likely to report that they find extra-trail activity important. This is consistent with previous literature that

suggests that in outdoor settings women tend to not seek out in these kinds of activities as often as men (Johnson *et al* 2001). However, gender was not a significant factor when looking at whether individuals actually engaged in extra-trail activity. This disparity in findings suggests that although women tend not to find extra-trail activity important, they engage at the same rate as men. One possible explanation for the difference in gender effect could be that a normative effect is occurring for groups recreating together. Although males are more likely to want to engage in extra-trail activities, men and women engage in these behaviours at the same rate. The norms held within the group would have a centralising effect on the behaviours of other members (Schultz *et al* 2007), where those who are in the minority with their views, are pulled to either engage or not engage in extra-trail activities. However, while this could be having some effect, potentially the most likely explanation is that people simply do not always engage in activities that they want to do or find important (Thaler and Sunstein 2009; Ajzen 2015), and instead a wide variety of situational cues will inform an individual's behaviour over their initial impulses. Taking this into consideration, it appears as though a younger demographic would be the most effective target for a conservation initiative, potentially with a leaning towards younger males as a result of their increased likelihood of wanting to engage in extra-trail activity.

5.3.1.2 Awareness

Contrary to much of the current criticism of the knowledge deficit model (Schultz 2002; Simis *et al* 2016), these findings provide an original contribution to knowledge by suggesting that, in the case of capercaillie conservation, awareness and knowledge are highly important factors in determining an individual's behaviour. Our findings show that individuals are less likely to engage in extra trail activity if they are aware of rare species in the area. This suggests that people recreating in these areas are more responsive and more likely to be environmentally sensitive if they have a general level of awareness of rare species in the area. However, this is contrary to some prior research in knowledge and pro-conservation behaviour, which suggests that increasing knowledge may not necessarily result in the adoption of pro-environmental behaviours or behavioural change (Schultz 2011). In contrast to this stance however, given the correct underlying attitudes and contextual cues are in place, education schemes can be an effective tool for enacting a change in behaviour (van der Ploeg *et al* 2011; Vicente-Molina *et al* 2013). In light of this, this study has shown a similar pattern where pro-environmental attitudes, as discussed in chapter four, are relatively common amongst the general public and instead the general public, while wanting to, are unable to behave in an environmentally sensitive way as they do not know how.

A particularly surprising finding within the chapter, however, is that unlike awareness of rare species, specific awareness of capercaillie in the area instead is more likely to cause people to

recreate off marked trails. Although these results seem to be at odds with each other, one potential explanation is that because capercaillie are a large, charismatic, flagship species, people are more likely to be attracted to the area to actively seek them out either just to see them or for photography. People have a tendency to place higher value on rarity and is thought to be a factor in leading to the decline of some species (Angulo *et al* 2009). The Anthropogenic Allee Effect (AAE) suggests that as a species becomes rarer, it's value increases and encourages continued exploitation (Courchamp *et al* 2006). AAE posits that as a rare species is exploited in some form and becomes rarer, its value, both economic and abstract, subsequently increases, thereby encouraging further exploitation which causes increasing rarity and so creating a feedback loop. AAE could explain the results we see here, suggesting that as capercaillie become rarer, their abstract value to certain groups increases, causing those groups to seek out interactions with the birds more eagerly. In the past this has been seen with groups of birdwatchers, colloquially known as 'twitchers', where their seeking out of rare birds is in fact detrimental to the species in some way causing their appeal to become even greater (Booth *et al* 2011). Hence, it is quite possible that the findings presented here suggest that AAE is playing a substantial role as a driver of extra-trail activity.

Further adding to the impact of AAE on the desire to see capercaillie is the current lack of an accessible, sustainable, and environmentally sensitive lek viewing site. A resource such as this used to exist at the RSPB osprey centre where visitors could visit a birding hide a set distance away from a known lek site where visitors could see capercaillie without disturbing them. However, recently this lek has moved on and is thought to be unlikely to return in the near future since capercaillie leks, once disturbed, often do not re-establish in that location for a number of years (Cas 2010). This scarcity of accessible and environmentally sensitive viewing opportunities could push more visitors to go further off marked trails in order to see this charismatic flagship species.

These results suggest that simply educating visitors about capercaillie is unlikely to have the desired effect of influencing the behaviours of all groups within the park. Instead it is likely that there are further underlying structures involved such as situational cues that encourage individuals to behave in a certain way. Park staff have reported to have found reflective tape attached to trees leading from a road or path, to a known lekking site. The belief here is that either wildlife photographers or bird watchers are marking paths to areas of the reserve that are otherwise difficult to locate where they know that they can get a good view of capercaillie. With these groups, where they are actively seeking out capercaillie, it is likely that an education scheme will likely not influence their behavioural decision making. Instead, an alternative

intervention would be necessary to reduce the undesirable behaviours within these groups. These potential alternatives, and the feasibility of which, will be discussed in the following chapter.

5.3.1.3 Norms

The importance of extra-trail activity is also influenced by how easily influenced individuals are by descriptive, perceptions of common behaviours, and injunctive norms, perceptions of approval or disapproval. People who feel more easily influenced by descriptive norms, as well as those who feel there are strong injunctive norms within the community, find extra-trail activity more important. This suggests that the individuals are being influenced more by the groups who engage in extra-trail activity than those who do not. For instance, if someone witnesses another person engaging in extra-trail activity in the area, they may be more inclined to feel as though extra-trail activity is not strictly taboo within the area. Similarly, if an individual feels as though their peers think that they should engage in extra-trail activities then they will be more comfortable in responding that extra-trail activity is important for them. These potentially negative effects of norms could be particularly apparent within the bird watching community where members will communicate with their peers about areas where they have seen a bird, lek, or other sign of capercaillie, there for encouraging peers to seek out these areas for themselves. The influence of these norms does not, however, translate across to predicting actual behaviour. Instead, the gap between behavioural intent or preference and actual behaviour is likely to be moderated by situational structures.

Normative messages for changing behaviour, however, often must be carefully designed as there is the possibility that a boomerang effect could occur (Schultz *et al* 2007). In this case, because normative messages alone are not unidirectional, there is the possibility that more people would be encouraged to engage in extra-trail activity. In order to counter this boomerang effect any normative messages used in the park for these behaviours would also need to include an injunctive message relating to social approval (Schultz *et al* 2007). Normative messages would target injunctive norms that people hold, however, how descriptive norms cannot be targeted as efficiently in this way. Instead, something like screens on the sides of the trail could reduce the rate at which individuals witness others recreating off marked trails. This also has the added benefit of being beneficial for capercaillie populations by reducing disturbance from the trail (CNPA 2015b). However, it must be noted that this would only be an effective intervention for individuals who would opportunistically engage in extra-trail activities.

5.3.2 Effectiveness of the law as a deterrent

Legislation is often used as a tool for the protection of vulnerable species (Koleček *et al* 2014), many species and habitats have benefited from the introduction of strict legislation and, in the

right circumstances, the greater protection afforded to them can play a substantial role in their conservation efforts (Verschuuren 2004). Within the UK this is not different for many rare and endangered species such as the capercaillie.

Capercaillie are protected by law through the Wildlife and Countryside Act (1981) and disturbance, either intentional or reckless, is explicitly stated:

> *"If any person intentionally or recklessly – (a) disturbs any wild bird included in schedule 1 while it is building a nest or is in, on or near a nest containing eggs or young; or (b) disturbs dependent young of such a bird, he shall be guilty of an offence and liable to a special penalty."*

Although this states that disturbing a schedule 1 bird is an offence it is only so if the individual has done so either recklessly or with intent. This along with the Land Reform (Scotland) Act (2003), should provide a legal and recreational framework that protects capercaillie from disturbance. However, this is a complicated subject where the 'right to roam' may sometimes take precedence, in the mind of the recreationist, over responsible access. However, introducing the legalities of the disturbance of capercaillie adds an extra layer of complexity when it comes to recreational disturbance. While the legislation states that any reckless disturbance of a ground nesting bird is an offence, what is unclear is exactly what constitutes as reckless. Since recklessness denotes an element of awareness, but disregard, of consequence, it could be argued that individuals who are unaware that capercaillie even exist within the area, would not be committing an offence should a disturbance event occur. As has been highlighted by Kelly *et al* (2004), the terminology used in the Wildlife and Countryside Act (1981) is lacking a clear definition within the UK legal frameworks and there for lacks statutory weight in many instances.

While the findings discussed in the previous chapter showed that not only is awareness and accurate understanding of the law low, findings from this chapter suggest that increasing the populations understanding of the law would likely not result in a reduction in extra-trail activities. What is more is that, as discussed in the previous chapter, most respondents who were aware of the law were overestimating its stringency. In light of this, it would be expected that any effect awareness of the law had on behaviour would then be overstated, and that in fact educating the public more thoroughly on the law, while increasing the perceptions of some, would decrease the perceptions of the laws extent to others.

It could also be argued that the individuals who are fully aware of the legal ramifications of their actions are taking part in these behaviours anyway. Activities such as birdwatching and wildlife photography require a great deal of knowledge of a species in order to sight or photograph it. In such cases, increasing their awareness of the law would not serve to dissuade them from

partaking in these activities in a potentially unsustainable manner. Instead, as has already been stated, a more effective intervention would possibly be the provision of sustainable viewing opportunities, although this initiative would also come with difficulties and barriers as will be discussed in the following chapter.

Considering these points, the legislation, in its current state, is vague and may perhaps lack legislative weight should a case of reckless disturbance be brought to court. However, the findings presented in this chapter suggest that a scheme to increase awareness of the law would not be efficient in reducing problematic behaviours, either through the general public, or more specific groups who are specifically looking for interactions with capercaillie. Instead a more suitable option would be to provide a sustainable and sensitive way for members of the public to view capercaillie while minimising potential disturbance.

5.3.3 General discussion

This chapter looks to identify the predictors of extra-trail activity through the use of the theory of planned behaviour and forms of environmental knowledge outlined by Frick *et al* (2004). With this view, we can see that certain normative elements are important when determining an individual's behavioural intent. However, individuals' environmental attitudes do not play a role in their behavioural intent. In contrast, norms and attitudes do not influence the extra-trail behaviours of visitors, instead it appears as though knowledge and awareness are a moderating factor in the transition from intent to behaviour.

A criticism of the theory of planned behaviour is that elements of knowledge and awareness, overlooked by the theory of planned behaviour, are an essential component within the decision and behaviour making process (Boerschig and De Young 1993). As the findings presented here suggest, awareness is an important factor which may influence the behaviour of individuals recreating within the park. Although more specific awareness of capercaillie has a different effect of behaviour than more general awareness of rare species, knowledge and awareness scheme would likely still prove to be a valuable tool for the conservation of capercaillie. While those who are aware of capercaillie in the area are more likely to engage in extra-trail activities, it could be argued, as discussed above, that these individuals are actively seeking out interactions with capercaillie instead of opportunistically walking off the trail without much forethought. Since in this instance knowledge appears to be playing a key role in the transition from behavioural intent to behaviour, an effective education scheme would likely provide at least some change in behaviours. However, these education schemes could prove to be a double edged sword where people will be more informed of how to behave in a sensitive way, but may, as a result of their increased knowledge and in line with AAE (Courchamp *et al* 2006), want to see or interact with

capercaillie more than before. For this reason, any education scheme must be coupled with an initiative to provide sustainable viewing opportunities to the potentially greater numbers of people wanting interactions with capercaillie that could arise from the education scheme.

One consideration here, however, surrounds the drivers and motives behind these extra-trail activities. Many people recreating within the park may well be engaging in extra-trail activities opportunistically and doing so without capercaillie in mind. Others, however, may in fact be engaging in extra trail activities in order to view capercaillie, and it is perhaps likely that it is these individuals who would have the higher levels of awareness and understanding of capercaillie ecology in the first place. In light of this, further initiatives seeking to increase awareness and understanding, would likely not influence their behaviours or decision making and, as stated above, an alternative intervention where these individuals could sustainably view capercaillie in their natural habitat would be essential. As will be discussed in more depth in the following chapter, the reinstatement of this kind of viewing opportunity would in practice be difficult due to the mobile nature of capercaillie lekking sites, and further conflict between the different large land owners over where this should be hosted.

Further, any education scheme must be multi-faceted in its approach to not only include the raising of awareness and understanding, but also to educate for place-connection (Mannion 2020), and to equip members of the public with the appropriate tools and competencies to engage and interact with the current scientific discourse (Weik *et al* 2011; Tauritz 2012). By not only educating the public in capercaillie conservation issues, but also seeking to equip members of the public with the skills and capabilities to understand, assess, and adapt their behaviour in accordance with, the knowledges presented to them, an effective education scheme would include the empowerment of the public, and not just increasing their awareness. As noted by Monroe *et al* (2019), these kinds of education programmes are already present within climate change education and would likely be successful in educating for sustainable recreation.

Additionally, Weik *et al* (2011) have identified five key competencies that must be educated for to educate effectively for sustainability. These competencies involve the ability to analyse complex socio-ecological systems, to anticipate and be able to picture possible future outcomes of actions, the ability to specify, negotiate, and apply sustainability values and goals, the ability to collectively design appropriate interventions, and the ability to engage with other actors to facilitate collaboration and conflict resolution. While these competencies form a sound structure for designing a holistic sustainability education scheme, the pervasive uncertainty that surrounds capercaillie conservation would require additional measures to educate for uncertainty (Tauritz 2012). Competence-based education initiatives also have a number of criticisms that should be addressed. Firstly, as eluded to above, some authors have noted that many of these competency-

based frameworks are generic, and leave would likely require adaptation to become more effective and relevant to any given situation (Weik *et al* 2011). Also, an aspect to education schemes which is often seen to be essential, is the ability to monitor their effectiveness, however, sustainability competencies have often been seen to be difficult to monitor successfully (Waltner *et al* 2019). Although these competency-based education schemes have received some criticism, there are elements that would be highly valuable in the context of capercaillie conservation. For instance, Breiting and Mogensen (1999) talk about action competence in the sense of educating individuals to not only understand how their actions impact the environments around them, as in action related knowledge (Frick *et al* 2004), but also to encourage engagement in the dialogue around human impacts on the environment.

However, as highlighted by Monroe *et al* (2019), one of the key aspects to educating for sustainability, whether climate change or sustainable recreation, is the use of engaging and active educational methods. With this in mind, engaging with members of the public may be particularly difficult due to the large and expansive nature of the reserves. At this point it would likely be most effective to seek to engage with these different communities through the community forums, both online and in person, such as local dog walking groups and online resources for recreationists, such as walkhighlands.com. Additionally, one aspect of education that is particularly important when tackling subjects such as sustainability is how information is expressed with regards to optimism or pessimism (Ojala 2012). Issues surrounding climate change, conservation, and sustainability are often viewed with pessimism, hopelessness and, subsequentially, inaction or apathy towards the given problem (Hicks and Holden 2007). Further confounding this issue is that by increasing knowledge and awareness around these issues can often bring about greater feelings of pessimism and hopelessness (Hicks and Bord 2001). While there is still some debate amongst conservation practitioners as to whether optimism within academic spheres is a help or hinderance (Faria 2020), Ojala (2012) argues that hope in a system is an important “motivational force” when educating for sustainability.

It must also be considered that it may not, in fact, be the majority of those who engage in extra-trail activity who are having the most substantial impact on capercaillie populations through disturbance events. Instead, it could be argued that it is the relatively few individuals who are traveling off marked trails searching for capercaillie who would be having a greater impact since the objective of their extra-trail activity is to find and view on of the birds. As noted by Pagel *et al* (2020), experienced wildlife photographers can often be pushy in order to get the perfect photograph. Here, birdwatchers and wildlife photographers could arguably have a much higher risk of disturbing a bird. Since capercaillie are thought to have a greater stress response to sporadic disturbance (Summers *et al* 2007), these disturbance events could cause a greater

impact than disturbance events caused, for instance, by mountain bikers following the same unofficial trails. However, much of this is conjecture since there is a large amount of uncertainty surrounding the actual impact of specific activities on capercaillie populations. For this reason, the design and implementation of future recreation targeted conservation efforts would benefit greatly from further research in this area.

While the majority of individuals recreating within the park could be captured through traditional survey methods, these quantitative methods employed here would not be appropriate or effective at recruiting, or engaging with, the much smaller populations who would be heading out into the forest specifically to look for capercaillie. Those individuals who would be looking specifically for capercaillie would likely have much more knowledge of capercaillie ecology allowing them to make more informed decisions as to when and where to look for these encounters. With this in mind, they would more likely be going out into the forest during either dawn or dusk when capercaillie are lekking or at their most active (Haysom 2013). For this reason, engaging with large numbers of these communities would be difficult and so the behaviours of these individuals would be much better investigated through more targeted and nuanced methods, such as a series of interviews or ethnography.

5.4 Conclusion

The aims of this chapter were to identify the key predictors of extra-trail behaviours and to identify how these behaviours could best be influenced or discouraged. The findings presented in this chapter suggest that while social norms are important factors when determining the behavioural intent of recreationists extra-trail behaviours, awareness and knowledge were, contrary to much of the previous literature (McKenzie-Mohr *et al* 2012), more important when it came to the transition to these individuals actually engaging in extra-trail activities. The law, perhaps through a lack of understanding and clarity, appears to not influence decision making with regards to extra-trail activity. However, it does appear to be that one possible effective way to reduce extra-trail activity would be to provide a well thought out education scheme. While this may work to reduce extra-trail activity amongst certain user groups, those who have more specific knowledge of capercaillie, and potentially who are more invested in viewing the birds, may not be influenced through these education schemes, perhaps in part due to the increasing desirability of viewing capercaillie as a result of the AAE. Instead, an education scheme must be coupled with a resource that would allow visitors to view capercaillie in a sustainable manner. In the following chapter, these themes surrounding the management of extra-trail activities will be investigated and discussed in more detail.

6 THE USE OF KNOWLEDGE IN THE IMPLEMENTATION OF CAPERCAILLIE CONSERVATION INITIATIVES UNDER UNCERTAINTY.

6.1 INTRODUCTION

This final analytical chapter in my thesis aims to investigate the strategies and challenges involved in the conservation of capercaillie, where there is a perceived lack of a strong evidence base for many management decisions. This chapter is broken up into three main sections, each addressing a different research question:

> ***3.a.*** *How are different sources of information utilised during the policy making and management process, and what are the key difficulties while addressing this?*
> ***3.b.*** *How are policy and management decisions disseminated and communicated to residents and visitors?*
> ***3.c.*** *How do conservation managers and policy makers interpret and utilise new empirical information?*

The first section investigates how policy makers and managers utilise different sources of information, and how this is influenced by uncertainty within the socio-ecological system. The second section will then explore how those management decisions are disseminated to residents and visitors. Finally, the third section refers back to the first two analytical chapters where focus group participants discuss the findings from these chapters and how these findings can be contextualised and grounded from an expert point of view.

These research questions were addressed through a key informant focus group which involved key stakeholders directly involved with policy and management of certain aspects of capercaillie conservation. As previously started in the methodology, the identities and identifying features of participants, organisations and reserves have been changed to not only protect participants but also areas that make up particularly sensitive capercaillie habitat. The first participant, Alex, is a conservation manager with a large NGO working at Gannochy Forest Park. Alex's role not only covers the management of capercaillie conservation but also the management of other areas and systems on the reserve, mainly from a natural sciences point of view. Sam, a conservation engagement officer, works for an organisation that is involved with policy and management of all aspects of a national park, not just a single reserve, and previously worked in a similar engagement role for a different reserve landowner. As a conservation engagement officer, Sam's background and current work relies heavily on social sciences and social interaction with locals and visitors. Robin, who works for the same organisation as Sam, is the manager of a large-scale

project looking at all aspects of capercaillie conservation across multiple reserves. Finally, Bobby, who works with both Alex's organisation but also Sam's and Robin's, is a capercaillie advisory officer and has much more of a focus on capercaillie ecology than the social-ecological systems. These four individuals were contacted for the focus group to bring expertise and diversity from all aspects of capercaillie conservation management and policy decision making.

6.2 How are different sources of information utilised during the policy making and management process and what are the key difficulties?

6.2.1 How does uncertainty around disturbance influence different management styles?

During the focus group exercise there was discussion surrounding a lack of empirical evidence on how disturbance events effect capercaillie behaviour and productivity. Participants discussed how difficult it is to gain meaningful insights into this dynamic even though there has been a lot of capercaillie focussed research in the past:

Alex: *Part of the challenge with that is the lack of knowledge that we've got. You're talking about in the winter in particular people going off path and flushing caper, and we don't have really clear, strong science to say that by you doing that it will have this effect on the caper population. That's a limitation. My observation coming into the world of caper is there's probably been more science done on caper than…*

Sam: *But we still know nothing.*

Alex: *But we still really, in terms of it taking us from having some knowledge to actually having the knowledge that we need to affect caper productivity, we haven't got to that point yet.*

Although the participants here are stating that a relatively high amount of research has been carried out on capercaillie, they are also discussing how this has not led to what they perhaps should be a proportionate increase in knowledge around anthropogenic disturbance. These sentiments are reflected in previous literature where population level responses have been recorded showing fewer capercaillie within areas of higher human footfall (Moss *et al* 2014), but not small-scale individual responses to disturbance and how this may impact productivity. This lack of strong empirical data to back up management decisions is a recurring theme throughout the focus group and is attributed to a number of problems within the management process.

Seemingly, one of the major issues with the research process around the disturbance of capercaillie is that the species is so vulnerable that any invasive research may be too risky and possibly have a deleterious impact on the population:

Bobby: *And it's really difficult to get a handle on disturbance because we've not looked really at how the birds move directly compared to people because it's very difficult to tag the birds. Because they're so vulnerable we really don't want to be doing anything that could cause any more stress or mortalities.*

These sentiments are highlighting the difficulty of monitoring an already fragile species where an intervention from the managers and conservationists could have a significant and detrimental impact on the population. A number of previous studies have shown that researchers and managers monitoring a fragile species can have, in some cases, a severe negative impact such as reduced daily nest survival in different grouse species such as Greater-Sedge grouse (Gibson *et al* 2015) and reduced adult survival rates, such as radio tagged Rock Ptarmigan (Cotter and Gratto 1995). However, this negative association between researcher activity and survivability or nesting success is not present across all ground nesting bird species (Ibanez-Alamo *et al* 2012) and so this trend may not extend to capercaillie. Since these more invasive monitoring methods, such as GPS tagging birds, have an unknown impact on the productivity, or for that matter survival, of capercaillie, managers are reluctant to implement these strategies for monitoring and research, as seen in the above quote from Bobby.

However, with a great deal of uncertainty around disturbance of capercaillie there are understandably different views on how, and if, monitoring, even at a population level, should be carried out:

Sam: *Have you ever thought of just not going in and researching at all for a few years and then going back in and seeing what difference it's made?*

Bobby: *I think the problem with that is they're so low that they could go extinct in that time.*

Sam: *But what are you going to do anyway even if they do, because you're not going to bring birds in from anywhere, so what are you…?*

Bobby: *Well, we might, and that would push us to. So if the birds dropped drastically that's our back up.*

Sam: *Good luck with that one.*

This dialogue is highlighting two issues with the monitoring, and potential disturbance, of capercaillie. Although both Sam and Bobby share the same objective of improving the capercaillie population within the area, each appears to have separate perceptions of the risk surrounding monitoring. Where Sam is advocating for a potentially higher risk scenario in order to gain insights into the impact of researchers and managers, Bobby is arguing that doing so may be far too risky and that the species may become locally extinct within that time. However, the argument for maintaining a monitoring program appears to be as a result of the lack of resilience within

Scottish populations of capercaillie. This is in that the population may not be in sharp decline but since productivity is generally low the ability for the population to bounce back, after an unexpected decline, is limited:

Bobby: *Deer fences 20 years ago were catastrophic in the decline of capercaillies, I'm sure you know, before people jumped on it and realised oh my gosh. Because adult survival was generally quite good, but productivity is not great, which is the main reason for the fact they're not increasing.*

Because of this lack of resilience, there appears, by some, to be a hesitation to step outside of the status quo where more uncertainty is added to an already complex and uncertain system. This kind of uncertainty, in any area, can bring about hesitation in the decision making process to the point where an individual feels so at risk of making the wrong choice that they are almost frozen in place, unable to make a decision as no obvious action available (Silva 2002, Buturovic and Tasic 2014). The dissonance between these two approaches to monitoring is especially difficult to resolve when monitoring is often a key element in management frameworks where uncertainty and conflict are present (Nuno *et al* 2014). However, what is unclear in this instance is if the hesitancy to stop monitoring is as a result of fear of an unknown high-risk outcome, or simply an alternative world view where the monitoring of a species is an essential component of a conservation program.

6.2.2 Difficulties engaging with stakeholders through anecdotal evidence and interorganisational conflict

Another issue with the lack of empirical data that was evident in the discussion related to how managers and conservationists interact and disseminate information and policy to the wider public and local stakeholders. Participants discussed how a lack of empirical evidence and a reliance on anecdote often gives rise to push back from different stakeholder groups:

Robin: *And I think when you've got, say, mountain bikers in High Burnside and they know there's a busy lek there and they know it's still quite busy and they're there as well building all their trails and doing all their things and they're saying show us the evidence that we're actually having an impact, so stop bothering us and go over there and sort out the predators.*

Here, stakeholder groups are described as being un-cooperative when engaged by managers. This behaviour is seen to be the result of a group not believing the anecdotal evidence being given and attempting to divert the efforts of managers onto another perceived stressor. This is not unique to this system and has been observed in other areas where greater uncertainty leads to less cooperation (Pollard *et al* 2019). A lack of cooperation here may be exacerbated by uncertainty, but what may be the leading factor may well be the opposing objectives and world views held by the different stakeholders. Whereas the goal of reserve managers may be conservation, many of

the recreationists using the area will have an objective that is more focussed on their individual activity. These objectives are closely tied to how individuals view the natural world, the values they hold, and ultimately what they think nature is 'for'. Georgina Mace (2014) identified four prominent historical positions on why conservation takes place and what the subsequent objectives of conservation efforts are. Although each positionality will have been prominent, to a greater or lesser extent, at different points in time, each will still be present in contemporary socio-ecological networks as stakeholders in different areas possess differing world views and values. These world views influence not only how individuals may interact with the natural world but also how the success of conservation is measured. For instance, a recreationist visiting the reserve may well view nature as being 'for people' where ecosystem services and human utility are how the natural environment is valued. Whereas a traditional conservationist may well be of the view that nature should exist despite the presence of humans, or that wilderness and unaltered natural environments should be prioritised over the utility of humans. It is easy to see how these views would be at odds with each other and cooperation is difficult when the objectives of each party are so disparate. In reality, many stakeholders will likely identify with the fourth, and most recent, ideology purported by Mace (2014), 'people and nature'. This is where instead of nature being a utility, or something that should be separate and protected from all human activity, the overall dynamic between humans and nature is seen in a more nuanced and pragmatic way. This way of thinking encourages developing stable and resilient human-nature interactions, however, the increase in complexity of this ideology leads to more complexity in how conservation success can be measured. It is easy to see here how these differing world views between conservation managers and visiting recreationists can create conflict and a lack of cooperation amongst recreation groups.

However, these disparities in world views are not only between conservation organisations and members of the public, but also occur between organisations managing neighbouring areas, and between governing bodies and those land managers. The 'people and nature' ideology (Mace 2014) is evident in the objectives and mission statements of the overarching park authority, where business, land stewardship, and nature are intertwined, each impacting and supporting the other (CNPA 2017). Whereas the other conservation organisations have historically been more aligned with the 'nature for itself' or 'nature despite people' ideologies, where the wellbeing of the natural environment in some areas must take priority over human utility and enjoyment, as expressed by Alex:

Alex: *The feeling I get if anything is that that division [between an area for recreation and an area for conservation] may become more extreme over time. So, something that's happened here in the past is paths have been removed to try and remove the disturbance pressure from foot traffic.*

This interorganisational dissonance in paradigms will only serve to further add to the uncertainty, where visitors and recreationists are receiving different messages about how to behave on different reserves around the national park. Although the main source of a lot of the uncooperative behaviour of recreationists may be a result of these different world views, it appears as though the multiple sources of uncertainty within the system are a significant compounding factor. Since it is thought to be incredibly difficult to enact a change in an individual's values (Stern 2000), it would likely be more efficient and effective to improve public cooperation by reducing uncertainty as much as possible.

Uncertainty within this system is often portrayed as being centred around ecological uncertainty, in that capercaillie are an elusive species that is difficult to monitor, and so the community as a whole is unsure of many components from how the species reacts to disturbance to how many individual birds are within certain areas. This ecological uncertainty not only causes doubt around how management should be targeted but will also potentially lead to recreationists and local stakeholders feeling unjustifiably targeted, as noted in a previous quote by Robin. This may also be further compounded by what has been an ongoing conflict between various user groups such as mountain bikers and walkers (Brown 2014), whereby each group feel targeted by management plans and deflects blame to another. This sentiment was highlighted during the discussion and there was a consensus that to avoid this, a single universally adopted behaviour was suggested as being an ideal goal:

Sam: *So if we can identify one thing that can then be prescribed across the whole caper area that would be really good*

Robin: *But delivered with an awareness of everything else that has happened so people don't still…*

Sam: *Yeah. Don't just see it as oh, you're just picking on us. Because that's always a risk. When you come down to recreation it's user groups, so it's either your dog owner or your mountain biker, and you've got to do it in a way that they're not victimised, and that's when it's not going to come from an organisation, it's got to come from your community.*

As highlighted by Brown (2014), perceptions of responsible outdoor citizenship are not equal amongst different user groups and conflict can occur where one group, for a number of reasons such as mountain bikers being perceived as 'reckless', can be viewed as deviant to the cultural norms of another group of users, such as wildlife photographers or bird watchers being quiet. With the uncertainty that surrounds anthropogenic disturbance of capercaillie, and the targeting of specific groups, managers may experience pushback from some communities, suggesting instead that it is a different group that are the problem. Friedman (2013) suggests that if certain criteria are not met, as to if the recipient is deserving of blame, then the act of managers blaming recreationists of un-environmentally friendly behaviour, may not only be irresponsible but may

also elicit an undesirable response. One of these criteria states that the 'wrongdoer' must be motivated and able to act accordingly following the blame. However, as a result of the ecological uncertainty, some user groups could argue, that since there is no clear evidence to suggest exactly how their behaviour should change, that they in fact do not possess the ability, or motivation, to act in accordance with the blaming party. An example of this would be mountain bikers riding on unofficial trails through a sensitive area. This activity would be considered as undesirable by the reserve managers and so they would ask mountain bikers to stay on marked trails. However, since this blame and subsequent request to alter the mountain biker's behaviour is based on what could be seen by some as inaccurate or minimal evidence, there would be little motivation to change their current behaviour to be in line with the requests of reserve managers.

During the discussion it was also noted that engagement with some communities could be compromised by the actions of managers and researchers themselves:

Sam: *I'm saying to one huge visitor population don't do that, and then there's a researcher trapesing off into the forest with their dogs looking for caper.*

Robin: *I was going to say…*

Sam: *It's ridiculous.*

Robin: *…one of the really difficult ones is with brood counting, so both people and dogs are in the forest, which the public are aware of. And then we do have quite a strict message on dogs, keep them on the lead during breeding season, whereas the dogs are running through the forest during breeding season actually looking for the chicks. So it's very difficult to try and… Because we do realise that that is causing a disturbance, and we are worried about that and we are constantly assessing whether we should be continuing doing it.*

Sam: *And you lose the trust of your general public if they know that's happening.*

This discrepancy in what is seen to be suitable behaviour is particularly apparent between managers and researchers using dogs for surveys and recreational dog walkers who are looking to exercise their dogs. This intra-organisational conflict between two different teams appears to be rooted in differing priorities and how some actions or behaviours are privileged over others:

Alex: *Has there been any change over the years at Rothimurchus with that?*

Sam: *Well, we were arguing with the environment team about it. So the recreation team were saying to the environment team this is ridiculous, there's far too many researchers going out into the forest. A lot of them weren't even doing stuff with caper, but they were in key caper habitats.*

Alex: *And is that still the same or has there been any change?*

Sam: *I think it's an ongoing debate that the environment team have with the rec team, because it's really hard to back up your arguments. You're saying to someone oh, please put your dog on a lead in this area because we know there's ground nesting birds, and then a pickup turns up and three pointers jump out and off they go into the woods. It's mixed messages, and it's that trust. And you'll find that in Carrbridge, building up the trust with the residents is so important, and it can be broken just like that, just by one image like that going out.*

In this instance, Sam is arguing that there is a disconnect between how the general public is asked to behave and how individuals acting on behalf of conservation and land management organisations behave. As highlighted previously, and eluded to by Bobby, there is often a difference between what activities are seen to be appropriate for conservationists within natural sciences and what activities are appropriate for the general public:

Bobby: *I just think that there's no point doing conservation work if you're not going to have one way of evaluating it.*

Bobby's statement here suggests that without monitoring, and subsequentially behaviours that are discouraged to the general public, are necessary for the success of a conservation scheme. It could be argued that, to some, the actions of a researcher who may be intentionally looking for capercaillie with a dog, or walking off marked trails in sensitive areas, are seen to be more worthy, and perhaps more responsible, than those of a casual dog walker. This line of thinking is in line with the more traditional conservation paradigms of 'nature for itself' and 'nature despite people', where a greater focus is placed on ecology and natural sciences, Bobby's background, than holistic conservation and social sciences, Sam's background (Mace 2014). As a response to this, Sam is arguing that the injunctive norms of not letting dogs off the leads in sensitive areas is at risk of being overruled by the descriptive norms where researchers and managers appear to break the rules that are set out by themselves. In these cases, such as in parenting (Morrongiello *et al* 2008) and medical training (Jaye *et al* 2006), where authority figures are observed breaking their own rules, it is often the actions of those individuals that influences how others then behave and not the intended messages that are initially expressed.

6.3 How are policy and management decisions disseminated and communicated to residents and visitors?

6.3.1 Bottom-up behaviour change instead of top-down enforcement

During the focus group, all members expressed how the current legislation surrounding the disturbance of capercaillie is not enough to cause an effective behaviour change. One reason for this was that the legislation itself is difficult to enforce as a result of the lack of knowledge held by not only recreationists using these spaces but also the lack of knowledge held by local enforcement officers:

Alex: *This maybe isn't the official organisation line, but in my eyes it [enforcement under the Wildlife and Countryside Act 1981] seems pretty hopeless.*

Bobby: *I think on a lek and you've watched someone photograph a caper and it still falls through means that… It's not clear enough as opposed to it's not strict enough. The repercussions are there, they're written there, but it's how do we get there.*

Sam: *There's no test case law though on it, so no one's…*

Robin: *There needs to be something to set a president first.*

Sam: *My belief is that no one's been charged in a criminal court for anything against SOAC [Scottish Outdoor Access Code], so there's no test case out there at all.*

Bobby: *But to be honest that's bad in itself but…*

Sam: *But if you ask a local policeman what is SOAC they haven't got a clue. So that's where I go back to we need to be promoting SOAC a lot more. I don't mean that only to our visitors, but I think to everyone. We need to sit down with the police officers and say do you understand what SOAC is, because they don't. We've even got wildlife crime officers that I've said to them do you know the ins and outs of SOAC, no we don't. And all they're looking for is proper conviction things that they can use. So it's either breach of the peace…so they'd only come out to us working in Glenmore of all those people if it was breach of the peace or criminal damage. Anything else, not interested. It's not their fault, but they don't have the means to prosecute on that, so it's not worth it.*

This exchange highlights the lack of enforcement surrounding current legislation, mainly the WCA and SOAC, and that there is not sufficient clarity or understanding for the legislation to work effectively. However, even if legislation was stricter, the consensus amongst all participants was that reliance on this top down method of encouraging preferred behaviours does not in fact have the desired effect. Here, participants express how there is a general lack of knowledge around the legislation within most stakeholder groups, further increasing the uncertainty within an already complex and uncertain system. In this instance however, instead of introducing ecological

uncertainty into the system, there is a level of legal uncertainty that surrounds this issue where recreationists are unsure, or unknowing, of the potential legal ramifications of their behaviours:

Robin: *I think that's it, everyone says oh, we can go anywhere. That's not actually what the Scottish outdoor access code… You can go anywhere as long as you're acting responsibly. So I think what we need to do is promote the Scottish outdoor access code a lot more effectively and really explain to people what we mean by that responsible behaviour.*

Sam also highlighted the added uncertainty that is introduced by enforcement officers either not fully understanding the legislation or prioritising other forms of wildlife crime that are more easily prosecuted. Within the UK the National Wildlife Crime Unit (NWCU) highlight certain offences or types of offence that are current priorities, these typically include offences surrounding the persecution of specific species, property type crimes such as poaching, and CITES crimes (NWCU 2019). It may be likely that these priority offences are taking precedence over what are seen to be lesser offences such as the intentional or reckless disturbance of a ground nesting bird.

It is clear in this case that the complexity and perceived ineffectiveness of current legislation are barriers to effective enforcement of the law surrounding both the intentional or reckless disturbance of capercaillie, and responsible outdoor access in accordance with the Scottish Outdoor Access Code. However, there appeared to be a consensus amongst participants that even if the legislation was clear and effective, it would not be the preferred medium for engendering an effective behaviour change within stakeholder groups:

Bobby: *It's not viable [enforcement and prosecution through legislation] and we don't want to do it. That's worst-case scenario. We want to start with a culture change.*

Sam: *If we're just going to sit on the back of it's illegal, it's the wrong thing to do, we've kind of failed in our work if we are only relying on the legal side of things. You want to create a culture change. The reason why people are…they really care, so it's making that energy of their care rather than anger in something really positive. So rather than making caper always oh, not capercaillie again, say no, what is really the public perception around here in a lot of the community. We won't totally change it on its head and say no, come on, you've got these special woodlands and we're really lucky that caper are here so we've got to look after them. So it's turning tables. That's why positive promotion of what you can do through SOAC out on the ground. It's promoting the positive behaviours, the responsibility, the responsible access. So rather than seeing SOAC as oh, well, we can't do anything because of SOAC, that's not what SOAC's there for. It's actually the opposite. You can actually promote really good, positive behaviours through SOAC.*

This sentiment is addressing the need for a bottom-up approach to engaging with communities as opposed to top-down legislative deterrents for certain behaviours. The argument here is that these changes in cultural affinity with capercaillie can be enacted through engaging with communities in a positive way and using some legislation as a guide. By placing responsibility on these communities, the change in culture would come in the form of what it means to be a

responsible outdoor citizen in these areas. By focusing on engendering this responsibility towards the safeguarding of capercaillie across all stakeholder groups, the end goal would be creating a single meaning of responsible outdoor citizenship across these groups, not only encouraging desirable behaviours, but also with the potential of reducing the conflict that arises from differing outdoor citizenships (Brown 2014).

It is also thought that while influencing these cultural norms within local and key stakeholder groups, this will also have a positive impact on the way visitors recreate within these sensitive areas:

Bobby: *I think it's the best place to start is with the community and with the locals and them taking ownership of it, and then that will influence the visitors.*

Sam: *And it's your local community that are talking to the visitors. So they're the ones giving out the visitor information whether it's in a B and B or in a visitor centre. So they have a better understanding, then they'll support those messages even more.*

This link between local communities and visitors and tourists is seen to be key when encouraging certain behaviours amongst populations that very from season to season, and day to day. This dissemination of ideals and cultural norms from one static community to another dynamic and changing one can be looked at in a similar way to how other social innovations diffuse through societies (Rogers 2003). In this instance there are two key groups of individuals, locals and visitors, one group of which would ideally already possess the desirable traits. In this instance, the members of the local community would be acting as opinion leaders, in the form of boundary spanners, who would be the key influencers for visitors adopting the local ethics (Burt 1999).

The influence that local groups have over the behaviours of tourists can be pronounced, particularly in specific areas of tourism such as eco-tourism (Witkowski and Reddy 2010). While there are a number of recognised influencers on tourist behaviour in the area, some examples where this influence has a negative effect were identified:

Alex: *That was an issue I picked up on in Deeside with cyclists is that the cyclists were going to a particular bike shop who gave advice on routes where to go, and those routes would include some of the key caper leks in the area. And there'd been various appeals to them over the years to stop doing that and direct them to other routes, but they refused to do that.*

This example highlights just how much an effect a single individual can have on the effectiveness of disseminating rules and desirable practices to visiting groups and emphasises the need for ubiquitous core values across all stakeholder groups. Here, the visitors receive contradicting information about where is safe and responsible to recreate from a key influencer, and potential source of authority, in the form of a local sports retailer. This disparity of norms between the local

sports retailer and other stakeholders, who hold capercaillie sensitive norms, is likely not a result of a structural hole within the network of local stakeholders as it was stated that contact was made over a number of occasions. However, what is unknown is the quality of this contact and how the pro-capercaillie sentiments were disseminated. In these settings, many individuals social identity comes from those who they share an affinity with around a given activity, such as mountain biking, and should they feel as though their social identity is being unjustly attacked then levels of trust between the two parties will suffer as a result (Friedman 2013). In these instances, in line with Young *et al* (2016), it is vital that communities do not feel as though their social identity is at risk in order to trust and engage with conservation and management groups. Further, Young *et al* (2013) suggest that stakeholder trust can be further engendered through stakeholder involvement in the conservation process.

6.3.2 Difficulties communicating policy and management plans to stakeholders

As has been said previously, the way in which some of the management plans have been disseminated has led to some stakeholder groups feeling as though they are being unfairly targeted. However, this perceived shortfall of previous engagement strategies is recognised by managers and conservationists as something that required a different approach. When engaging with communities previously there was a pattern of managers only disseminating the message that was seen to be relevant for the particular group in question:

Bobby: *Yeah. But it does mean that…and I think we're experiencing this in the Cairngorms capercaillie project is that people then pass the buck and say why aren't you doing X, Y, Z, what about all those other things, and the answer is we are, we are exercising all the tools in the box…*

Alex: *But we're not talking to you about them.*

Bobby: *Yeah, they're not relevant to you. They don't mean anything to you, so we're not talking about them.*

Sam: *But I think we assume it doesn't mean anything to them, when I think that it does mean something to them. It's just that we take the assumption that it doesn't mean anything to them.*

However, this strategy is at odds with the desired bottom-up community driven conservation that is desired. By restricting the flow of information to only what certain individuals deem to be necessary, managers are situating themselves in a privileged position and there for reinforcing a top-down management strategy with some similar features to fortress conservation, whereby conservationists are hierarchically separated from local communities (Brockington 2004). Within systems such as this it is common to see community resistance to conservation schemes that do not include these stakeholder groups during the decision-making process (Robbins 2000).

However, it is acknowledged that alternative communication strategies are required within the park:

Robin: Yeah. I think that sometimes maybe conservation can feel a little elitist and specialist and it's technical therefore we wouldn't talk to the public about everything that we've been doing. But actually I think we need to get into that space of being completely open and honest of everything that we've tried.

By including stakeholders in every stage of the management process, at least in expressing what else is happening, local communities will gain a more complete understanding of the state of the conservation of capercaillie, there for increasing the levels of trust between managers and stakeholders and improving cooperation (Young *et al* 2013; Stern and Coleman 2015).

It must be noted that, given the pervasive nature of uncertainty in a number of spheres of conservation not only capercaillie conservation, the education of conservation professionals in how to appropriately deal with, and also educate with, uncertainty, is highly important. Tauritz (2012) outlines a set of competencies for dealing with uncertainty in sustainability education. As highlighted by Tauritz, while too little uncertainty can lead to complacency and boredom, a given amount of uncertainty can, in fact, be beneficial for the learning process, whereby the uncertainty is a motivating factor leading to accelerated learning. Conversely, if a system contains too much uncertainty then learning is again hindered due to cognitive or emotional overload. This latter situation is relevant to capercaillie conservation within the cairngorms, where there appears to be so much uncertainty that, for some, learning is becoming stagnated. In these instances, Tauritz (2012) suggests overcoming this overload by teaching to tolerate and embrace uncertainty. This strategy of learning to tolerate uncertainty, requires an acceptance that there will be situations where the outcome cannot be known, and through gradual exposure to uncertain scenarios individual's desensitisation towards, and perhaps the embracement of, uncertainty would increase (Doherty and Clayton 2011). As evidenced by the disparity in feelings towards capercaillie monitoring, it appears to be the case where some conservation professionals are more accepting of uncertainty, and there for more at liberty to support alternative practices, than others. In addition, tolerance of uncertainty is also largely informed by an individual's ability to reflect on their own ideologies, beliefs and paradigmatic biases, and through this reflexive practice the ability to reconsider alternative strategies. This reflexive practice is evident amongst capercaillie practitioners, however, perhaps the disposition of some individuals towards more conservative management strategies suggests that either their willingness to accept uncertainty, or their risk tolerance, is relatively low, although the two are likely invariably related. By educating park staff to accept uncertainty, they would then be better equipped to further educate and engage with members of the public.

Given the difficulties expressed regarding engaging members of the public due to uncertainty, and the low probability of that uncertainty being substantially lessened, along with a general education scheme it would be important to encourage conservation managers, as suggested by Tauritz (2012), to both educate the public in a way to engender a tolerance of uncertainty, and also to lessen their uncertainties. It appears to be the case currently that education within the park for capercaillie conservation often looks to limit the awareness of uncertainty for the general public, which is evidenced by the focus group participants discussing how some information is not disclosed to members of the public if it is not thought to be relevant. However, it is likely that this only serves to further distance members of the public and recreationists from the policy making process which would further engender a lack of trust in the conservation bodies. Instead, by involving members of the public more in the management and policy process, and educating stakeholders in how to access and evaluate sources of knowledge, the public will gain a greater understanding of not only the mechanism behind conservation policy, but also how pervasive uncertainty is an almost unavoidable truth in conservation settings (Tauritz 2012). As discussed by Gordon (2006), the acceptance of uncertainty is an essential skill in our increasingly complex world. If the public also gain competencies in accepting and embracing uncertainty, then it is likely that their acceptance of conservation initiatives, with larger amount of uncertainty, would increase (Gordon 2006).

6.4 How do conservation managers and policy makers interpret and utilise new empirical information?

When presented with findings from the quantitative survey conducted earlier in the research process, stakeholders taking part in the focus group showed differing levels of belief with some elements of the data. This mainly lay around the estimates of extra-trail activity based on the indirect questioning techniques employed. If the estimate of behaviour prevalence matched an individual's preconceptions of what activities are being performed within the park, their response to the analysis would be one of corroboration. When shown estimates on estimates of visitors walking off trails one participant responded saying that the estimate was different to their expectations, but they were not shocked:

Bobby: *It is higher, but I'm also not shocked from just anecdotal things that I've seen. I worked on Gannochy as the intern last winter and I was always in the forest and on occasions literally in the middle of the forest people were, I'd be like what are you doing here. And there has been more than one occasion. So, it's not a shock, but it is a bit higher than I would have thought.*

Whereas estimates of walking dogs off the leads in sensitive areas, after seeing informative signage (Fig 4.6), were met with disbelief:

Sam: *I don't believe that… I don't believe that at all.*

Bobby: *If only dogs could talk.*

Sam: *[from a dog's perspective] They let me off, it was cool.*

Bobby: *[from a dog's perspective] What do you mean you didn't let me off, I've been running all over the place.*

What seems to be the case here is that, at least some, of the stakeholders involved in the focus group have clear ideas about the levels of these activities occurring within the park where occurrence of these behaviours could only be at their perceived frequency or higher, but never less. Whereas knowledge use within some of these organisations would, in an ideal scenario, be strictly instrumental, where empirical knowledge is used directly to solve policy problems (Waylen and Young 2014), the reality may be that more often these findings are used in conceptual or strategic ways. Where conceptual and strategic use of knowledge differ, is that conceptual knowledge use applies new knowledge and information to gain a wider understanding of a topic with regards to previously held ideas (Dunlop 2014). Strategic knowledge use, on the other hand, involves the tactical application, or withholding, of certain information that contradicts a given standpoint or goal (Boswell 2008). While members of these organisations may ideally be non-partisan to attitudes or paradigms, many stakeholders working in conservation will have come from, and educated in, a conservation related background where certain values will have been instilled and perhaps encouraged. We might infer that these instilled values could influence an individual's perception and interpretation of not only anecdotal evidence but also research based empirical evidence (Reid *et al* 2011).

Crouzat *et al* (2018) identify several positionalities within the science-policy interface, which differ based on an not only an individual's standing along the science-policy spectrum, but also what produced knowledge is used for, from knowledge produced purely for scientific gain or knowledge for advocacy of a specific issue. One of these positions, the It could be argued that, in the above exchange, respondents fall into an issue-advocate posture, where individuals are using specific research outcomes to support particular policy decisions, instead of filling an officer role whereby research findings are used in a non-biased manner to inform policy (Crouzat *et al* 2018). From the above extracts, it appears to be the case that there are specific user groups that are seen as being problematic, in this instance dog walkers, that have historically been the focus of policy and management efforts. Because of these historical views and values, managers and policy makers may be more willing to dismiss new empirical findings that are contrary to those existing values. Since these new findings do not fit with, and perhaps even detract from, current

management decisions, we may wonder if managers dismiss some new evidence in order to verify their initial management strategies (Tennoy *et al* 2016).

It could be argued that given the time and resources managers have spent on tackling free roaming dogs, they are hesitant to significantly alter the management strategy to prioritise an alternate group, fitting more with an issue-advocate positioning where new knowledge is being used in a strategic way to support specific policies (Crouzat *et al* 2018). This seems to be unlikely as, during the focus group, participants regularly alluded to plans for the assessment of current management plans and the development of new visitor management strategies. This included alternative strategies for facilitating responsible viewing of capercaillie and leks:

Alex: *But why hasn't the RSPB, a bit like the eagle watch on Mull, why haven't we tried to set that [a dynamic visitor capercaillie watch] up in partnership with other landowners?*

And the introduction of large-scale research projects to feed into adaptive management plans:

Alex: *There's hope with the large-scale service project I was talking about here that that will give us some answers around habitat manipulation at Abernethy that will allow us to implement those on a larger scale.*

However, it is important not to dismiss any discrepancy between the quantitative data and the response from the stakeholders as bias. Each participant was contacted due to their expertise in different areas of capercaillie conservation and tourism in the Cairngorms National Park. Instead, it may be the case that this discrepancy is not a result of bias or a specific agenda, but rather that the local experts feel that some findings are more pertinent to the local situation than others (Tennoy *et al* 2016). This alternative explanation would instead be that experiential knowledge, often referred to as 'indigenous knowledge' (Fazey *et al* 2006), held by these stakeholders is used as a lens for determining the validity or accuracy of the newly acquired empirical knowledge. Experiential knowledge is suggested to be most effective when it is in the form of expert experiential knowledge; which is thought to take up to ten years within a specific field to acquire (Fazey *et al* 2006), although it can be difficult to differentiate between the two. The evidence presented here suggests that it may well be the case that these stakeholders are in fact using their own experiential knowledge to verify the newly acquired information, a position that is supported within the literature (Pullin *et al* 2004; Fazey *et al* 2006). However, this screening of new evidence with experiential knowledge must, in all disciplines, be done in a reflexive manner (Drescher *et al* 2013).

6.5 CONCLUSION

The lack of a strong and broad base of empirical evidence, surrounding capercaillie disturbance and recreation, presents several problems and conflicts, not only during the policy making process, but when implementing those policies and communicating with other stakeholders. Firstly, a lack of depth of empirical evidence, specifically surrounding anthropogenic disturbance, has led to managers and policy makers relying heavily on anecdotal and experiential knowledge. Although this utilisation of anecdote and experiential knowledge is a common occurrence within conservation and environmental management (Pullin *et al* 2004), difficulties have been experienced in this situation where recreationists and local stakeholders do not comply with rules or requests put in place through policy.

Other areas on non-compliance with rules may rely on law enforcement, this is not seen to be a viable option when considering the disturbance of capercaillie. There appears to be a general hesitance across all conservation organisations involved to begin prosecuting individuals for the disturbance of a ground nesting bird, but instead effect a cultural change. Managers and policy makers, within the national park, want to effect this change in a way that will lead to more bottom-up behavioural changes, where visiting recreationists are influenced in their behaviour by local stakeholders, instead of using top-down enforcement to achieve compliance.

While managers within the park are looking towards a bottom-up change in behaviour, there have been challenges when it comes to engaging some members of the community. One of these challenges is that when communicating to some stakeholder groups that their activity could be detrimental to capercaillie conservation, these groups feel unfairly targeted and blamed, which leads to further non-compliance. Again, one of the leading factors with this non-compliance is seen to be the lack of strong empirical evidence to support management and policy decisions. However, this some of this gap could be bridged by involving local groups more in the management process, right the way from research through to policy implementation (Stern and Coleman 2015), instead of the current model of management where stakeholders are kept separate for much of the process that is deemed to be unimportant to them. This inclusion of local groups in the management process, and educating both the park staff and members of the public in how to accept and reduce uncertainty in learning environments, in line with Tauritz (2012), would also likely go some way to further reducing the impact of the socio-ecological uncertainty surrounding capercaillie conservation.

When presented with estimates of findings from the first two analysis chapters, there was a mixed response as to the validity and accuracy of the results. It appears not all new empirically sourced evidence was treated with the same level of trust, findings presented that did not fit with

an individual's previously held beliefs were met with more scepticism than other findings. Upon first inspection it may appear that this scepticism is a result of biases, formed out of anecdotal evidence. Whereas, in line with Pullin *et al* (2004), this may be a result of managers and policy makers screening new information with expert experiential knowledge, developed over many years, in order to contextualise this new information in a way that is pertinent to the current situation.

A lack of in-depth knowledge surrounding capercaillie disturbance and specific activities is a substantial hindering factor for the management of capercaillie conservation. From designing management plans and policy, to causing difficulties when engaging with stakeholders, there are several areas during the management process where this added uncertainty makes management particularly difficult. However, by utilising strategies, such as stakeholder engagement within the management process, and employing expert experiential knowledge, the overall impact of this uncertainty may be reduced.

7 DISCUSSION AND CONCLUSION

7.1 INTRODUCTION

The conservation of capercaillie and management of recreation provides a number of challenges to conservation managers across Scotland. Firstly, prior to this research, the numbers of individuals taking part in undesirable and extra-trail activities was relatively unknown as well as what drives people to engage in these activities. Further, collaboration both within and between organisations and landowners, as with many other conservation scenarios, provides challenges both through the agreement of conservation goals and the methods through which those goals should be achieved.

In this chapter I will bring together findings from the previous three analytical chapters into a wider discussion around the main themes present throughout this thesis. I will first start be reviewing the findings pertinent to each research question and how these address current gaps in knowledge. The following section will be a narrative discussion around these findings in relation to key emergent themes that are present throughout the thesis, how these findings relate to a wider context, and what this means for the conservation of capercaillie across Scotland. Finally, I will outline the methodological and policy implications of the findings presented throughout this thesis, along with limitations of this study, future research directions, and restating the original contributions made.

7.1.1 Review of research aims and key findings

1.a. *What are the current patterns of behaviour within the Cairngorms National Park in relation to capercaillie conservation?*

When designing recreation management plans to reduce the anthropogenic disturbance of capercaillie, it is essential to first understand the provenance of the specific behaviours that are thought to be causing these disturbance events. In this thesis, through the use of an indirect questioning methods, I have provided an estimate of these behaviours within the Gannochy Forest Park. Of those behaviours examined, by far the most commonly occurring extra-trail behaviour is walking off marked trails. However, individuals walking their dog off the lead, while not as numerous, is a higher proportion of those who walk dogs in the area. In this instance, it is difficult to state which of these key behaviours is the most damaging since we are unaware of the direct impact each has on capercaillie populations. While (Moss *et al* 2014) suggests that dog walking is likely the most damaging of these behaviours due to the dog's ability to track and seek out capercaillie, this is largely conjecture. Further, there are groups of people who would also walk off the trail specifically to look for capercaillie. Bearing this in mind, we cannot say with any

certainty which activities are the most deleterious, is it that more commonly occurring, but perhaps more benign, behaviours are having a greater impact than less common, but potentially more deleterious behaviours. What we can determine from these estimates is that extra-trail activity is a pervasive issue throughout the area, and at such high numbers must be a core focus of conservation efforts.

> ***1.b.*** *What are the current levels of awareness and values amongst visitors to CNP of capercaillie conservation issues?*

Given that capercaillie are considered to be a flagship species for the Cairngorms National Park, the levels of awareness of capercaillie conservation issues is surprisingly low. Not only are the majority of people not aware of causes of more specific issues around capercaillie conservation, many are not even aware of their presence within the park. This discrepancy between the role of a flagship species, such as encouraging engagement with conservation (Dietz *et al* 1994), and the low awareness of said flagship species, suggests a lack of full utilisation and education across the park. Further, while there is general criticism of the knowledge deficit model of environmental and conservation engagement (Schultz 2002; Simis *et al* 2016), in this instance, where we found the majority of people hold pro-environmental attitudes, an educational initiative would go some way to engaging the public more in capercaillie conservation.

> ***2.a.*** *What are the key predictors of extra-trail behaviours amongst recreationists within the park?*

In this thesis, a model combining the theory of planned behaviour and forms of environmental knowledge was used to assess the key predictors of extra trail behaviours amongst the recreationist population in the Gannochy Forest Park. While behavioural intent is influenced by norms, arguably the most important finding from chapter 5 is that awareness plays a complex role in determining an individual's extra-trail behaviour. Whereas individuals with more environmental knowledge are less likely to walk off marked trails, once people begin to gain awareness of capercaillie, they engage in extra-trail activity more readily. It is likely in this instance that, since capercaillie are a large and charismatic rare species, they are subject to the anthropogenic allee effect, where the more rare a resource is, in this case sightings of a rare bird, the more people will desire that resource, thus driving the resource to become more scarce.

> ***2.b.*** *How can these behaviours best be targeted and influenced to reduce anthropogenic disturbance of capercaillie?*

Given the influence of knowledge on the extra-trail behaviour of recreationists within the park, an education scheme would likely be an effective method for reducing these activities. However,

while an education scheme would reduce the undesirable behaviours of the least aware individuals, there would likely be an increase in people seeking out interactions with capercaillie as a result of the AAE, and as such any education scheme must be coupled with the provision of alternative and sustainable viewing opportunities. Without this there is a risk of, instead of encouraging more people to stay on marked trails, more people would be pushed into extra-trail activity.

> ***3.a.*** *How are different sources of information utilised during the policy making and management process, and what are the key difficulties while addressing this?*

At this point in the thesis the themes of uncertainty started to become particularly evident. As a result of a lack of quantitative empirical evidence on the impact of specific recreational activities, managers and conservationists felt an over reliance on their own experiential knowledge and anecdotal reports. This presented a number of challenges during the conservation and management process, particularly at two key stages. Firstly, conflicts have arisen as a result of the high levels of uncertainty where, since there is no clear way forward, managers clash over how to progress and the perceived risk each is willing to take by following a different management method. Secondly, with the levels of uncertainty currently within the socio-ecological system, and in line with previous literature (Pollard *et al* 2019), conservation managers are finding it difficult to engage with local stakeholders and recreationists without the more privileged quantitative evidence to back up their management decisions thus resulting in higher levels on non-compliance.

> ***3.b.*** *How are policy and management decisions disseminated and communicated to residents and visitors?*

While there may be elements of capercaillie conservation where managers disagree on the best course of action, there is a consensus that any behavioural change that is to occur within the target population would ideally come from a bottom-up approach. Taking an approach where communities and local stakeholders are an integral component of the management process fits with a 'people and nature' positionality of conservation as outlined by Mace (2014). However, again uncertainty has a substantial impact on the management styles that must be employed, and, as stated above, causes a number of difficulties when engaging with members of the public, notably through non-compliance and feelings of blame.

> ***3.c.*** *How do conservation managers and policy makers interpret and utilise new empirical information?*

Although historically there has been in general a privileging of quantitative lines of enquiry within conservation (Gerber *et al* 2000), the results from chapters 4 and 5 of this thesis were not met with unanimous corroboration when presented to capercaillie conservationists and managers. Chapter 6 provides evidence of conservation managers utilising anecdote and their own experiential knowledge to ground and contextualise these new findings to what they feel is pertinent to the current situation. However, the extent to which this occurred appears to be influenced by the individuals disciplinary background, where those who are more involved in the social sciences more readily scrutinise newly acquired quantitative findings, perhaps as a result of differing epistemological stances. This utilisation of expert, or indigenous, knowledge can be a highly beneficial tool in conservation (Fazey *et al* 2006), although, as noted by Pullin *et al* (2004), it must be done in a reflexive manner to minimise bias.

7.2 General discussion

7.2.1 How do we engage members of the public in capercaillie conservation?

While anthropogenic disturbance from recreation may not be the leading cause of capercaillie decline in Scotland, its impact is by no means trivial, and is likely to compound the impact of other forms of decline (Moss *et al* 2014). While this thesis has addressed one source of uncertainty around the prevalence of damaging recreational behaviours, these findings mean relatively little without an understanding of how to best influence these behaviours and engage members of the public in capercaillie conservation initiatives.

Firstly, the findings presented in this thesis suggest that recreationists, visitors in particular, are simply unaware of capercaillie conservation issues. Since the Cairngorms National Park authority state capercaillie as one of their flagship species, it seems unusual for there to be such low levels of awareness. While the theory of planned behaviour notes perceived behavioural control as one of the key elements in the decision-making process, without the knowledge of the behaviours that are available to them, or how these behaviours are impacting on the world around them, an informed decision cannot be justifiably made. In this instance, it could be argued that by having such low levels of understanding takes away the agency of recreationists to make informed decisions and by not educating the public further conservation organisations would instead have to rely on structural cues to influence behaviour. Again, this difference between approaches can be clearly seen across different reserves, whereas Gannochy looks to influence behaviours mostly through the provision of very specific advertised path networks. Conversely, an estate like Rothiemurchus provides visitors with all of the information necessary to make their own informed choices, by making visitors aware of how their behaviour can impact capercaillie, along with adding the normative cues around which of these behaviours are expected while in the forest.

Adding to this issue is the fact that each of the different major landowners around the national park have different strategies for dealing with the disturbance of capercaillie. For instance, while some land owners do not advertise the fact that capercaillie are present, in order to not attract people coming to look for the birds, other land owners openly state that capercaillie are present in the forest and law down very clear and explicit expectations of how visitors are expected to behave. As noted by Weber (1964), in order for rules to be maximally effective, there must be clear and consistent messages about the types of behaviours that are expected and those which are undesirable. This inconsistency in messaging was highlighted both in the early informal meetings with local stakeholders, and during the focus group process, as being an issue. However, unless all landowners, with land containing capercaillie populations, operating within the national park can cooperate and put across these consistent messages, then this will remain a persistent hinderance to the management of recreation with regards to capercaillie conservation.

However, engaging the public in capercaillie conservation does not just mean the provision of education schemes. As the findings discussed in chapter 5 suggest, simply increasing awareness is unlikely to alone provide the desired behavioural change. The anthropogenic allee effect, as discussed in chapter 5, is the process by which as a resource becomes more scarce it's value increases and in turn leading to greater exploitation of that resource (Courchamp *et al* 2006). In this case, interactions with capercaillie can be understood as being a resource, and as more people become aware of the rarity, and charismatic nature of capercaillie, more people will seek out interactions. A number of years ago this may not have proven to be such as issue since 'Caper Watch', an event hosted by the RSPB where visitors could safely and sustainably view a capercaillie lek from a hide, was a regular and fairly reliable resource where visitors wanting those wild interactions could do so while minimising their impact on the capercaillie. However, since the abandonment of this lek site land managers cannot direct their visitors to this site and guarantee them a sighting of capercaillie. As has been seen all over the world in an array of settings, tourists often seek out interactions with the local charismatic wildlife, such as bears in Alaska (Albert and Bowyer 1991), gorillas in central Africa (Otsuka and Yamakoshi 2020), or cetacean off the coast of Scotland (Woods-Ballard *et al* 2003). Given this tendency for humans to seek out wild interactions with rare and charismatic species, alternative and sustainable viewing opportunities must be afforded, especially for fragile species easily impacted by disturbance such as capercaillie. While wild interactions with capercaillie may currently be limited until landowners and organisations begin to cooperate more, as discussed in chapter 6, there is an alternative in that the Highlands Wildlife Park, located near Kingussie in the cairngorms, is currently home to two capercaillie hens. Zoos and captive animal centres have not only been shown to be effective in the education of the public in conservation (Patrick *et al* 2007) but can also be effective in engendering pro-

environmental attitudes amongst zoo visitors (Hacker and Miller 2016). Given this, perhaps the Highland Wildlife Park could be a more readily adopted alternative to Caper Watch in the short term. However, not taking into account the criticisms of captivity programs, of which there are many, it may also be that this resource may not sate the desires of individuals who want a wild interaction with capercaillie in their natural habitat.

As this thesis shows, improving behaviours with regards to capercaillie conservation is not just about increasing the *knowledge* of the capercaillie's ecology amongst outdoor recreationists. As I have discussed in chapter 5 section 5.3, visitors and outdoor recreationists knowledge of capercaillie alone does not lead to greater sensitivity to the needs of capercaillie. Perhaps more worryingly, that an increase in their knowledge of capercaillie may well contribute to these individuals becoming more likely to seek out an encounter. Because of this, it is important that we look to address the issue of education in formal, non-formal and informal settings, and what roles discrete educational programmes targeting capercaillie might play in doing more than increasing the environmental and ecological knowledge of capercaillie amongst these relevant individuals. The current environmental and ecological catastrophes that are occurring across the globe are driving environmental educators to re-think and re-define the ways in which we view environmental education, in particular with a focus on addressing our inter-species, and more than human, relationships as opposed to the dissemination of environmental and ecological facts (Lynch and Mannion 2021; Presson *et al* 2022). In this regard, ecological literacy is seen to be a highly important component to delivering environmental education, and seeks to instil in the student a greater understanding of the interconnectedness of human and non-human actors (McBride *et al* 2013). In much of the contemporary literature, ecological literacy is not simply an understanding of the ecology of capercaillie, or any other non-human actor, but it puts the human and non-human relationship at the forefront allowing students to become more affective and emotionally attenuated with their more than human counterparts and seeing themselves as part of a whole (Rousell 2021; Lynch and Mannion 2021).

On the basis of the findings presented in this thesis, specifically those discussed in chapter 5, ecological literacy becomes particularly important when the individuals in question are seeking out non-human encounters, as has been shown to often be the case with capercaillie throughout this thesis. In relation to these findings, having greater ecological literacy can afford these individuals a greater sense of shared agency between themselves and their non-human counterparts allowing them to become more attuned with how, not only the capercaillie influence their behaviour, but also how they in turn influence the capercaillie. However, the present study's finding suggests that ecological literacy needs to be engendered in a place-responsive manner that is not divorced from the system of interest, but instead is entirely situated within it. As

highlighted by Lynch and Mannion (2021), while taking a place specific, or place-responsive, approach can lead to greater attunement of students to more than human actors. Place-responsive education, and the attunement of learners to place-responsive processes and species needs, does not occur passively. Instead proponents suggest this requires an educator to more purposefully attend to the more than human, at times employing opportunities for interactions with other spaces to re-create the relations we have with them.

For capercaillie, we might want to recall that purposeful incorporation of more than human interactions can happen in a variety of ways, for example via structured field trips (Persson *et al* 2022) or digital interaction (Boyd 2018), and, depending on the desired outcome and specific situational factors, can be supported in their approach by the human, the non-human, and the material. In a more-than-human and place-responsive approach, an educator can guide a student to attend to not only to each of these individual elements but also can support them in becoming more sympathetic to the way each element influences and is influenced by each other. For example, in this case, the human aspect of the assemblage would not only include the student themselves but also other people such as locals and visitors, how people's behaviour can influence the behaviour of the more-than-human (capercaillie), but also how material elements, such as the environment and weather, can shape and change these interactions. However, while place-responsive education must directly involve the place in question, given that capercaillie are a fragile species we need to create a scenario where interaction and rationality can be explored without putting the capercaillie, their behaviours, or the environment, at risk of being disturbed, for example through the use of some tools that can enhance the learning experience, such as binoculars, or if digital, then virtual reality.

In this regard, place-responsive education relating to capercaillie conservation has great potential for engendering greater ecological literacy amongst outdoor recreationists. One possible line of development for the support of the conservation of capercaillie seems to lie in a wide variety of possible educational programming, especially provision that takes a place-responsive approach. If an education programme, with a relational more than human approach utilising the resources available to the various conservation organisations within the national park, such as the RSPB, can establish at a stable lekking site then not only could the visitors desire for inter-species encounters with capercaillie be satisfied but also with sufficiently experienced educators, could allow for these individuals to gain a deeper understanding of their interconnectedness with this specific environment. However, as I have discussed earlier in this thesis, finding an established and stable lekking site for this to occur is not only practically difficult, but also socio-politically difficult. This can be practically difficult as capercaillie leks can be elusive and tend to not occur near to areas of high footfall and therefor often impractical to take groups to due to the terrain.

Up until a few years ago there was an active capercaillie lek very near to a visitor centre within the park which not only proved to be popular with visitors and bird watchers, but was also a convenient way for conservationists to allow for more than human encounters in a controlled manner. However, since this lek has been abandoned no alternative has been implemented. This brings us on to the socio-political difficulties of establishing a new resource like this. Revisiting the discussions presented in section 6.2 of this thesis, as there are multiple large land owners across the national park, coordination to improve public access to capercaillie viewing opportunities can be difficult with the recently abandoned "caper watch" yet to be re-established. With this in mind however, a static lekking site, especially one located so close to a visitor centre, may not be the only, or even most appropriate, location for place specific education of capercaillie to occur. As discussed by Boyd (2018), place-responsive education does not necessarily require students to be synchronously situated within the same physically space, and in fact students learning at a distance can participate in place-responsive education effectively through digital means. In this regard, there are lessons to be learned from other species, such as Osprey, where live webcams are installed at a nest site allowing visitors a much closer view of the animals that they would ordinarily be afforded. These experiences could be further enhanced using augmented reality or virtual reality, increasing the users sense of place by situating themselves within the capercaillie's habitat. These digital learning experiences would not only afford visitors and users an opportunity to situate themselves within a capercaillie lek, for instance, but would also serve to reduce the potential of lek disturbance caused by viewing to a minimum. With the guidance of experienced educators, students could experience capercaillie lekking in a much more place-responsive way than could happen otherwise.

While not within in the scope of this research, an investigation into the challenges and benefits of employing the help of local communities as environmental educators would likely prove to be a significant contribution to these issues. Of particular interest would be how local communities, and individuals within those communities, may be able to contribute to more scaffolded education of tourists as expert educators, and one of many with agency, within the system. While there is a body of literature investigating the role of local communities in ecotourism, these are primarily interested in ecotourism as a commercial venture with locals acting as owners or employees of these ecotourism programmes (Kiss 2004) and how involving locals in these programmes can lead to greater empowerment, mainly via financial means (Cham *et al* 2021). However, the end goal in the case of capercaillie conservation may not solely be to involve local communities financially in ecotourism but instead to encourage their engagement with locals as casual educators. One potential barrier to this however would be ensuring the knowledge and values of the local individuals is in line with the end goals of the conservation schemes, and this is

an area that has seen little investigation within capercaillie conservation and within the national park. As I have already stated, at the time of conducting this research there were tensions between many local communities and the national park authority and conservation organisations, which ultimately lead to a limiting of access to these communities. However, if access to these groups could be arranged then it would not only be beneficial, but also perhaps necessary, to investigate if and how locally-led initiatives and groups might be further supported to act as educators within these spaces. If this is in fact not the case, and these local communities are disaffected or not engaged with capercaillie conservation in a positive way, then their involvement with educating tourists would clearly not be beneficial. However, further research investigating the role that local communities could play as co-producers of educational provision with conservationists, landowners and other stakeholders, would be very beneficial and have both academic and practical implications.

Commented [WS10]: Education scheme development

As I discussed in section 2.1.4, a strategy that is often utilised within conservation for engaging with members of the public in conservation is through the use of flagship species (Lundberg et al 2020). Throughout its range, and specifically within the Cairngorms National Park, capercaillie have been labelled with multiple conservation related tags, such as indicator species and flagship species, and it is this status as a flagship species that this thesis should perhaps call into question. The findings of this thesis, and subsequent implications, may well point towards a reconsideration of capercaillie as a flagship species, at least within the Cairngorms National Park. While capercaillie fulfil many of the criteria often cited for a flagship species (Verissimo et al 2014; Albert et al 2018), for reasons brought to the fore by this thesis its status as a flagship may well be inappropriate, at least under the current circumstances. While capercaillie are in fact large, charismatic, and emblematic of their habitat, within Scotland the species appears to fall short of one of the primary goals of a flagship species which is to raise awareness. The findings of this thesis show that relatively few people actually know about capercaillie, which begs the question that if the public know so little about the species, how can it be used to raise awareness of conservation initiatives in an effective manner? The true function of flagship species is often debated within the literature, largely around whether the end goal is to improve conservation efforts or to serve a more socio-economic function (Ducarme et al 2013), whereas in reality most cases exist somewhere in the middle of this spectrum. However, as this thesis has shown that people are largely unaware of capercaillie it would not be a stretch to suggest that, as a flagship species within the national park, capercaillie would appear to be less than effective as a flagship species for the purposes sated above.

Additionally, as I discussed in chapter 6 the conservation professionals were somewhat hesitant to further advertise the fact that capercaillie were in the reserve due to the fact that the species is

so easily disturbed by people. Tied in with this is, as the findings of this thesis suggest, that as people become more aware of capercaillie, they are more likely to seek out more-than-human encounters with the species. Ordinarily this would not be an issue, but because disturbance is thought to be one of the leading factors in capercaillie decline and effective habitat loss, it seems as though the ultimate goal of having capercaillie as a flagship species would cause further reductions in their realised niche and eventually a greater reduction in their numbers. With this in mind there appears to be a disconnect between the purpose of having capercaillie as a flagship species and the ultimate goals of its strategic use as one.

Within the Cairngorms National Park there are a number of flagship species representing a wide variety of conservation initiatives and ecosystems. While the suitability of these other flagship species is not within the scope of this research, the suitability of capercaillie being used in such a way must be drawn into question. In this instance, we must be mindful that even though a species may possess some of the traits commonly associated with flagship species may not necessarily mean that their employment as a flagship species is a suitable strategy. In this regard, capercaillie, as I have discussed earlier in this thesis, do possess many of these traits, namely that they are large, charismatic, and emblematic of their ecosystem (Suter et al 2002; Mikolas et al 2015; Kortmann et al 2018). However, it perhaps should be argued that, based on the findings of this research, they are unsuitable to fulfil that role. Not only are capercaillie not widely known, meaning they are unlikely to encourage further engagement with specific conservation initiatives, but the increased notoriety would, as the findings of this thesis suggest, lead to more people seeking to engage with them in ways that are not compatible with successful conservation of the species.

One of the other flagship species utilised within the Cairngorms National Park is the Osprey (CNPA 2019), a species that seen to be so emblematic of the Cairngorms that it makes up part of the logo of the Cairngorms National Park Authority. Osprey are a well-known flagship species within the national park across several locations (CNPA 2019), and as with capercaillie, they are large, charismatic, and emblematic of their ecosystem (Garlick 2019). However, they may be more suited to the role of flagship species than capercaillie are for a number of reasons. Unlike capercaillie, there are multiple ways for members of the public to have interactions with this species without causing disturbance. For example, there are several landowners who provide a continuous live feed of an osprey nest, or a hide is built to allow visitors to view the birds through binoculars in the presence of an expert from the relevant organisation. Conversely, members of the public do not currently have such opportunities to engage with capercaillie in such a way and the fragility and ephemeral nature of a capercaillie lek make it difficult to establish and predict. With this in mind however, there are other conservation areas that use osprey as a flagship

species where increased ecotourism from advertising the osprey has led to a population decline. Monti *et al* (2018) found that osprey populations were seeing a decline within a marine protected area in Corsica following a sharp increase of osprey focussed ecotourism. This further serves to highlight that the use of a flagship species is not a trivial decision and that, if not carefully considered, the result can be contrary to the desired outcome.

Interaction with charismatic species that are under threat can, and often does, change not only attitudes and perceptions held by the public but also politicians and policy makers, as demonstrated by Xiang *et al* (2011) with golden snub-nosed monkeys. However, it is meaningful interactions that are guided by considered experts that can make the difference in this regard, especially with such a fragile species like capercaillie. While Xiang *et al* (2011) found that there were significant socio-economic benefits to flagship species ecotourism, including increased funding flowing into the conservation of the golden snub-nosed monkeys, they also found that the species was exposed to additional risk of disease as a direct result of the increased tourism. While the driver of decline may be different between osprey, golden snub-nosed monkeys, and capercaillie, it is easy to draw comparisons between these cases. Just as with the osprey in Corisca and golden snub-nosed monkeys in China, the use of capercaillie as a flagship species may have been borne out of a desire to increase the species profile and bring socio-economic benefits to local conservation areas, however, in doing so the species may well be at much greater risk of being exposed to conditions that are not compatible with the species conservation success.

All of this is not to say that capercaillie cannot play the role of a flagship species, or indeed that flagship species as a conservation strategy does more harm than good, but instead that given the susceptibility of capercaillie populations being negatively impacted by human disturbance, their use as a flagship species must be sensitively investigated and developed with a great deal of regard for the potentially negative implications of greater awareness. Under the current strategies employed by policy makers within the national park, the use of capercaillie as a flagship species is not working, people are generally unaware of the species, and those who are, are more likely to seek out encounters that could potentially lead to significant disturbance.

Commented [WS11]: Flagship and charismatic species

Engagement with the public on capercaillie conservation is a challenge given the pervasive uncertainty within the socio-ecological system, however, there appears to be several other significant barriers to effective pubic engagement. Firstly, visitors are simply not aware of not only the intricacies of the human-capercaillie dynamic, but perhaps not even aware of capercaillie themselves, because of this many members of the public will not be aware of how to behave in these situations. Compounding this issue is that across the national park, the multitude of landowners and conservation organisations do not appear to be working in a truly cooperative way where each has their own objectives, paradigmatic approaches to conservation, and

management strategies, leading to inconsistent messaging across the national park. Finally, and perhaps the most problematic issue to address, is that there is no resource available for visitors to have positive and sustainable interactions with capercaillie in the wild. With greater inter-organisational cooperation, there may be some progress in this regard, but given the shy and elusive nature of capercaillie, this will still prove to be a significant challenge.

7.2.2 The impact of uncertainty on capercaillie conservation, and how this applies to the conservation of fragile species

A recurring theme that became more prevalent throughout completion of this thesis, is that uncertainty in the socio-ecological dynamics between capercaillie and humans proves to be a recurring and pervasive issue. We know that capercaillie populations are negatively impacted by anthropogenic disturbance and recreation (Moss *et al* 2014), but we are uncertain of exactly how each of these behaviours impact on capercaillie more specifically. Further, while previous literature has suggested that different types and sources of disturbance may impact capercaillie in different ways (Thiel *et al* 2011), there is a great deal of uncertainty around how pervasive these behaviours are, and exactly how capercaillie respond to these different disturbance events.

This thesis has looked to address some of these areas of uncertainty to enable more informed recreation management decisions to be made with greater confidence. Firstly, in the area of focus for this thesis, the Gannochy Forest Park, the levels of extra-trail activity have been found to be relatively high with up to as 20% of the population walking off marked trail, and not accounting for the other extra-trail activities. If these estimates are expanded to the rest of the Cairngorms National Park, then this could mean that as many as 374000 individuals recreating off marked trails and potentially causing disturbance events. Visitor number are predicted to continue to increase (CNPA 2015a), and perhaps more so following improved access upon completion of the A9 dualling, the potential for widespread disturbance is very high.

While the findings in this thesis are centred around the Gannochy Forest Park, these findings are transferrable to aspects of capercaillie conservation throughout the Cairngorms National Park. It is essential that when making recommendations and policy decisions in the context of capercaillie and recreation that the same messages are put across to the public in all areas of the national park. All reserves within the national park are interconnected through an intricate path network, meaning that while people are recreating, they will not necessarily stay within one area. With often complex and undefined boundaries between different landowners, the different rules and expectations that visitors are expected to adhere to can quickly add up causing confusion and ultimately non-compliance. For this reason, especially within the Cairngorms National Park, it is critical that landowners and organisations apply the same methods for recreation management

and share the same messages of acceptable behaviours. However, the socio-political landscape within the park is complex with these different landowners holding potentially contrasting objectives and priorities. For instance, while one landowner may prioritise the health of an ecosystem over human utilisation, another may prioritise recreation and public engagement with the outdoors. Given these conflicting ideologies, it becomes more apparent that the national park authority must play a mediating intermediary role in order to get these spatially consistent recreational messages across in all areas of the national park. As is noted by Redpath *et al* (2013), the inclusion of a third party, in this instance the Cairngorms National Park Authority, with seeming more neutral views, or at least less obviously biased, can greatly improve the engagement of a wide range of stakeholders.

Another consideration to take into account is that the Gannochy Forest Park is known more for its nature tourism as opposed to its sporting opportunities, unlike some of the other forested areas in the national park. Given this, it could be argued that other areas within the national park, which are more known for sporting activities, would see even lower levels of awareness of capercaillie conservation, meaning that a widespread and consistent education scheme is even more important across the park.

While there are multiple models for how to manage ecological systems under uncertainty, many of these follow a quantitative modelling methodology, such as information gap theory (Regan *et al* 2005), whereby probabilities of various states are assigned to the model in order to determine the scenario which provides the highest utility while minimising the potential impact of uncertainty. However, a key problem with this approach is that the complex socio-ecological systems are left either unaddressed or treated with a reductionist point of view where social phenomena can be described through a series of numbers or models. In light of this, due to the highly complex and dynamic social systems involved within the Cairngorms National Park, these methods would not be appropriate, and instead taking an approach similar to Nuno *et al* (2014) whereby a qualitative approach is taken using an assessment model as a framework. Nuno *et al* (2014) utilised the management strategy evaluation (MSE) (Bunnefeld *et al* 2011) as a framework, which would be particularly useful for the management of capercaillie as uncertainty is not only addressed directly in the framework but is an integral component. This approach would also have the benefit of utilising the rich expert knowledge held by not only the reserve managers and conservationists, but also the other multiple actors across the national park from recreation centre staff to local residents.

However, a major drawback of these methods is that many conservation managers may not have the training, expertise, or resources to carry out the management evaluations without outside academic help due to, either, the complex statistical requirements of the quantitative models, or

the nuanced interviewing and social science skills required by a the more qualitative focussed approach.

One element that must be addressed in this instance, is that uncertainty within any system is at its core determined by the epistemological viewpoints of the individuals who are managing that system (Gerber *et al* 2000). Throughout this thesis I have discussed how a lack of quantitative knowledge is a driving cause for this research and a source of uncertainty for conservation managers. However, as evidenced in chapter 6 through discussing experiential knowledge, there is a strong privileging of quantitative evidence with regards to decision making processes and when engaging with members of the public. Given this it is easy to see how a lack of quantitative evidence for the interactions between recreationists and capercaillie is seen as adding high levels of uncertainty, whereas the expert and indigenous knowledge held by conservationists, landowners, and local residents, is not held to the same regard. Although expert knowledge is being used to verify and ground new quantitative findings, it appears as though these expert knowledges are not seen to be in and of themselves sufficient for making conservation management decisions. However, this is likely due to the mostly ecological and natural science background of the conservationists, and it could be argued that the expert knowledge should be employed more in this scenario, providing, as shown by Drescher *et al* (2013), it is done so in a reflexive manner. As discussed by Diaz *et al* (2018), there is a current trend in a shift towards context specific conservation as an approach which values local and indigenous knowledges much more highly than historical conservation paradigms, such as the reliance on quantitatively derived knowledge for policy and management (Roebuck and Phifer 1999). The reasoning behind this paradigmatic shift is that by empowering the experiential knowledge of stakeholders engenders the idea that not only are different sources of information valuable tools for conservation planning, but they also allow for a more nuanced approach to human-nature relations that is more congruent with an inter-species paradigm (Oakley *et al* 2010; Mannion 2020).

Uncertainty, is by no means a trait only associated with the conservation of capercaillie within the Cairngorms National Park as has been discussed in chapter 6 of this thesis, in fact it is a theme that is often pervasive across many conservation and environmental policy decision landscapes (Mason *et al* 2018), and indeed in policy making within other fields such as climate change policy (Head 2008). In these instances, uncertainty has been seen as one of the contributing factors for what are known as wicked problems (Head 2014). Wicked problems, as defined by Rittel and Webber (1974), are problems that are very difficult to fully define, with many areas of uncertainty, complex interactions between each element, and those which cannot be solved using linear methods of problem solving and lack clear solutions. Since these wicked problems cannot be resolved using conventional methods, non-conventional management options must be

implemented (Game *et al* 2014). As I have stated above, tackling climate change is one example of a wicked problem (Head 2014). Factors that go in to defining climate change as a wicked problem include uncertainty around exactly what climate change is, what is driving climate change, and how we can best implement policy to limit any further damage (Head 2014). However, uncertainty is not the only contributor that gives rise to a wicked problem, climate change policy initiatives are often controversial with not only environmental implications but also a wide array of social and political implications that may not be well received by the public and those affected (Mason *et al* 2018). Given these issues, policy makers in various fields facing wicked problems have been implementing alternative management and policy making strategies (Game *et al* 2014; Head 2014; Mason *et al* 2018). Building on Game *et al* (2014), Head (2014), and Mason *et al* (2018), the findings of my research, as shown in chapter 6 section 6.2.1, shows that conservation managers involved in capercaillie conservation within the national park are faced with tackling management problems under high levels of uncertainty and so such alternative strategies may well be highly beneficial.

Traditional and conventional management strategies within conservation often take the shape of top-down management with relatively few individuals (Game *et al* 2014). However, this approach has been criticised within wicked problem contexts as not being context specific and not accounting for the multitude of interconnected agencies within the system, not only agencies of the capercaillie and conservationists, but also of visitors, locals, small business owners and others. A wicked problem approach to this issue is to take a pluralist approach to identifying solutions that involves all stakeholders that reflects the pluralist nature of modern conservation problems (Game *et al* 2014). In this regard, as is the case within the cairngorms national park, bringing greater privilege to the voices of members of the local communities and other non-conservation organisations into the policy decision landscape may well help to engage diverse voices within the decision making process leading to more context specific solutions. Additionally, as I have already stated, uncertainty can often lead to distrust of the policy making process and un-cooperation amongst stakeholders (Pollard *et al* 2019). These issues of trust between conservationists and stakeholders is currently a significant obstacle and concern amongst conservation managers as shown by the findings of this research in chapter 6.

Policy making landscapes that are reliant on more traditional science driven approaches are more susceptible to disruption and ineffectiveness from an increase in uncertainty (Liu *et al* 2007). As this research has shown to be the case within the cairngorms national park and specifically with capercaillie conservation policy, the uncertainty within the system is endemic and diverse, there for policy making must also be equally diverse. Inexorably linked to the strategy of tackling wicked problems with distributed decision making is to engage with individuals and groups with diverse

and wide ranging expertise (Game *et al* 2014). In this regard, the diverse expertise, thinking, and world views of different stakeholders encourages creative and pro-active action. In his 2019 book Rebel Ideas, Matthew Syed (2019) makes a case for how diverse thinking within a corporate context can be hugely beneficial not only for innovation but also resilience, using examples from climate change action, prevention of terrorism, and competitive sport. Not only this but Syed goes further to outline how a lack of diverse thinking may not only be ineffective and struggle to innovate, but also how homogenous groups of experts, who all think the same way, making far reaching decisions can in fact have dire consequences in some situations.

These arguments for diverse expertise are not new and certainly not unique to Syed (2019) and have been framed in multiple ways. Another such framing that takes a much more theoretical approach is highlighted by Verweij *et al* (2006) coining the term clumsy solutions. Verweij *et al* (2006) make the case for countering "rationalist" approaches to dealing with uncertainty and wicked problems with a diverse and pluralist approach. The arguments made by Verweij *et al* (2006) hinge upon their categorisation of social and world views into four distinct typologies, these being individualism, egalitarianists, hierarchy, and fatalism, each of which is diametrically opposed along one of two axes, the first being the amount of emphasis put onto societal roles and rules, the second being the importance of groups. In brief, the individualist views groups as being unimportant and are more ego centric, egalitarianists on the other hand prioritise groups above the individual while not prescribing to structured hierarchies, the hierarchy point of view is similar to egalitarians while maintaining a hierarchy amongst groups and individuals, finally fatalists are characterised as being cynical and sceptical of their own actions having any influence on the natural world (for a further discussion see Verweij *et al* 2006). Based on this, they posit that each of these positionalities brings unique and nuanced elements of knowledge and experience that may not be captured by the others and that each must exist in relation to the others in order to be sustainable. With this in mind, Verweij *et al* (2006) make the case for clumsy solutions as being those that creatively combine the opposing expertise, world views and perspectives in creative ways to not only identify solutions, but to determine what the problems are in the first place. The multitude of different stakeholders present within capercaillie conservation and pervasive uncertainty surrounding several aspects of capercaillie conservation highlighted in this thesis, would suggest that utilising this kind of clumsy solutions approach to tackling this wicked problem would be appropriate and could potentially lead to more effective policy making.

Khan and Neis (2010) utilise the clumsy solutions approach for tackling the rebuilding and reorganisation of fisheries to address rapidly declining fish stocks. With high levels of uncertainty linked to not only social processes but also ecological impacts and governing systems. Further to

this, fisheries management within the contexts described by Khan and Neis (2010) is spatially diffuse and subject to jurisdiction based management strategies in a similar way to capercaillie conservation within the caringorms national park. Their argument is that given the high levels of uncertainty within the system and the wicked nature of the socio-ecological problems, reforming the management strategies to be more in line with a clumsy solution approach, while not a cure-all solution, would be beneficial to explore. In the case of fishery management, they conclude by suggesting that clumsy solutions that incorporate all stakeholders in decision making and problem solving would not only readdress historical power dynamics, but would encourage creative problem solving and help to redefine objectives inclusive of all stakeholders, all of which are seen to be essential for sustainability (Khan and Neis 2010). In this regard, capercaillie conservation is in a very similar position where top down, hierarchy based institutions are the most involved in the decision making process and ultimately it is these institutions that set the objectives. Therefor if we can educate local conservation managers and policy makers to engage with decision making in a more "clumsy", or pluralist, manner then some of the current issues surrounding capercaillie conservation may be alleviated somewhat with a more sustainable decision making process.

Another element of managing wicked problems that occurs frequently in the literature involves objective setting (Head 2014; Mason *et al* 2018), and which is also seen to be a challenge for the multiplicity of stakeholders involved in capercaillie conservation as I have discussed earlier in this research. For instance, in conventional circumstances, it is perfectly reasonable to set clear objectives that measure the success of a specific program. However, within the context of wicked problems, and especially so where the amount of uncertainty within the system is so high, trade-offs are an almost certainty and so setting objectives that do not account for the multitude of ecological and social aspects present would likely result in many stakeholder groups becoming marginalised and losing their voice (Balint *et al* 2011). Instead, a more productive approach would be to acknowledge trade-offs and where they might occur as a result of the different strategies implemented. For instance, relating this to the context of capercaillie conservation, there are some very clear trade-offs that could occur when implementing a conservation strategy that is very focussed on capercaillie, such as what could be seen as limiting of outdoor recreationists liberties and rights to the freedom to roam and that one cannot be achieved without a trade-off in another aspect. As noted by Game *et al* (2014), wicked problems, especially where the levels of uncertainty are so pronounced, cannot have a single right solution but instead trade-offs amongst a suite of potential solutions that may be more or less preferable to the different stakeholder groups involved. As I have previously discussed in chapter 6, the policy makers and managers involved in capercaillie conservation within the cairngorms national park do appear to be cognisant of the trade-offs inherent in the system when making management decisions. However,

it is unclear how much of this is shared and if objectives are there for co-produced with those involved.

This leads us on to dissemination of success and failures within wicked problem settings, which as my findings in chapter 6 show is an area of concern for conservation of capercaillie within the national park, specifically in that some information is purposefully withheld from the general public. Game *et al* (2014) assert that wicked problems necessitate innovative problem solving, something that cannot happen without the open sharing of past failure. However, failure is often difficult to share with others as it often feels very personal and that an admission of failure would leave us open to criticism, accountability, and blame (Hannush 2021). These perceptions of failure and subsequent hesitancy to share our failures with others are not only present within conservation and environmental management (Richards and Kabjian 2001; Game *et al* 2014), but are present within many different industries where failures can have dire consequences. One such industry that has relatively recently been taking significant steps to learn from failure is the medical industry. The medical industry has often been criticised for its lack of clarity in errors resulting in avoidable harm to patients resulting in the Institute of Medicine publishing their 1999 report To Err is Human (Kohn *et al* 1999). This report, as a response to multiple avoidable deaths during what should have been routine procedures, puts into question the roll of failure sharing within health services and how the culture of the time was incompatible with the notion of learning from previous mistakes. Their goal therefor was to encourage a cultural change within medicine where practitioners felt able to share these experiences with others and where acknowledging errors would be seen as a praiseworthy exercise with the hope that the sharing of failure would result in more robust systems and greater innovation where practitioners felt safe to admit fault with the understanding that failure is an unavoidable aspect of being human (kohn *et al* 1999). While uptake of this way of thinking was at first slow (Leape and Berwick 2005), significant progress has since been made, in part thanks to popular science literature, such as Black Box Thinking (Syed 2015) bringing these issues to the forefront of the public's mind. These recent advances have in some part been the result in taking principles from the airline industry which has had a strong culture of being open with failure since investigations into the Pan American Airlines crash in 1988 (Ben-Yosef 2006). These cultural shifts towards being more open about failures are not only appropriate and applicable to these industries, but to all arguably all industries dealing with wicked problems. Open and clear conversations between conservation managers and stakeholders about past and present failures would likely lead to not only arriving at optimal solutions sooner, but also more cooperation by building trust with stakeholders (Young *et al* 2013). While this is by no means a new concept within conservation, Stravinsky (2000) proposed these very same concepts under the banner of safe-fails, there has been less traction

within conservation science and conservation management (Chambers *et al* 2022), especially when compared to the airline and medical industries. Given my findings where conservation managers were seen to keep stakeholders at arm's length with regards to the intricacies of conservation initiatives, these kinds of cultural shifts are sorely needed within the context of this thesis.

As discussed in this thesis in chapter 6, conservation managers involved in this research were very much aware that their keeping other stakeholders at arm's length with regards to the details, including failures, of previous conservation efforts may well be degrading trust with the communities in question. However, at the time of research, these practices were still very much in place and posed a tangible problem for local conservation managers. If we take a wicked problem approach then a strong argument for greater clarity with stakeholders could be made whereby being more open with these stakeholders about failures would not only build more trust but also likely engender greater confidence and innovation amongst policy makers. In conjunction with this, educating conservation managers and policy makers to employ a suite of techniques used when dealing with wicked problems would not only provide opportunity for more sustainable problem solving and community engagement, but would also result in a management system that is more resilient to pervasive uncertainty when compared with more conventional decision making systems in conservation.

Commented [WS12]: Theorising uncertainty

In summary, uncertainty is a pervasive and widespread issue when tackling the conservation of capercaillie and designing recreation management plans, and is one of the core and fundamental attributors to a problem being identified as a wicked problem. The resulting challenges of this uncertainty include difficulties in engaging with members of the public, inter-disciplinary and inter-organisational conflict, and hesitation in enacting alternative management decisions. However, there are tools that can aid in the decision making process when conservation managers are faced with uncertainty, and while many of these methods may require specialist consultation, a more qualitative approach that maximises the use of expert knowledge, such as the adaptation of the MSE framework by Nuno *et al* (2014), or the adoption of strategies employed for the tackling of wicked problems, would greatly benefit management decisions being made within the Cairngorms National Park.

7.3 IMPLICATIONS

7.3.1 Methodological implications

As is highlighted in the capercaillie framework (CNPA 2015b), there is a great need for a well thought out and structured approach to assessing and monitoring undesirable behaviours

amongst recreationists and visitors within the Cairngorms National Park. While the use of indirect questioning techniques has been widely applied to assessing the prevalence of undesirable and rule breaking behaviours or traits, such as illegal hunting (Nuno *et al* 2013), sexual assault (Krebs *et al* 2011), and prejudice towards marginalised groups (Ostapczuk and Musch 2011), there appears to be little evidence of the use of these techniques for estimating morally ambiguous recreational behaviours. In this thesis, I have utilised a forced response method for investigating a range of behaviours, the moral or social acceptability of which, unlike explicitly illegal behaviours, is not always precisely clear. In this instance, conservation managers within the park have installed signage asking for dogs to be kept under close control at certain time of the year, making their stance on walking dogs off the lead clear. However, the other behaviours investigated in this thesis, which have been identified as problematic for capercaillie conservation, and unofficially discouraged, are not explicitly communicated to visitors as being undesirable. This, in addition with the general lack of awareness of capercaillie conservation issues amongst recreationists, could lead to some ambiguity in just how acceptable these behaviours are and, as a result, could impact the effectiveness, or requirement for, the employment of indirect questioning techniques. However, findings from this thesis suggest that in situations such as this, the use of indirect questioning techniques is still valid and useful, especially so when grounded with the experiential knowledge of local experts, as discussed in chapter 6, and can be particularly useful in a policy and management setting.

As is highlighted in the capercaillie framework (CNPA 2015b), the assessment and monitoring of recreation in the context of capercaillie conservation is key for designing future recreation and conservation initiatives. This thesis shows that using an indirect questioning technique, alongside experiential knowledge, is a valid and useful method for investigating the prevalence of undesirable behaviours and traits.

However, there are a number of factors to consider when recommending the use of a forced response technique for an ongoing behavioural monitoring scheme. Firstly, indirect questioning techniques in themselves are not spatially explicit, and so it would be difficult to make management decisions in terms of spatial units, whereby specific areas of the reserve can be determined as being either high priority or sacrificial. This lack of a spatial element to a forced response design could be addressed by employing a participatory mapping exercise with respondents, which itself would likely undermine any benefit of confidentiality brought about by the forced response design. However, there are other methods of gaining spatially explicit behavioural data which will be discussed shortly.

Another element of RRT is that these methods would likely require in person data collection and so are relatively time and resource intensive method, especially for an ongoing monitoring

program. With this in mind, the feasibility of this method would also be hampered by the often spread out nature of pour points within the park, and that there are large areas with very little footfall, meaning that the time taken for data collection would be disproportionately high compared with other methods. Instead, the use of an activity recording app such as Strava could be a more appropriate method for monitoring recreational behaviour within the park.

Accessing recreational data from activity recording mobile phone apps, such as Strava or ViewRanger, would allow conservation managers to spatially identify areas of the reserve that are seeing the highest levels of extra trail activity. These data, being spatially explicitly, have been used effectively for a wide array of management projects in the past, such as the planning of sustainable transport options (Hong *et al* 2018), the monitoring of cycling patterns in cities (Hochmair *et al* 2019), and for the analysing the popularity of reserves for different recreational activities (Norman and Pickering 2019). For this reason, the use of these spatially explicit, and crowd sourced, behavioural data would allow managers to identify very specific areas of the park that are seeing the highest levels of extra-trail activity allowing for spatially explicit management decisions to be made with a greater degree of confidence.

While indirect questioning methods continue to prove to be an effective means for estimating undesirable behaviours for academic and research purposes, the labour intensive in person data collection means that this particular method may not, in actual fact, be appropriate for use as an ongoing monitoring scheme by already stretched conservation and land management organisations. In this case, an alternative method for recreation monitoring, such as the use of crowd sourced data collected through activity tracking apps, would be more appropriate and should be explored in more detail.

7.3.2 Policy implications and tentative directions

In this section, I now consider the relation of the findings presented in this thesis to current capercaillie policy and management decisions, and tentative future directions. It is important to note that, while these recommendations can be applied to other areas of capercaillie conservation, and perhaps for the conservation of other fragile species, each situation presents unique issues and as such, the importance of contextualising quantitatively derived findings with qualitative work is highly important.

Recommendation 1: An improved education programme for visitors and the general public.

Currently, the management strategy for discouraging extra trail activity in many areas of the Cairngorms National Park, is largely through the use of trail side natural barriers and changes to topographical elements in the areas (CNPA 2015b). This style of approach follows principles underpinned by nudge theory (Thaler and Sunstein 2009) where indirect cues are used to

influence the behaviour of individuals. However, while this approach could prove to be effective at deterring individuals who would opportunistically venture off marked trails, it would not account for those who are actively seeking extra-trail activity. For this reason, other approaches must be adopted.

Based on the findings presented in this thesis, it appears as though the visitor population at the Gannochy forest park would benefit from an education scheme utilising clear and informative signage. Not only this but also educating in a way to educate both the educators and members of the public to manage prolific uncertainty (Tauritz 2012), and to introduce wider array of inter-species educational programs. As was shown in chapter 4, there are large proportions of the population recreating in these areas who are unaware of the presence of capercaillie, l*et al*one how to behave in sensitive habitat. Since the majority of people in the area hold pro-environmental attitudes, perhaps the most pressing issue would be to increase recreationists action related knowledge so that they can make more informed decisions around how to behave. Although there is signage within the park that asks for dogs to be kept under close control, the message behind these signs is not immediately clear and does not address other behaviours aside from dog walking.

In the future, signage, explicitly stating how visitors are expected to behave, and how this benefits capercaillie populations, would likely benefit capercaillie conservation efforts. Further, due to the role of norms that has been identified, particularly from park staff, if this were to be accompanied by a larger and more public facing ranger service, then these education initiatives may prove to be more effective.

Recommendation 2: Alternative and sustainable viewing opportunities for those who are actively seeking out capercaillie.

While there are large proportions of the population who visit the national park, who have relatively low levels of awareness of capercaillie, there are still those who visit specifically to see capercaillie in the wild. For this reason, an improved education scheme would not necessarily be sufficient to deter some of these individuals from seeking out interactions with capercaillie. Additionally, by raising awareness of a rare and charismatic species, there is a chance increasing the number of people who would want to view that species, as a result of the anthropogenic allee effect (Courchamp *et al* 2006), and consequentially, increase the number of people who venture off marked trails looking for an encounter. For this reason, any education programme must be accompanied by the provision of sustainable capercaillie viewing opportunities.

While organised capercaillie viewing has been provided in a single location in the past, known as ‘Caper Watch’, the lek site where this took place has recently been abandoned. Additionally, there

are two capercaillie hens in captivity at the Highland Wildlife Park, however, this may not satisfy visitors who are looking for a wild experience. By re-establishing an event such as 'Caper Watch', visitors would be able to view wild capercaillie in a sensitive and sustainable way, minimising any potential disturbance. Provision of a resource such as this could further be utilised as part of a wider inter-species education programme involving not only capercaillie and other rare and sensitive species, but landscapes and habitats. This inter-species educational program would look to make these human-animal encounters emotionally consequential and break down long held anthropocentric world views (Oakley *et al* 2010) and enhancing feelings of place-connection (Mannion 2020). Place-connection, however, cannot be fostered through encounters alone and would be most effectively engendered through encounters which are mediated by mentors, to allow for a greater understanding of, and empathy towards, other non-human species (Halpenny 2010; Mannion 2020). This also ties in with a shift in the way the public relates to and understands nature, following a paradigmatic shift in line with a people-and-nature framing (Mace 2014). By allowing for more meaningful guided interaction, members of the public would develop a deeper understanding of how their behaviour is directly linked to not only the capercaillie, but the wider environment, and would facilitate a move away from the dualistic concept of consumptive and non-consumptive recreation, and towards stakeholders gaining a deeper understanding of their actions in the context of the environments around them.

However, there are some significant barriers that would be involved with the provision of capercaillie viewing opportunities. Since the location and size of capercaillie leks can be difficult to predict, a permanent location would likely be unsuccessful. Due to this, a 'Caper Watch' that has access to a number of locations around the park would be more likely to provide viewing opportunities to the public. With the variable nature of this potential service comes an additional barrier in that each landowner throughout the national park would need to collaborate and agree on where this would take place. However, each landowner and organisation would bring different priorities and potential conflict, as was discussed in chapter 6. However, although these barriers may prove to be problematic, similar events take place with different species such as with Golden Eagles on the Isle of Mull. With this in mind, providing adequate collaboration between organisations, a similar model could be employed within the Cairngorms National Park.

Recommendation 3: Inclusion of target recreation and stakeholder groups in all aspects of management process to avoid a negative response from feeling unfairly targeted, and as part of a wider education scheme.

While the findings from this thesis point towards the above policy recommendations, the cooperation of recreationists is not guaranteed. As discussed in chapter 6, cooperation of different groups of stakeholders can rely heavily on not only knowing the drivers behind the

target behaviours, but also on a sensitive and appropriate delivery. Involving these communities directly in the management process will help to both, hopefully, increase the populations associations with the species, and also go some way to reducing feelings of blame that could lead to pushback and non-compliance.

While community involvement would likely involve only local stakeholder groups, there would still be a carryover effect on to visiting recreationists through changing norms and local rules within communities. In many outdoor recreation communities, visitors often rely on local knowledge on where to go for their activity and what is available. Whether this is in the form of discussion on online forums, the purchasing of a guidebook, or through direct communication, local knowledge will invariably play a role in informing the recreational behaviours of visitors.

This apparent shift in focus away from the exclusionary principles of fortress conservation (Brockington 2002), and towards co-management, within the Cairngorms National Park, appears to be at odds with the general trend in conservation which is thought to be moving to a neo-liberal approach (Vaccaro *et al* 2013). This neo-liberal approach to conservation is seen by some to be a backwards step as it moves back towards the exclusionary principles of fortress conservation and the commodification of nature, where conservation is driven by the market and financial incentives (Dhandapani 2015). However, while it does not appear to be the case that conservationists working within the Cairngorms National Park are moving towards the neo-liberal traits, such as the commodification of nature for conservation, the analysis from this study suggests that a move from a form of fortress conservation to co-operative conservation appears to be stalling somewhat, where there is a desire for reform but a hesitation to change. While it may be a slow process, evidence presented here suggests that the inclusion of stakeholders throughout the conservation process, and a move towards co-operative conservation, will go some way to a long-term goal of a shift to an inter-species paradigm.

There are various ways in which conservation organisations can involve local communities in the management process, one of which is already being employed in the area. Recently, regular meetings and public consultations have been taking place with some local communities to encourage their adoption of capercaillie as a flagship species and engagement with capercaillie conservation initiatives. However, one of the issues that has been identified in chapter 6 is that if all aspects of capercaillie conservation are discussed with stakeholders, and not just elements that are deemed to be relevant to their situation. Instead, engaging stakeholders in all aspects of capercaillie conservation engenders trust and cooperation, as opposed to non-compliance through feelings of blame. Further, a transition to co-operative conservation management would serve to further embed the paradigmatic shift towards an inter-species framing.

7.4 LIMITATIONS AND FUTURE RESEARCH

While this research has made an original contribution, there are naturally some limitations associated with both the methodological approach and the scope of recommendations to be made due to the uncertainty within the system. One aspect of this research that could be considered as a limitation is that the sample size for the statistical analysis is relatively low, at 159 responses the sample is at the lower end of the target sample size set out for this study. However, an initial power analysis carried out prior to data collection suggested that a minimum sample of 139 would be required and further analysis were carried out with sufficient power to produce interesting results. During data collection, the sample size was limited by a number of factors, perhaps most predominantly by the wetter than average summer over the 2017 season (Met Office 2017) resulting in fewer viable days for data collection, and potentially a lower response rate as a result of the inclement weather.

Another limitation is that the data collected were potentially not representative of the users of the whole of the national park. Since a number of data collection sites were untenable due to ongoing research being carried out by the Cairngorms National Park Authority, or the presence of delicate social relationships between the users of these areas and the park authority, the only viable study site was the Gannochy Forest Park. However, the Gannochy Forest Park is one of the most visited areas of the Cairngorms National Park and is also thought to have one of the capercaillie populations which is struggling the most, therefor it could be argued that the findings gathered from this area are more transferrable to others, as opposed to the other way around.

While the focus of this research was on individuals using the park during the capercaillie breeding season, and so primarily encapsulating visitors who live out with the Cairngorms National Park, local residents are also a source of disturbance (Brown 2015). Due to ongoing tensions between local residents and the Cairngorms National Park Authority over capercaillie issues, direct and purposeful contact with local residents was explicitly excluded from the scope of this study. However, further research is needed, and is ongoing, with these local communities in order to not only encourage behaviours that are more sensitive to capercaillie disturbance, but also to encourage the adoption of capercaillie as a local flagship species which the local residents are proud of.

Due to the high levels of uncertainty within the system, it is difficult to identify which behaviours are most damaging to capercaillie populations. As such, further policy implications must be tentative in order to avoid the singling out of specific user groups resulting in feelings of blame and resentment, as discussed in chapter 6. With this in mind, further research into the specifics of the socio-ecological system would be highly beneficial for designing future policy. However, due

to the shy and cryptic nature of capercaillie, it would be extremely difficult to gather data on direct interactions between recreationists and capercaillie. Whereas, in the past, there have been a small number of capercaillie hens fitted with gps trackers to gather spatial data on the bird movements, this was deemed to cause too much stress to the birds to be an effective means for future research (personal comms). Other proxies could be used for investigating the human-animal interactions to gain a greater understanding of the dynamics involved. One potential method would involve the use of data collected from people counters within the park alongside capercaillie location data. While this kind of niche modelling involving data on human behaviour has been done before (Timar and Phaneuf 2009), the impact of different types of behaviour or activities could be more deeply investigated by applying weights to people counter data. These weights would be created by collecting spatial data of routes taken by visitors along with their chosen activity, and could be collected either through participatory mapping exercises, or through the use of a fitness tracking mobile app such as Strava or ViewRanger. However, there are a number of difficulties that would be associated with using data from these apps. Firstly, while data derived from these apps would differentiate between walkers, runners, skiers, or cyclists, there would be no way of looking into if the activity was being undertaken with a dog, an activity that is anecdotally thought to have a significant impact on capercaillie disturbance. Secondly, access to these data sets can be difficult, both due to privacy considerations, and in terms of the costs associated. However, these considerations would not be prohibitive and could be use tangentially with other lines of enquiry.

An additional limitation to this is that there are groups of recreationists who potentially have not been captured by the survey. Specifically, avid wildlife photographers and bird watchers may not be as readily recruited for quantitative surveys. Individuals belonging to these groups who are actively seeking out capercaillie when they are at their most active very early in the morning, because of this, and the remoteness of where these activities would take place, conventional quantitative methods would be inefficient. Instead, to access these groups it would be more effective to have a more targeted approach by engaging with local photography guides, birdwatching groups, and online forums, following with a qualitative line of enquiry allowing for a deeper and more nuanced insight into these relatively small communities.

Not only would it be a highly valuable addition to this research to capture these recreationists who may have been missed but it would also likely prove to be beneficial to investigate the roles of each type of recreationist in a more nuanced way in future research. While initially this was planned for within this thesis, breaking down analyses by different types of recreationists proved to be impractical for the scope this thesis took. As I have highlighted above the sample size collected from the visitor survey while being sufficient for quantitative analysis, was insufficient

for further distillation of these analysis within different categories of recreationists as the samples would become too small for any effect sizes to be observable. However, this would of course be a valuable addition for further research in this area and would provide a basis for highly tailored, group specific, interventions. A possibility for this kind of analysis would involve a technique such as cluster analysis to identify what groups the visitors to these areas fall within based on some demographic variables. Following on from this a fruitful line of inquiry would be to identify key traits that members of these groups have in common with one another to determine the most effective methods of engaging with each of the groups for the benefit of capercaillie. This would also likely involve further qualitative analysis with key stakeholders within these communities such as local outdoor recreation guides, professional photographers, and tourism agencies alongside some of the visiting recreationists themselves. Involving both aspects of these communities would be essential to capture both the regular recreationist, as well as those whose livelihoods depend upon the landscapes in question. As I have stated above, this further investigation would provide erudite contributions to not only the academic literature, but would also be greatly beneficial to local conservation bodies looking to mitigate the impact of various user groups on not only capercaillie populations but other fragile landscapes within the national park.

Commented [WS13]: Further analysis of different user groups.

Finally, given wide array of different landowners, conservation organisation, and local stakeholders involved in capercaillie conservation, social network analysis would be an extremely valuable tool to disentangle and examine the relationships present. Especially since there are so many different conservation objectives, paradigms and world views, a mixed methods approach to this network analysis would be able to pull apart the more nuanced relationships between different groups. By using Mace's (2014) conservation paradigms alongside the theory of diffusion of innovation (Rogers 2003) we could further see how ideologies and novel management practices spread throughout a complex management network, and perhaps more crucially, see where the break in this chain lies.

It appears as though the future of research into the socio-ecological dynamics of capercaillie conservation has a relatively clear and staged process. Firstly, further research must be carried out into the interactions between capercaillie and the different user groups within the park in order to gain an understanding of the more problematic behaviours that are the causing the greatest strain on capercaillie populations. Following this, these identified groups can be engaged with and recruited on a more targeted basis which, following the identification of the most damaging activities, would allow for more specific policy recommendations to be made.

7.5 ORIGINAL CONTRIBUTION

1. Through the use of a randomised response technique, we can estimate the proportions of visitors to the Cairngorms National Park who are partaking in potentially deleterious extra-trail behaviours. I have shown that there is a substantial proportion of the population, up to 374000 individuals per year, who visit the Cairngorms National Park who may be engaging in extra-trail activity, and as a result potentially putting a great deal of added disturbance to an already struggling population of capercaillie.
2. Using Frick *et al's* (2004) forms of environmental knowledge, I have identified that there is in general a substantial lack of awareness of capercaillie conservation issues amongst visitors in the Cairngorms National Park, particularly around effectiveness knowledge, and further how this lack of knowledge is hindering capercaillie conservation efforts.
3. While mixed methods and interdisciplinary research is becoming more prevalent within conservation (Kinnebrew *et al* 2020), this research has successfully combined complex quantitative data and analysis with rich qualitative data to investigate the socio-ecological systems involved with the conservation of a fragile species, such as capercaillie. The use of quantitative survey data, and triangulation and grounding through a key stakeholder focus group, has led to the production of viable, evidence-based policy recommendations for capercaillie conservation within the Cairngorms National Park.
4. Through this mixed methods approach, this thesis has gone some way to highlighting how conservation managers, of different disciplinary backgrounds, react to newly acquired information, and how this new information is interpreted in the context of conservation in national parks. The findings presented show that while conservation managers utilise experiential knowledge to interpret and contextualise new information, in a way similar to that outlined by Diaz *et al* (2018), disciplinary backgrounds are still a hindering factor when looking to implement a paradigmatic shift towards the co-production of conservation and an inter-species world view.

7.6 REFLECTIONS

As outlined by Finlay (2002), research, whether through qualitative or quantitative lines of enquiry, is a "joint product of the participants, the researcher, and their relationship". Given this, it is vitally important that the researcher understands the process by which they came to any specific project and should identify the disciplinary and paradigmatic biases and preferences which would invariably influence the research process. Further, as identified by Young *et al* (2018), reflexivity is as a practice is relatively uncommon within conservation research but is none the less something that must be addressed by the researcher, especially with regards to qualitative lines of inquiry. With regards to this project, having come from a natural sciences

background, with a positivist, perhaps reductionist, world view, it was important that I took steps at all stages of the research process to address and evaluate how my biases and preconceptions could influence the project.

Before the research design phase began, through wider reading in social science journals, and interaction with peers within the department, my viewpoints shifted more towards pragmatism, and the integration of qualitative and quantitative methodologies, to more deeply investigate the research questions, became the apparent research approach. Further, my own beliefs surrounding how we should best conserve nature, have shifted somewhat since the beginning of the PhD process. Prior to beginning this thesis, I would have likely aligned myself with a 'nature despite people' world view (Mace 2014), however, throughout the process I have come to more strongly align with the 'people and nature' stance. These worldviews which I held could very easily influence my research, especially during the focus group phase, where I was seen to be equally expert by the participants. In order to reduce the influence of my own ideologies on this process, I played more of a moderator roll and followed a pre-determined focus group topic guide. While I took part in the discussion to move the dialogue in line with this topic guide, I tried to keep my input to a minimum which I believe reduced my influence without resulting in off topic discussion.

As discussed earlier in this thesis, flagship species, such as capercaillie, can play a significant and invaluable role in engaging members of the public in conservation initiatives (Walpole and Leader-Williams 2002; CNPA 2015b). Throughout this doctorate process my thoughts, opinions and feelings towards this concept have changed somewhat. When first starting out on this PhD journey, I was very much not a proponent for single species conservation or flagship species chosen for their charismatic qualities, however, the potential for capercaillie to be an umbrella species for whole ecosystems (Suter *et al* 2002; Mikolas *et al* 2015) made capercaillie focussed conservation a much more appealing objective.

My thoughts, valuations, and feelings have changed a great deal, largely through engaging with members of the public who aren't deeply involved with the world of conservation. Engaging with lay people in wild spaces highlighted to me just how important more than human encounters are for engendering conservation minded behaviours and environmentalism amongst members of the public. While carrying out fieldwork I interacted with many different types of people, from many different backgrounds, who became interested in capercaillie conservation after I had discussed it with them. However, I am unsure if having such a fragile species, so susceptible to disturbance, is wise given the propensity for individuals to seek out more than human encounters with charismatic species, as discussed in chapter 5. It also seems to be somewhat paradoxical in the approach being taken with capercaillie as a flagship species within the national park.

While the species is advertised around the national park and is an important cultural icon, there is at the same time a desire to limit awareness of capercaillie to limit damage by individuals seeking out encounters. However, from my own perspective I can fully understand and empathise with individuals wanting to seek out these encounters as it can have a significant impact on one's perspective. In this regard, I have had my own perspective and ethical framings shift as a result of encounters with capercaillie. At the beginning of my PhD I had never seen a capercaillie before and, as already stated, I didn't hold favourable views on single species conservation. However, at various points throughout the fieldwork process I had these more than human experiences with capercaillie in the wild that began to change my perspective. As I had more of these chance encounters with capercaillie while conducting fieldwork I began to feel more connected with the species, and in turn more connected with the research project, as these animals were made more immediate and tangible to me as opposed to being elusive and abstract. The ways these interactions influenced my thinking is not unique to this research and is in fact a pattern that has been observed many times before and has a rich literature from diverse disciplines. In particular, I have already cited some of these sources throughout this thesis, for instance, Lynch and Mannion (2021) describe how meaningful and place-responsive encounters can help attune the individual with the more-than-human, Presson *et al* (2022) observed similar responses in fieldwork participants. While my perspective on conducting conservation efforts for the benefit of a single species only hasn't changed a great deal, my outlook now is much more sympathetic to using charismatic species for engaging members of the public and facilitating a transition towards the inclusion of the more than human as a valuable feature of new, more sustainable ways of life.

Commented [WS14]: Reflexivity and positionality

During the design and implementation of the survey I was careful to maintain robustness in data collection by using a standardised survey design and established methodologies. Further, during data collection, I made sure to reduce any power dynamic and influence that could have occurred between myself and the participants, by not being close by while surveys were completed. The nature of the randomised response design also reduced my influence on the participants as I could not be certain if the responses given to these sensitive questions were truthful or not.

I was careful to be reflexive from the beginning of the research process to minimise my influence on the participants, both within the focus group and during the survey design and implementation. However, while I acknowledge that as a researcher, with conscious and unconscious biases, my own ideologies will have invariably influenced the research process, the steps that I have taken go some way to minimising this influence. This reflexive journey is one I hope is clear throughout this thesis. Showing that as my thoughts and beliefs on not only conservation but also social research changed, so too did my approach to carrying out this research.

Commented [WS15]: Reflexivity and positionality

7.7 CONCLUDING REMARKS

As noted by Diaz *et al* (IPBES 2019), it is essential for human-environment relations to change in order to effectively tackle the global issues surrounding biodiversity loss. In this context, the conservation of capercaillie in Scotland is no different, and in line with the UK governments 25-year environmental plan (DEFRA 2018), the recovery of nature, and capercaillie populations, must involve and address these human-environment relations. Capercaillie decline in Scottish populations is thought to have a number of causes including climate change, habitat loss, and predation. However, while anthropogenic disturbance from recreation may not be a direct leading cause of this decline, it is thought that disturbance is a substantial compounding factor. With an ever-increasing number of visitors travelling to the Cairngorms National Park, the potential for disturbance of capercaillie will only increase. The work presented in this thesis provides an overview of recreation, capercaillie conservation, and anthropogenic disturbance in the Gannochy Forest Park and the wider Cairngorms National Park. Policy recommendations have been made based on the findings from a quantitative line of inquiry, primarily the increasing of public understanding through education schemes. However, what has become increasingly more evident throughout this thesis is the role that uncertainty plays in the management process. Both through causing inter-organisational conflict and being a source of non-compliance amongst members of the public, uncertainty around the specific impact of recreation on capercaillie populations is a significant challenge. However, with the Cairngorms National Park Authority playing a mediating role between the large and diverse collection of landowners, more consistent conservation goals, and clear and consistent education of visitors, will likely go some way to reducing the influence of this uncertainty by learning to not only tolerate it, but embrace it.

8 BIBLIOGRAPHY

Aipanjiguly, S., Jacobson, S. K., and Flamm, R., 2003. Conserving manatees: knowledge, attitudes, and intentions of boaters in Tampa Bay, Florida. *Conservation Biology*, 17, 1098-1105.

Ajzen, I., 1991. The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50, 179-211.

Ajzen, I., 2015. The theory of planned behaviour is alive and well, and not ready to retire: a commentary on Sniehotta, Presseau, and Araújo-Soares. *Health Psychology Review*, 9(2), 131-137.

Albarracin, D., Johnson, B. T., Fishbein, M., and Muellerleile, P. A., 2001. Theories of reasoned action and planned behavior as models of condom use: a meta-analysis. *Psychological Bulletin*, 127(1), 142.

Albert, D.M. and Bowyer, R.T., 1991. Factors related to grizzly bear: human interactions in Denali National Park. *Wildlife Society Bulletin (1973-2006),* 19(3), 339-349.

Andren, H., 1992. Corvid density and nest predation in relation to forest fragmentation: a landscape perspective. *Ecology*, 73(3), 794-804.

Angulo, E., Deves, A.L., Saint Jalmes, M. and Courchamp, F., 2009. Fatal attraction: rare species in the spotlight. *Proceedings of the Royal Society B: Biological Sciences*, 276(1660), 1331-1337.

Armitage, C. J., and Conner, M., 2001. Efficacy of the theory of planned behaviour: A meta-analytic review. *British Journal of Social Psychology*, 40(4), 471-499.

Armitage, C. J., Armitage, C. J., Conner, M., Loach, J., and Willetts, D., 1999. Different perceptions of control: Applying an extended theory of planned behavior to legal and illegal drug use. *Basic and Applied Social Psychology*, 21(4), 301-316.

Arnberger, A. and Eder, R., 2011. The influence of age on recreational trail preferences of urban green-space visitors: a discrete choice experiment with digitally calibrated images. *Journal of Environmental Planning and Management*, 54(7), 891-908.

Ashley, F., 2021. Accounting for research fatigue in research ethics. *Bioethics*, *35*(3), 270-276.

Baines, D. and Andrew, M., 2003. Marking of deer fences to reduce frequency of collisions by woodland grouse. *Biological Conservation*, 110(2), 169-176.

Baines, D. and Summers, R. W., 1997. Assessment of bird collisions with deer fences in Scottish forests. *Journal of Applied Ecology*, 34, 941-948.

Baines, D., Moss, R. and Dugan, D., 2004. Capercaillie breeding success in relation to forest habitat and predator abundance. *Journal of Applied Ecology*, 41(1), 59-71.

Balint, P. J., Stewart, R. E., & Desai, A. (2011). *Wicked environmental problems: Managing uncertainty and conflict.* Washington DC: Island Press.

Bamberg, S., and Möser, G., 2007. Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour. *Journal of Environmental Psychology*, 27(1), 14-25.

Bazeley, P., 2018. *Integrating analyses in mixed methods research*. Sage, London.

Beale, C. M. and Monaghan, P., 2004. Human disturbance: people as predation-free predators? *Journal of Applied Ecology*, 41(2), 335-343.

Beck, J.M., Elliott, K.C., Booher, C.R., Renn, K.A. and Montgomery, R.A., 2021. The application of reflexivity for conservation science. *Biological Conservation*, *262*, 109322.

Bellard, C., Bertelsmeier, C., Leadley, P., Thuiller, W. and Courchamp, F., 2012. Impacts of climate change on the future of biodiversity. *Ecology Letters*, 15(4), 365-377.

Ben-Yosef, E., 2006. *The Evolution of the US Airline Industry: theory, strategy and policy (Vol. 25).* Springer Science & Business Media.

Bero, L.A., 2005. Tobacco industry manipulation of research. *Public health reports*, *120*(2), 200.

Bevanger, K., 1995. Estimates and population consequences of tetraonid mortality caused by collisions with high tension power lines in Norway. *Journal of Applied Ecology*, 32, 745-753.

Blumstein, D. T., Fernandex-Juricic, E., Zollner, P. A. and Gerity, S., C., 2005. Inter-specific variation in avian respnses to human disturbance. *Journal of Applied Ecology*, 42, 943-953.

Boerschig, S., and De Young, R., 1993. Evaluation of selected recycling curricula: Educating the green citizen. *The Journal of Environmental Education*, 24(3), 17-22.

Bolderdijk, J.W., Gorsira, M., Keizer, K. and Steg, L., 2013. Values determine the (in) effectiveness of informational interventions in promoting pro-environmental behavior. *PloS One*, 8(12), p.e83911.

Bollmann, K., Graf, R. F., Debrunner, R. and Suter, W., 2004. *The capercaillie as indicator of high species richness: potential and limitations of the umbrella species concept*. In Proc 12th Annual IALE Conf on Landscape Ecology of Trees and Forests, Cirencester, UK.

Booth, J. E., Gaston, K. J., Evans, K. L., and Armsworth, P. R., 2011. The value of species rarity in biodiversity recreation: A birdwatching example. *Biological Conservation*, 144(11), 2728-2732.

Boswell, C, 2008, The political functions of expert knowledge: Knowledge and legitimation in European Union immigration policy. *Journal of European Public Policy*, 15, 471–488.

Breiting, S. and Mogensen, F., 1999. Action competence and environmental education. *Cambridge Journal of Education*, 29(3), 349-353.

Brittain, S., Ibbett, H., de Lange, E., Dorward, L., Hoyte, S., Marino, A., Milner-Gulland, E.J., Newth, J., Rakotonarivo, S., Veríssimo, D. and Lewis, J., 2020. Ethical considerations when conservation research involves people. *Conservation Biology*, *34*(4), 925-933.

Brockington, D., 2002. *Fortress conservation: the preservation of the Mkomazi Game Reserve, Tanzania*. Indiana University Press, Bloomington.

Brockington, D., 2004. Community conservation, inequality and injustice: myths of power in protected area management. *Conservation and Society*, 2(2), 411-432.

Brooks, T. M., Mittermeier, R. A., Mittermeier, C. G., Da Fonseca, G. A., Rylands, A. B., Konstant, W. R., Flick, P., Pilgrim, J., Oldfeld, S., Magin G. and Hilton-Taylor, C., 2002. Habitat loss and extinction in the hotspots of biodiversity. *Conservation Biology*, 16(4), 909-923.

Brown, K.M., 2014. Spaces of play, spaces of responsibility: Creating dichotomous geographies of outdoor citizenship. *Geoforum*, 55, 22-32.

Brown, K.M., 2015. The role of landscape in regulating (ir) responsible conduct: moral geographies of the 'proper control' of dogs. *Landscape Research*, 40(1), 39-56.

Bryman, A., 2006. Integrating quantitative and qualitative research: how is it done? *Qualitative Research*, 6, 97-113.

Bryman, A., 2012. *Social Research Methods*. 4th ed. New York: Oxford University Press.

Budaev, S.V., 2010. Using principal components and factor analysis in animal behaviour research: caveats and guidelines. *Ethology*, 116(5), 472-480.

Burt, R.S., 1999. The social capital of opinion leaders. *The Annals of the American Academy of Political and Social Science*, 566(1), 37-54.

Buturovic, Z. and Tasic, S., 2014. Decisions under Uncertainty: Action-Hesitancy Model. Available at SSRN 2524830.

Carey, M.A., 1994. The group effect in focus groups: Planning, implementing, and interpreting focus group research. *Critical issues in qualitative research methods*, 225, 41.

Carlsen, B. and Glenton, C., 2011. What about N? A methodological study of sample-size reporting in focus group studies. *BMC medical research methodology*, *11*(1), 1-10.

Čas, M., 2010. Disturbances and predation on capercaillie at leks in Alps and Dinaric Mountains. *Šumarski List*, 134(9-10), 487-494.

Catt, D. C., Dugan, D., Green, R. E., Moncrieff, R., Moss, R., Picozzi, N. and Tyler, G. A., 1994. Collisions against fences by woodland grouse in Scotland. *Forestry*, 67(2), 105-118.

Chambers, J.M., Massarella, K. and Fletcher, R., 2022. The right to fail? Problematizing failure discourse in international conservation. *World Development,* 150, 105723.

Chan, J.K.L., Marzuki, K.M. and Mohtar, T.M., 2021. Local community participation and responsible tourism practices in ecotourism destination: A case of lower Kinabatangan, Sabah. *Sustainability*, 13(23), p.13302.

Chao, Y. 2012. Predicting people's environmental behaviour: theory of planned behaviour and model of responsible environmental behaviour. *Environmental Education Research*, 18, 437-461

Chen, M. F., and Tung, P. J., 2014. Developing an extended theory of planned behavior model to predict consumers' intention to visit green hotels. *International Journal of Hospitality Management*, 36, 221-230.

Cho, Y. I., Johnson, T. P. and VanGeest, J. B., 2013. Enhancing surveys of health care professionals, a meta-analysis of techniques to improve response. *Evaluation and the Health Professions*, 36, 382-407.

Christie, M., Hanley, N., Warren, J., Murphy, K., Wright, R., and Hyde, T., 2006. Valuing the diversity of biodiversity. *Ecological Economics*, 58(2), 304-317.

Cialdini, R. B., and Goldstein, N. J., 2004. Social influence: Compliance and conformity. *Annual Review of Psychology*, 55, 591-621.

CNPA 2017. *Cairngorms National Park Partnership Plan 2017-2022.* Grantown-on-Spey: Cairngorms National Park Authority.

CNPA, 2015a. *Cairngorms Visitor Survey 2014-2015*. Grantown-on-Spey: Cairngorms National Park Authority.

CNPA, 2015b. *Cairngorms Capercaillie Framework: Phase 1 Report*. Grantown-on-Spey: Cairngorms National Park Authority.

CNPA, 2019. *Cairngorms Nature Actional Plan 2019-2024*. Grantown-on-Spey: Cairngorms National Park Authority.

Cotter, R.C. and Gratto, C.J., 1995. Effects of nest and brood visits and radio transmitters on rock ptarmigan. *The Journal of Wildlife Management*, 59(1), 93-98.

Courchamp, F., Angulo, E., Rivalan, P., Hall, R.J., Signoret, L., Bull, L. and Meinard, Y., 2006. Rarity value and species extinction: the anthropogenic Allee effect. *PLoS Biol*, 4(12), p.e415.

Crespo, C.J., Smit, E., Andersen, R.E., Carter-Pokras, O. and Ainsworth, B.E., 2000. Race/ethnicity, social class and their relation to physical inactivity during leisure time: results from the Third National Health and Nutrition Examination Survey, 1988–1994. *American Journal of Preventive Medicine*, 18(1), 46-53.

Crouzat, E., Arpin, I., Brunet, L., Colloff, M.J., Turkelboom, F. and Lavorel, S., 2018. Researchers must be aware of their roles at the interface of ecosystem services science and policy. *Ambio*, 47(1), 97-105.

Crutzen, P. J. and Stoermer, E. F., 2000. The Anthropocene. *Global Change Newsletter,* 41, 17–18.

Cutt HE, Giles-Corti B, Wood LJ, Knuiman MW, Burke V., 2008, Barriers and motivators for owners walking their dog: results from qualitative research. *Health Promotion Journal of Australia*, 19, 118-124.

Czech, B., Krausman, P. R. and Devers, P. K., 2000. Economic Associations among Causes of Species Endangerment in the United States Associations among causes of species endangerment in the United States reflect the integration of economic sectors, supporting the theory and evidence that economic growth proceeds at the competitive exclusion of nonhuman species in the aggregate. *BioScience*, 50(7), 593-601.

de Boer, H. Y., Van Breukelen, L., Hootsmans, M. J. and Van Wieren, S. E., 2004. Flight distance in roe deer Capreolus capreolus and fallow deer Dama dama as related to hunting and other factors. *Wildlife Biology*, 10(1), 35-41.

de Juana, E., 1994. *Family tetraonidae (grouse). Handbook of the Birds of the World: New World Vultures to Guineafowl.* Lynx Edicions, Barcelona, Spain, 401-402.

de Snoo, G. R., Herzon, I., Staats, H., Burton, R. J. F., Schindler, S., van Dijk, J., Lokhorst, A. M., Bullock, J. M., Lobley, M., Wrbka, T., Schwarz. G., and Musters, C. J. M., 2013. Toward effective nature conservation on farmland: making farmers matter. *Conservation Letters*, 6, 66-72.

DEFRA, 2018. *A Green Future: Our 25 Year Plan to Improve the Environment*. British Government, London.

Dhandapani, S., 2015. Neo-liberal capitalistic policies in modern conservation and the ultimate commodification of nature. *Journal of Ecosystem & Ecography*, 5(2), 1-4.

Díaz, S., Pascual, U., Stenseke, M., Martín-López, B., Watson, R.T., Molnár, Z., Hill, R., Chan, K.M., Baste, I.A., Brauman, K.A. and Polasky, S., 2018. Assessing nature's contributions to people. *Science*, 359(6373), 270-272.

Díaz-Siefer, P., Neaman, A., Salgado, E., Celis-Diez, J. L., and Otto, S., 2015. Human-environment system knowledge: A correlate of pro-environmental behavior. *Sustainability*, 7(11), 15510-15526.

Dietz, J.M., Dietz, L.A. and Nagagata, E.Y., 1994. *The effective use of flagship species for conservation of biodiversity: the example of lion tamarins in Brazil*. In Creative conservation (32-49). Springer, Dordrecht.

Do Valle, P. O., Rebelo, E., Reis, E., and Menezes, J., 2005. Combining behavioral theories to predict recycling involvement. *Environment and Behavior*, 37(3), 364-396.

Doherty, T.J. and Clayton, S., 2011. The psychological impacts of global climate change. American *Psychologist*, 66(4), p.265.

Drescher, M., A. H. Perera, C. J. Johnson, L. J. Buse, C. A. Drew, and M. A. Burgman., 2013. Toward rigorous use of expert knowledge in ecological research. *Ecosphere* 4(7), 83.

Duffus, D.A. and Dearden, P., 1990. Non-consumptive wildlife-oriented recreation: A conceptual framework. *Biological Conservation*, 53(3), 213-231.

Dunlop, C.A., 2014. The possible experts: how epistemic communities negotiate barriers to knowledge use in ecosystems services policy. *Environment and Planning C: Government and Policy*, 32(2), 208-228.

Duriez, O., Sachet, J. M., Ménoni, E., Pidancier, N., Miquel, C. and Taberlet, P., 2007. Phylogeography of the capercaillie in Eurasia: what is the conservation status in the Pyrenees and Cantabrian Mounts? *Conservation Genetics*, 8(3), 513-526.

Eagles, P.F., McCool, S.F., Haynes, C.D. and Phillips, A., 2002. *Sustainable tourism in protected areas: Guidelines for planning and management (Vol. 8)*. IUCN, Gland.

Elliott, M. A., and Armitage, C. J., 2009. Promoting drivers' compliance with speed limits: Testing an intervention based on the theory of planned behaviour. *British Journal of Psychology*, 100(1), 111-132.

Ewing, S. R., Eaton, M. A., Poole, T. F., Davies, M. and Haysom, S., 2012. The size of the Scottish population of Capercaillie *Tetrao urogallus*: results of the fourth national survey. *Bird Study*, 59, 126-138.

Fabian, Y., Bollmann, K., Brang, P., Heiri, C., Olschewski, R., Rigling, A., Stofer, S. and Holderegger, R., 2019. How to close the science-practice gap in nature conservation? Information sources used by practitioners. *Biological Conservation*, *235*, 93-101.

Fahrig, L., 2003. Effects of habitat fragmentation on biodiversity. *Annual Review of Ecology, Evolution, and Systematics*, 34, 487-515.

Faria, L.R., 2020. Conservation optimism and reckoning with the future. *Conservation Biology*. Advance online publication, doi: 10.1111/cobi.13601.

Farquhar, J.D., 2012. *Case study research for business*. Sage: London.

Fazey, I., Fazey, J.A., Salisbury, J.G., Lindenmayer, D.B. and Dovers, S., 2006. The nature and role of experiential knowledge for environmental conservation. *Environmental Conservation*, 33(1), 1-10.

Finlay, L., 2002. "Outing" the Researcher: The Provenance, Process, and Practice of Reflexivity. *Qualitative Health Research*, 12(4), 531–545.

Fischer, R. J., 1993. Social desirability bias and the validity of indirect questioning. *The Journal of Consumer Research*, 20, 303-315.

Fishbein, M., and Ajzen, I., 1975. *Belief, Attitude, Intention and Behaviour: An Introduction to Theory and Research*. Addison-Wesley Publishing Company: Reading MA (USA)

Franta, B. and Supran, G., 2017. The fossil fuel industry's invisible colonization of academia. *The Guardian. March*, *13*.

French, D. P., and Cooke, R., 2012. Using the theory of planned behaviour to understand binge drinking: The importance of beliefs for developing interventions. *British Journal of Health Psychology*, 17(1), 1-17.

Frick, J., Kaiser, F.G., and Wilson, M., 2004. Environmental knowledge and conservation behavior: Exploring prevalence and structure in a representative sample. *Personality and Individual Differences*, 37(8), 1597-1613.

Frid, A. and Dill, L. M., 2002. Human-caused disturbance stimuli as a form of predation risk. *Conservation Ecology*, 6(1), 11.

Friedman, M., 2013. How to blame people responsibly. *The Journal of Value Inquiry*, 47(3), 271-284.

Gallagher, K. M., and Updegraff, J. A., 2012. Health message framing effects on attitudes, intentions, and behavior: a meta-analytic review. *Annals of Behavioral Medicine*, 43(1), 101-116.

Game, E. T., Meijaard, E., Sheil, D., & McDonald-Madden, E., 2014. Conservation in a wicked complex world; challenges and solutions. *Conservation Letters*, 7, 271–277.

Game, E.T., Meijaard, E., Sheil, D. and McDonald-Madden, E., 2014. Conservation in a wicked complex world; challenges and solutions. *Conservation Letters*, 7(3), 271-277.

Garlick, B., 2019. Cultural geographies of extinction: Animal culture among Scottish ospreys. Transactions of the Institute of British Geographers, 44(2), 226-241.

Gerber, L.R., DeMaster, D.P. and Roberts, S.P., 2000. Measuring Success in Conservation: Assessing efforts to restore populations of marine mammals is partly a matter of epistemology: How do you know when enough is enough? *American Scientist*, 88(4), 316-324.

Gibson, D., Blomberg, E.J., Atamian, M.T. and Sedinger, J.S., 2015. Observer effects strongly influence estimates of daily nest survival probability but do not substantially increase rates of nest failure in Greater Sage-Grouse. *The Auk: Ornithological Advances*, 132(2), 397-407.

Gilbert, G., Gibbons, D.W. and Evans, J., 1998. *Bird Monitoring Methods: a manual of techniques for key UK species*. RSPB and British Trust for Ornithology.

Gonzalez, M. A., Garcia-Tejero, S., Wengert, E. and Fuertes, B., 2014. Severe decline in Cantabrian Capercaillie *Tetrao urogallus* cantabricus habitat use after construction of a wind farm. *Bird Conservation International*, 26(2), 256.

Gordon, M., 2006. Welcoming confusion, embracing uncertainty: Educating teacher candidates in an age of certitude. *Paideusis*, 15(2), 15-25.

Greenslade, J. H., and White, K. M., 2005. The prediction of above-average participation in volunteerism: A test of the theory of planned behavior and the volunteer's functions inventory in older Australian adults. *The Journal of Social Psychology*, 145(2), 155-172.

Hacker, C.E. and Miller, L.J., 2016. Zoo visitor perceptions, attitudes, and conservation intent after viewing African elephants at the San Diego Zoo Safari Park. *Zoo Biology*, 35(4), 355-361.

Halpenny, E.A., 2010. Pro-environmental behaviours and park visitors: The effect of place attachment. *Journal of Environmental Psychology*, 30(4), 409-421.

Han, Y., and Hansen, H., 2012. Determinants of sustainable food consumption: A meta-analysis using a traditional and a structural equation modelling approach. *International Journal of Psychological Studies*, 4(1), 22.

Hanley, N., Shogren, J. and White, B., 2013. *Introduction to Environmental Economics*. Oxford University Press: Oxford.

Hannush, M.J., 2021. Responsibility (response-ability): the capacity for the acceptance, assumption, and owning of responsibility. In Markers of Psychosocial Maturation (307-314). Palgrave Macmillan, Cham.

Hardin, G., 1968. The tragedy of the commons. *Science*, 162, 1243-1248.

Haysom, S., 2013. *Capercaillie survey methods*. Scottish Natural Heritage, Inverness.

Head, B.W., 2008. Wicked problems in public policy. *Public policy*, 3(2), 101-118.

Head, B.W., 2014. Evidence, uncertainty, and wicked problems in climate change decision making in Australia. *Environment and Planning C: Government and Policy*, 32(4), 663-679.

Head, K. J., and Noar, S. M., 2014. Facilitating progress in health behaviour theory development and modification: The reasoned action approach as a case study. *Health Psychology Review*, 8(1), 34-52.

Heberlein, T. A., 2012. Navigating environmental attitudes. *Conservation Biology*, 26(4), 583-585.

Heck, D.W. and Moshagen, M., 2018. RRreg: An R Package for Correlation and Regression Analyses of Randomized Response Data. *Journal of Statistical Software*, 85(2), 1-29.

Hicks, D., and A. Bord. 2001. Learning about global issues: Why most educators only make things worse. *Environmental Education Research,* 4, 413–25.

Hicks, D., and C. Holden. 2007. Remembering the future: What do children think? *Environmental Education Research,* 13: 501–12.

Hines, J. M., Hungerford, H. R., and Tomera, A. N., 1987. Analysis and synthesis of research on responsible environmental behavior: A meta-analysis. *The Journal of Environmental Education*, 18(2), 1-8.

Hochmair, H.H., Bardin, E. and Ahmouda, A., 2019. Estimating bicycle trip volume for Miami-Dade County from Strava tracking data. *Journal of Transport Geography*, 75, 58-69.

Holmes, A. G. D., 2020. Researcher Positionality--A Consideration of Its Influence and Place in Qualitative Research--A New Researcher Guide. *Shanlax International Journal of Education*, 8(4), 1-10.

Holmes, C. M., 2003. The influence of protected area outreach on conservation attitudes and resource use patterns: a case study from western Tanzania. *Oryx*, 37(3), 305-315.

Hong, J., McArthur, D.P. and Livingston, M., 2018. The evaluation of large cycling infrastructure investments in the Glasgow Clyde Valley planning area before, during, and after the Commonwealth Games: the use of crowdsourced data. *Transportation*, 47, 2859–2872

Howell, A. P., Shaw, B. R., and Alvarez, G., 2014. Bait shop owners as opinion leaders a test of the theory of planned behavior to predict pro-environmental outreach behaviors and intentions. *Environment and Behavior*, 47, 1107-1126

Hsu, S. J., 2004. The effects of an environmental education program on responsible environmental behavior and associated environmental literacy variables in Taiwanese college students. *The Journal of Environmental Education*, 35(2), 37-48.

Hwang, Y. H., Kim, S. I., and Jeng, J. M., 2000. Examining the causal relationships among selected antecedents of responsible environmental behavior. *The journal of environmental education*, 31(4), 19-25.

Ibanez-Alamo, J.D., Sanllorente, O. and Soler, M., 2012. The impact of researcher disturbance on nest predation rates: a meta-analysis. *Ibis*, 154(1), 5-14.

IPBES, 2019. *Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*. S. Díaz, J. Settele, E. S. Brondízio E.S., H. T. Ngo, M. Guèze, J. Agard, A. Arneth, P. Balvanera, K. A. Brauman, S. H. M. Butchart, K. M. A. Chan, L. A. Garibaldi, K. Ichii, J. Liu, S. M. Subramanian, G. F. Midgley, P. Miloslavich, Z. Molnár, D. Obura, A. Pfaff, S. Polasky, A. Purvis, J. Razzaque, B. Reyers, R. Roy Chowdhury, Y. J. Shin, I. J. Visseren-Hamakers, K. J. Willis, and C. N. Zayas (eds.). IPBES secretariat, Germany.

IUCN, 2015. *The IUCN Red List of Threatened Species*. Version 2015-4. <http://www.iucnredlist.org>. Downloaded on 19 November 2015.

Jaye, C., Egan, T. and Parker, S., 2006. 'Do as I say, not as I do': Medical Education and Foucault's Normalizing Technologies of Self. *Anthropology and Medicine*, 13(2), 141-155.

John, F.S., Brockington, D., Bunnefild, N., Duffy, R., Homewood, K., Jones, J.P., Keane, A.M., Milner-Gulland, E.J., Nuno, A. and Razafimanahaka, J.H., 2016. Research ethics: assuring anonymity at the individual level may not be sufficient to protect research participants from harm. *Biological Conservation,* 196, 208–209.

Johnson, C. Y., Bowker, J. M., and Cordell, H. K., 2001. Outdoor recreation constraints: An examination of race, gender, and rural dwelling. *Southern Rural Sociology,* 17, 111-133.

Johnson, R.B. and Onwuegbuzie, A.J., 2004. Mixed methods research: A research paradigm whose time has come. *Educational Researcher*, 33(7), 14-26.

Johnson, R.B., Onwuegbuzie, A.J. and Turner, L.A., 2007. Toward a definition of mixed methods research. *Journal of Mixed Methods Research*, 1(2), 112-133.

Johnston, K. L., and White, K. M., 2003. Binge-drinking: A test of the role of group norms in the theory of planned behaviour. *Psychology and Health*, 18(1), 63-77.

Joint Nature Conservation Committee, 2013. *10th Report by the United Kingdom under Article 12 on the implementation of the Directive on the conservation of wild birds (2009/147/EC) from January 2008 to December 2012*. JNCC, Peterborough.b

Kaiser, F. G., 2006. A moral extension of the theory of planned behavior: Norms and anticipated feelings of regret in conservationism. *Personality and Individual Differences*, 41(1), 71-81.

Kaiser, F. G., Hübner, G., and Bogner, F. X., 2005. Contrasting the theory of planned behavior with the value-belief-norm model in explaining conservation behavior. *Journal of Applied Social Psychology*, 35(10), 2150-2170.

Kasper, D. V., 2009. Ecological habitus: Toward a better understanding of socioecological relations. *Organization and Environment*, 22, 311-326.

Kelbie, P., 2003. *Capercaillie puts a spoke in the wheels of mountain bikers* (June 28), The Independent. Retreived from: www.independent.co.uk

Kelly, C., Glegg, G.A. and Speedie, C.D., 2004. Management of marine wildlife disturbance. *Ocean and Coastal Management*, 47(1-2), 1-19.

Khan, A.S. and Neis, B., 2010. The rebuilding imperative in fisheries: Clumsy solutions for a wicked problem?. *Progress in Oceanography*, 87(1-4), 347-356.

Kinnebrew, E., Shoffner, E., Farah-Pérez, A., Mills-Novoa, M. and Siegel, K., 2020. Approaches to interdisciplinary mixed methods research in land change science and environmental management. *Conservation Biology*. Advance online publication.

Kiss, A., 2004. Is community-based ecotourism a good use of biodiversity conservation funds?. *Trends in ecology & evolution*, 19(5), 232-237.

Kitchin, R., 2014. Big Data, new epistemologies and paradigm shifts. *Big Data and Society*, 1(1), 1-12.

Klaus, S., 1991. Effects of forestry on grouse populations: case studies from the Thuringian and Bohemian forests, Central Europe. *Ornis Scandinavica*, 22(3), 218-223.

Kohn KT, Corrigan JM, Donaldson MS. To Err Is Human: Building a Safer Health System. Washing ton, DC: National Academy Press; 1999

Koleček, J., Schleuning, M., Burfield, I.J., Báldi, A., Böhning-Gaese, K., Devictor, V., Fernández-García, J.M., Hořák, D., Van Turnhout, C.A., Hnatyna, O. and Reif, J., 2014. Birds protected by national legislation show improved population trends in Eastern Europe. *Biological Conservation*, 172, 109-116.

Kortland, K., 2003. Multi-scale forest habitat management for Capercaillie. *Scottish Forestry*, 57(2), 91-96.

Krause, D., Luzzini, D. and Lawson, B., 2018, Building the Case for A Single Key Informant in Supply Chain Management Survey Research. *J Supply Chain Manag*, 54, 42-50.

Krebs, C.P., Lindquist, C.H., Warner, T.D., Fisher, B.S., Martin, S.L. and Childers, J.M., 2011. Comparing sexual assault prevalence estimates obtained with direct and indirect questioning techniques. *Violence Against Women*, 17(2), 219-235.

Krueger, R.A., 2014. *Focus groups: A practical guide for applied research*. Sage publications.

Kurki, S., Nikula, A. R. I., Helle, P. and Linden, H., 1998. Abundances of red fox and pine marten in relation to the composition of boreal forest landscapes. *Journal of Animal Ecology*, 67, 874-886.

Kurki, S., Nikula, A., Helle, P. and Linden, H., 2000. Landscape fragmentation and forest composition effects on grouse breeding success in boreal forests. *Ecology*, 81(7), 1985-1997.

Lam, S. P., 1999. Predicting intentions to conserve water from the theory of planned behavior, perceived moral obligation, and perceived water right. *Journal of Applied Social Psychology*, 29(5), 1058-1071.

Lam, S. P., 2006. Predicting intention to save water: Theory of planned behavior, response efficacy, vulnerability, and perceived efficiency of alternative solutions1. *Journal of Applied Social Psychology*, 36(11), 2803-2824.

Larson, C.L., Reed, S.E., Merenlender, A.M. and Crooks, K.R., 2016. Effects of recreation on animals revealed as widespread through a global systematic review. *PloS one*, 11(12), e0167259.

Laurance, W.F., Koster, H., Grooten, M., Anderson, A.B., Zuidema, P.A., Zwick, S., Zagt, R.J., Lynam, A.J., Linkie, M. and Anten, N.P., 2012. Making conservation research more relevant for conservation practitioners. *Biological Conservation*, *153*, 164-168.

Leape, L.L. and Berwick, D.M., 2005. Five years after To Err Is Human: what have we learned?. *Jama*, 293(19), 2384-2390.

Lewis, S.L. and Maslin, M.A., 2015. Defining the anthropocene. *Nature*, 519(7542), 171-180.

Lincoln, Y.S. and Guba, E.G., 2013. *The constructivist credo*. Left Coast Press.

Liu, J., Dietz, T., Carpenter, S.R., Alberti, M., Folke, C., Moran, E., Pell, A.N., Deadman, P., Kratz, T., Lubchenco, J. and Ostrom, E., 2007. Complexity of coupled human and natural systems. *science*, 317, 1513-1516.

López-Mosquera, N., García, T., and Barrena, R., 2014. An extension of the theory of planned behavior to predict willingness to pay for the conservation of an urban park. *Journal of Environmental Management*, 135, 91-99.

Lynch, J., & Mannion, G., 2021. Place-responsive pedagogies in the anthropocene: Attuning with the more-than-human. *Environmental Education Research*, 27(6), 864–878

Mace, G.M., 2014. Whose conservation? *Science*, 345(6204), 1558-1560.

Mackintosh, C., Griggs, G. and Tate, R., 2018. Understanding the growth in outdoor recreation participation: an opportunity for sport development in the United Kingdom. *Managing Sport and Leisure*, 23(4-6), 315-335.

Mahmud, S. N. D., and Osman, K., 2010. The determinants of recycling intention behavior among the Malaysian school students: an application of theory of planned behaviour. *Procedia-Social and Behavioral Sciences*, 9, 119-124.

Malt, J. M. and Lank, D. B., 2009. Marbled murrelet nest predation risk in managed forest landscapes: dynamic fragmentation effects at multiple scales. *Ecological Applications*, 19(5), 1274-1287.

Mannion, G., 2020 Re-assembling environmental and sustainability education: orientations from New Materialism. *Environmental Education Research*, 26(9-10), 1353-1372

Marzluff, J. M. and Neatherlin, E., 2006. Corvid response to human settlements and campgrounds: causes, consequences, and challenges for conservation. *Biological Conservation*, 130, 301-314.

Mason, T.H., Pollard, C.R., Chimalakonda, D., Guerrero, A.M., Kerr-Smith, C., Milheiras, S.A., Roberts, M., R. Ngafack, P. and Bunnefeld, N., 2018. Wicked conflict: Using wicked problem thinking for holistic management of conservation conflict. *Conservation letters*, 11(6), p.e12460.

Maxwell, J.A., 2016. Expanding the history and range of mixed methods research. *Journal of Mixed Methods Research*, 10(1), 12-27.

McBride, B. B., Brewer, C. A., Berkowitz, A. R., & Borrie, W. T., 2013. Environmental literacy, ecological literacy, ecoliteracy: What do we mean and how did we get here? *Ecosphere*, 4(5), 1–20.

McEachan, R. R. C., Conner, M., Taylor, N. J., and Lawton, R. J., 2011. Prospective prediction of health-related behaviours with the theory of planned behaviour: A meta-analysis. *Health Psychology Review*, 5(2), 97-144.

McFadyen, J. and Rankin, J., 2016. The role of gatekeepers in research: learning from reflexivity and reflection. *GSTF Journal of Nursing and Health Care*, 4(1).

McKenzie-Mohr, D., Lee, D. N., Schultz, P. W., and Kotler, P., 2012. *Social Marketing to Protect the Environment: What Works*. Sage: California.

McNicholas, J., Gilbey, A., Rennie, A., Ahmedzai, S., Dono, J. A., and Ormerod, E., 2005. Pet ownership and human health: a brief review of evidence and issues. The *British Medical Journal*, 331(7527), 1252-1254.

McPherson, M., Smith-Lovin, L., and Cook, J. M., 2001. Birds of a feather: Homophily in social networks. *Annual Review of Sociology*, 27(1), 415-444.

Mercer, J., 2007. The challenges of insider research in educational institutions: Wielding a double-edged sword and resolving delicate dilemmas. *Oxford review of education*, *33*(1), 1-17.

Merton, R. K., 1972. Insiders and Outsiders: A Chapter in the Sociology of Knowledge. *American Journal of Sociology*, 78, 9-47.

Met Office, 2017. https://www.metoffice.gov.uk/about-us/press-office/news/weather-and-climate/2017/a-wet-summer-comes-to-a-close

Mikoláš, M., Svitok, M., Tejkal, M., Leitão, P. J., Morrissey, R. C., Svoboda, M., Seedre, M. and Fontaine, J. B., 2015. Evaluating forest management intensity on an umbrella species: Capercaillie persistence in central Europe. *Forest Ecology and Management*, 354, 26-34.

Miles, M. B., Huberman, A. M. and Saldana, J., 2014. *Qualitative Data Analysis: A Methods Sourcebook*. 3rd edition, California, Sage Publications

Miller, S. G., Knight, R. L. and Miller, C. K., 2001. Wildlife responses to pedestrians and dogs. *Wildlife Society Bulletin*, 29, 124-132.

Monroe, M.C., Plate, R.R., Oxarart, A., Bowers, A. and Chaves, W.A., 2019. Identifying effective climate change education strategies: a systematic review of the research. *Environmental Education Research*, 25(6), 791-812.

Monti, F., Duriez, O., Dominici, J.M., Sforzi, A., Robert, A., Fusani, L. and Grémillet, D., 2018. The price of success: integrative long-term study reveals ecotourism impacts on a flagship species at a UNESCO site. *Animal Conservation*, 21(6), 448-458.

Morrongiello, B.A., Corbett, M. and Bellissimo, A., 2008. " Do as I say, not as I do": Family influences on children's safety and risk behaviors. *Health Psychology*, 27(4), 498.

Moss, R., 1986. Rain, breeding success and distribution of capercaillie *Tetrao urogallus* and black grouse Tetrao tetrix in Scotland. *Ibis*, 128, 65-72.

Moss, R., Leckie, F., Biggins, A., Poole, T., Baines, D. and Kortland, K., 2014. Impacts of human disturbance on capercaillie *Tetrao urogallus* distribution and demography in Scottish woodland. *Wildlife Biology*, 20(1), 1-18.

Moss, R., Oswald, J. and Baines, D., 2001. Climate change and breeding success: decline of the capercaillie in Scotland. *Journal of Animal Ecology*, 70(1), 47-61.

Murphy, J. J., Allen, P. G., Stevens, T. H., and Weatherhead, D., 2005. A meta-analysis of hypothetical bias in stated preference valuation. *Environmental and Resource Economics*, 30(3), 313-325.

Newing, H., Eagle, C., Puri, R.K. and Watson, C.W., 2011. *Conducting research in conservation* (Vol. 775). Oxfordshire: Routledge.

Norman, P. and Pickering, C.M., 2019. Factors influencing park popularity for mountain bikers, walkers and runners as indicated by social media route data. *Journal of environmental management*, 249, 109413.

Nuno, A., Bunnefeld, N. and Milner-Gulland, E.J., 2014. Managing social–ecological systems under uncertainty: implementation in the real world. *Ecology and Society*, 19(2).

Nuno, A., Bunnefeld, N., Naiman, L. C. and Milner-Gulland, E. J., 2013. A novel approach to assessing the prevalence and drivers of illegal bushmeat hunting in the Serengeti. *Conservation Biology*, 27, 1355-1365.

NWCU, 2020. *Current UK Priorities.* [ONLINE] Available at: https://www.nwcu.police.uk/how-do-we-prioritise/priorities/. [Accessed 10 April 2020].

Oakley, J., Watson, G.P., Russell, C.L., Cutter-Mackenzie, A., Fawcett, L., Kuhl, G., Russell, J., van der Waal, M. and Warkentin, T., 2010. Animal encounters in environmental education research: Responding to the “question of the animal”. *Canadian Journal of Environmental Education*, 15, 86-102.

Ojala, M., 2012. Hope and climate change: The importance of hope for environmental engagement among young people. *Environmental Education Research*, 18(5), 625-642.

Okun, M. A., and Sloane, E. S., 2002. Application of planned behavior theory to predicting volunteer enrollment by college students in a campus-based program. *Social Behavior and Personality: an international journal*, 30(3), 243-249.

Ostapczuk, M. and Musch, J., 2011. Estimating the prevalence of negative attitudes towards people with disability: A comparison of direct questioning, projective questioning and randomised response. *Disability and Rehabilitation*, 33(5), 399-411.

Ostrom, E., 2015. *Governing the Commons: The Evolution of Institutions for Collective Action (Canto Classics).* Cambridge: Cambridge University

Otsuka, R. and Yamakoshi, G., 2020. Analyzing the popularity of YouTube videos that violate mountain gorilla tourism regulations. *PloS One*, 15(5), p.e0232085.

Pagel, C.D., Orams, M.B. and Lück, M., 2020. Experienced photographer's behaviour during commercial swim-with-wildlife tours: comparative case studies of three operations in the South Pacific. *Current Issues in Tourism*, Advance online publication.

Patrick, P.G., Matthews, C.E., Ayers, D.F. and Tunnicliffe, S.D., 2007. Conservation and education: Prominent themes in zoo mission statements. *The Journal of Environmental Education*, 38(3), 53-60.

Payne, L. L., Mowen, A. J., and Orsega-Smith, E., 2002. An examination of park preferences and behaviors among urban residents: the role of residential location, race, and age. *Leisure Sciences*, 24(2), 181-198.

Perkins, H. W., Haines, M. P., and Rice, R., 2005. Misperceiving the college drinking norm and related problems: a nationwide study of exposure to prevention information, perceived norms and student alcohol misuse. *Journal of Studies on Alcohol*, 66(4), 470-478.

Persson, K., Andrée, M. and Caiman, C., 2022. Down-to-earth ecological literacy through human and nonhuman encounters in fieldwork. *The Journal of Environmental Education*,. 53:2, 99-116

Picozzi, N., Moss, R. and Catt, D. C., 1996. Capercaillie habitat, diet and management in a Sitka spruce plantation in central Scotland. *Forestry*, 69(4), 373-388.

Pollard, C.R., Redpath, S., Bussière, L.F., Keane, A., Thompson, D.B., Young, J.C. and Bunnefeld, N., 2019. The impact of uncertainty on cooperation intent in a conservation conflict. *Journal of Applied Ecology*, 56(5), 1278-1288.

Pouwels, R., Sierdsema, H., Henkens, R.J. and van Eupen, M., 2017. Harmonizing outdoor recreation and bird conservation targets in protected areas: Applying available monitoring data to facilitate collaborative management at the regional scale. *Journal of environmental management*, 198, 248-255.

Pullin, A.S., Knight, T.M., Stone, D.A. and Charman, K., 2004. Do conservation managers use scientific evidence to support their decision-making? *Biological Conservation*, 119(2), 245-252.

Radford, J., Bosanquet, P., Webster, R. and Blatchford, P., 2015. Scaffolding learning for independence: Clarifying teacher and teaching assistant roles for children with special educational needs. *Learning and Instruction*, 36, 1-10.

Redpath, S.M., Young, J., Evely, A., Adams, W.M., Sutherland, W.J., Whitehouse, A., Amar, A., Lambert, R.A., Linnell, J.D., Watt, A. and Gutierrez, R.J., 2013. Understanding and managing conservation conflicts. *Trends in Ecology and Evolution*, 28(2), 100-109.

Regan, H.M., Ben-Haim, Y., Langford, B., Wilson, W.G., Lundberg, P., Andelman, S.J. and Burgman, M.A., 2005. Robust decision-making under severe uncertainty for conservation management. *Ecological Applications*, 15(4), 1471-1477.

Reid, K.A., Williams, K.J.H. and Paine, M.S., 2011 Hybrid knowledge: place, practice, and knowing in a volunteer ecological restoration project. *Ecology and Society,* 16(3), 19.

Revelle, W., 2018 psych: *Procedures for Personality and Psychological Research*, Northwestern University, Evanston, Illinois, USA, https://CRAN.R-project.org/package=psych Version = 1.8.10.

Richards, D.J. and Kabjian, M.R., 2001. *Improving environmental knowledge sharing. Information Systems and the Environment*. National Academies Press: Washington.

Rintamaki, H., Karplund, L., Linden, H. and Hissa, R., 1984. Sexual differences in temperature regulation and energetics in the capercaillie *Tetrao urogallus*. *Ornis Fennica*, 61(3), 69-74.

Rittel, H.W. and Webber, M.M., 1974. Wicked problems. *Man-made Futures*, 26(1), 272-280.

Rodriguez, C. C., del Mar Rueda Garcia, M. and Cebrian, A., 2015. *Randomized Response Techniques for Complex Surveys*. R package version 0.0.3.

Roebuck, P. and Phifer, P., 1999. The persistence of positivism in conservation biology. *Conservation Biology*, 13(2), 444-446.

Rogers, E.M., 2003. *Diffusion of Innovations*, Fifth edition, New York: Free Press.

Rousell, D., 2021. Cosmopolitical encounters in environmental education: Becoming-ecological in the intertidal zones of Bundjalung national park. *The Journal of Environmental Education*, 52(2), 133–148.

RStudio Team, 2016. *RStudio: Integrated Development for R*. RStudio, Inc., Boston, MA

Sandelowski, M., 1995. Sample size in qualitative research. *Research in nursing & health*, *18*(2), 179-183.

Saniga, M., 2003. Ecology of the capercaillie (*Tetrao urogallus*) and forest management in relation to its protection in the West Carpathians. *Journal of Forest Science*, 49(5), 229-239.

Saniga, M., 2011. Why the capercaillie population (*Tetrao urogallus L.*) in mountain forests in the Central Slovakia decline? *Folia Oecologica*, 38(1), 110.

Sapolsky, R. M., Romero, L. M. and Munck, A. U., 2000. How do glucocorticoids influence stress responses? Integrating permissive, suppressive, stimulatory, and preparative actions. *Endocrine Reviews*, 21(1), 55-89.

Schultz, P. W., 2002 *Knowledge, education, and household recycling: Examining the knowledge-deficit model of behavior change*. In: T. DietzP. Stern. *New tools for environmental protection*. Washington DC: National Academy of Sciences. 67-82.

Schultz, P. W., 2011. Conservation means behaviour. *Conservation Biology*, 25(6), 1080-1083.

Schultz, P. W., Nolan, J. M., Cialdini, R. B., Goldstein, N. J., and Griskevicius, V., 2007. The constructive, destructive, and reconstructive power of social norms. *Psychological Science*, 18(5), 429-434.

Scottish Statutory Intruments (SSI), 2001. *Affecting The Wildlife and Countryside Act 1981 (Amendment) (Scotland) Regulations 2001* Available at: http://www.legislation.gov.uk/ssi/2001/337/contents/made Accesses: 10/11/2015

Seeland, K., Moser, K., Scheuthle, H., and Kaiser, F. G., 2002. Public acceptance of restrictions imposed on recreational activities in the peri-urban Nature Reserve Sihlwald, Switzerland. *Urban Forestry and Urban Greening*, 1, 49-57.

Sheppard, B. H., Hartwick, J., and Warshaw, P. R., 1988. The theory of reasoned action: A meta-analysis of past research with recommendations for modifications and future research. *Journal of Consumer Research*, 15(3), 325-343.

Sieber, J. E. and Stanley, B., 1988. Ethical and professional dimensions of socially sensitive research. *American Psychologist*, 43, 49-55.

Silva, E.A., 2002. Indecision factors when planning for land use change. *European Planning Studies*, 10(3), 335-358.

Simis, M.J., Madden, H., Cacciatore, M.A. and Yeo, S.K., 2016. The lure of rationality: Why does the deficit model persist in science communication? *Public understanding of science*, 25(4), 400-414.

Sirkiä, S., Lindén, A., Helle, P., Nikula, A., Knape, J. and Lindén, H., 2010. Are the declining trends in forest grouse populations due to changes in the forest age structure? A case study of Capercaillie in Finland. *Biological Conservation*, 143(6), 1540-1548.

Sniehotta, F. F., Presseau, J., and Araújo-Soares, V., 2014. Time to retire the theory of planned behaviour. *Health Psychology Review*, 8(1), 1-7.

St John, F. A. V., Edwards-Jones, G., and Jones, J. P. G., 2010. Conservation and human behaviour: lessons from social psychology. *Wildlife Research*, 37, 658-667.

Sterl, P., Eder, R. and Arnberger, A., 2010. Exploring factors influencing the attitude of ski tourers toward the ski touring management measures of the Gesause National Park. *Journal on Protected Mountain Areas Research and Management*, 2, 31-38.

Stern, M.J. and Coleman, K.J., 2015. The multidimensionality of trust: Applications in collaborative natural resource management. *Society and Natural Resources*, 28(2), 117-132.

Stern, P. C., 2000. Toward a coherent theory of environmentally significant behaviour. *Journal of Social Issues.* 56(3): 407-24.

Storch, I. and Segelbacher, G., 2000. Genetic correlates of spatial population structure in central European capercaillie *Tetrao urogallus* and black grouse *T. tetrix*: a project in progress. *Wildlife Biology*, 6(4), 305-310.

Storch, I., 2007. Conservation status of grouse worldwide: an update. *Wildlife Biology*, 13, 5-12.

Storch, I., 2013. Human disturbance of grouse-why and when? *Wildlife Biology*, 19(4), 390-403.

Stravinsky, I., 2000. Writing the wrongs: developing a safe-fail culture in conservation. *Conservation Biology*, 14(6), 1567-1568.

Suarz-Seaone, S. and Garcia-Roves, P., 2004. DFo disturbances in surrounding areas affect a core population of cantabiran capercaillie *Tetrao urogallus cantabricus*? The case of the natural reserve of Muniellos (Asturias, NW Spain). *Ardeola*, 51, 395-409.

Summers, R. W., Dugan, D. and Proctor, R., 2010. Numbers and breeding success of Capercaillies *Tetrao urogallus* and Black Grouse T. tetrix at Abernethy Forest, Scotland. *Bird Study*, 57(4), 437-446.

Summers, R. W., McFarlane, J. and Pearce-Higgins, J. W., 2007. Measuring avoidance by capercaillies *Tetrao urogallus* of woodland close to tracks. *Wildlife Biology*, 13(1), 19-27.

Summers, R. W., Proctor, R., Thorton, M. and Avey, G., 2004. Habitat selection and diet of the Capercaillie *Tetrao urogallus* in Abernethy Forest, Strathspey, Scotland: Capsule Woodland characteristics are important for fully grown birds and for broods. *Bird Study*, 51(1), 58-68.

Suter, W., Graf, R. F. and Hess, R., 2002. Capercaillie (*Tetrao urogallus*) and Avian Biodiversity: Testing the Umbrella-Species Concept. *Conservation Biology*, 16(3), 778-788.

Sutton, S., 1998. Predicting and explaining intentions and behavior: How well are we doing? *Journal of Applied Social Psychology*, 28(15), 1317-1338.

Syed, M., 2019. *Rebel ideas: The power of diverse thinking*. Hachette UK.

Tengö, M., Hill, R., Malmer, P., Raymond, C.M., Spierenburg, M., Danielsen, F., Elmqvist, T. and Folke, C., 2017. Weaving knowledge systems in IPBES, CBD and beyond—lessons learned for sustainability. *Current Opinion in Environmental Sustainability*, 26, 17-25.

Tennøy, A., Hansson, L., Lissandrello, E. and Næss, P., 2016. How planners' use and non-use of expert knowledge affect the goal achievement potential of plans: Experiences from strategic land-use and transport planning processes in three Scandinavian cities. *Progress in Planning*, 109, 1-32.

Thaler, R.H., and Sunstein, C.R., 2009. *Nudge: Improving Decisions About Health, Wealth and Happiness*. London: Penguin Books.

Thiel, D., Jenni-Eiermann, S., Braunisch, V., Palme, R. and Jenni, L., 2008. Ski tourism affects habitat use and evokes a physiological stress response in capercaillie *Tetrao urogallus*: a new methodological approach. *Journal of Applied Ecology*, 45(3), 845-853.

Thiel, D., Jenni-Eiermann, S., Palme, R. and Jenni, L., 2011. Winter tourism increases stress hormone levels in the Capercaillie *Tetrao urogallus*. *Ibis*, 153(1), 122-133.

Thiel, D., Ménoni, E., Brenot, J. F. and Jenni, L., 2007. Effects of recreation and hunting on flushing distance of capercaillie. *The Journal of Wildlife Management*, 71(6), 1784-1792.

Timar, L. and Phaneuf, D.J., 2009. Modeling the human-induced spread of an aquatic invasive: The case of the zebra mussel. *Ecological Economics*, 68(12), 3060-3071.

Toner J., 2009. Small is not too Small: Reflections Concerning the Validity of Very Small Focus Groups (VSFGs). *Qualitative Social Work*. 8(2), 179-192.

Tonglet, M., Phillips, P. S., and Read, A. D., 2004. Using the Theory of Planned Behaviour to investigate the determinants of recycling behaviour: a case study from Brixworth, UK. *Resources, Conservation and Recycling*, 41(3), 191-214.

Tremblay, P., 2001. Wildlife tourism consumption: consumptive or non-consumptive? *The International Journal of Tourism* Research, 3(1), 81.

Van de Walle, S. and Van Ryzin, G.G., 2011. The order of questions in a survey on citizen satisfaction with public services: Lessons from a split-ballot experiment. *Public Administration*, 89(4), 1436-1450.

van den Hout, A., van der Heijden, P. G., and Gilchrist, R., 2007. The logistic regression model with response variables subject to randomized response. *Computational Statistics and Data Analysis*, 51(12), 6060-6069.

van der Ploeg, J., Cauilan-Cureg, M., van Weerd, M. and De Groot, W.T., 2011. Assessing the effectiveness of environmental education: mobilizing public support for Philippine crocodile conservation. *Conservation Letters*, 4(4), 313-323.

Venables, W. N. and Ripley, B. D., 2002. *Modern Applied Statistics with S*. Fourth Edition. Springer, New York.

Vermeir, I., and Verbeke, W., 2008. Sustainable food consumption among young adults in Belgium: Theory of planned behaviour and the role of confidence and values. *Ecological Economics*, 64(3), 542-553.

Verschuuren, J., 2004. *Effectiveness of nature protection legislation in the European Union and the United States: the habitats directive and the endangered species act*. In Cultural landscapes and land use (39-67). Springer, Dordrecht.

Verweij, M., Douglas, M., Ellis, R., Engel, C., Hendriks, F., Lohmann, S., Ney, S., Rayner, S. and Thompson, M., 2006. Clumsy solutions for a complex world: the case of climate change. *Public administration*, 84(4), 817-843.

Vicente-Molina, M.A., Fernández-Sáinz, A. and Izagirre-Olaizola, J., 2013. Environmental knowledge and other variables affecting pro-environmental behaviour: comparison of university students from emerging and advanced countries. *Journal of Cleaner Production*, 61, 130-138.

Vitousek, P.M., 1994. Beyond global warming: ecology and global change. *Ecology*, 75(7), 1861-1876.

Walpole, M.J. and Leader-Williams, N., 2002. Tourism and flagship species in conservation. *Biodiversity and Conservation*, 11(3), 543-547.

Waltner, E.M., Rieß, W. and Mischo, C., 2019. Development and validation of an instrument for measuring student sustainability competencies. *Sustainability*, 11(6), p.1717.

Warner, S. L., 1965. Randomised response: A survey technique for eliminating evasive answer bias. *Journal of the American Statistical Association* 60: 63–69.

Warner, S. L., 1971. The linear randomised response model. *Journal of the American Statistical Association*, 66(336), 884–888.

Waylen, K.A. and Young, J., 2014. Expectations and experiences of diverse forms of knowledge use: the case of the UK National Ecosystem Assessment. *Environment and Planning C: Government and Policy*, 32(2), 229-246.

Weber, M. 1964. *The Theory of Social and Economic Organization*. Translated by A. M. Henderson and Talcott Parsons. London: Collier-Macmillan.

Wechsler, H., Nelson, T. E., Lee, J. E., Seibring, M., Lewis, C., and Keeling, R. P., 2003. Perception and reality: a national evaluation of social norms marketing interventions to reduce college students' heavy alcohol use. *Journal of Studies on Alcohol*, 64(4), 484-494.

Wegge, P. and Rolstad, J., 2011. Clearcutting forestry and Eurasian boreal forest grouse: Long-term monitoring of sympatric capercaillie *Tetrao urogallus* and black grouse *T. tetrix* reveals unexpected effects on their population performances. *Forest Ecology and Management*, 261(9), 1520-1529.

Wegge, P., Rølstad, J. and Gjerde, I., 1992. *Effects of boreal forest fragmentation on capercaillie grouse: empirical evidence and management implications*. In Wildlife 2001: populations (738-749). Springer Netherlands.

White, P. C. L., Vaughan Jennings, J., Renwick, A. R. and Barker, N. H. L., 2005. Questionnaires in ecology: a review of past use and recommendations for best practice. *Journal of Applied Ecology*, 42, 421-430.

White, P.C., Jennings, N.V., Renwick, A.R. and Barker, N.H., 2005. Questionnaires in ecology: a review of past use and recommendations for best practice. *Journal of Applied Ecology*, 42(3), 421-430.

Whittaker, D. and Knight., 1998. Understanding wildlife responses to humans. *Wildlife Society Bulletin*, 26, 312-317.

Wicker, A. W., 1969. Attitudes versus actions: The relationship of verbal and overt behavioral responses to attitude objects. *Journal of Social Issues*, 25(4), 41-78.

Wiegand, T., Revilla, E. and Moloney, K. A., 2005. Effects of habitat loss and fragmentation on population dynamics. *Conservation Biology*, 19(1), 108-121.

Wilkinson, N. I., Eaton, M. A., Marshall, G., and Haysom, S., 2018. The population status of Capercaillie *Tetrao urogallus* in Scotland during winter 2015–16. *Bird Study*, 65(1), 20-35.

Winlow, H., Simm, D., Marvell, A. and Schaaf, R., 2013. Using focus group research to support teaching and learning. *Journal of Geography in Higher Education*, *37*(2), 292-303.

Winter, S., 2017. *Bullish bird that toppled David Attenborough faces road to ruin* (May 15). The Express. Retreived from: www.express.co.uk

Witkowski, T.H. and Reddy, S., 2010. Antecedents of ethical consumption activities in Germany and the United States. *Australasian Marketing Journal*, 18(1), 8-14.

Woods-Ballard, A.J., Parsons, E.C.M., Hughes, A.J., Velander, K.A., Ladle, R.J. and Warburton, C.A., 2003. The sustainability of whale-watching in Scotland. *Journal of Sustainable Tourism*, 11(1), 40-55.

Xiang, Z., Yu, Y., Yang, M., Yang, J., Niao, M. and Li, M., 2011. Does flagship species tourism benefit conservation? A case study of the golden snub-nosed monkey in Shennongjia National Nature Reserve. *Chinese Science Bulletin*, *56*(24), 2553-2558.

Yin, R., 2009. *Case Study Research: Design and Methods*, fourth edition, Thousand Oaks, CA: Sage Publications.

Young, J., Watt, A., Nowicki, P., Alard, D., Clitherow, J., Henle, K., Johnson, R., Laczko, E., McCracken, D., Matouch, S. and Niemela, J., 2005. Towards sustainable land use: identifying and managing the conflicts between human activities and biodiversity conservation in Europe. *Biodiversity & Conservation*, 14(7), 1641-1661.

Young, J.C., Jordan, A., Searle, K.R., Butler, A., Chapman, D.S., Simmons, P. and Watt, A.D., 2013. Does stakeholder involvement really benefit biodiversity conservation? *Biological Conservation*, 158, 359-370.

Young, J.C., Rose, D.C., Mumby, H.S., Benitez-Capistros, F., Derrick, C.J., Finch, T., Garcia, C., Home, C., Marwaha, E., Morgans, C. and Parkinson, S., 2018. A methodological guide to using and reporting on interviews in conservation science research. *Methods in Ecology and Evolution*, 9(1), 10-19.

Young, J.C., Searle, K., Butler, A., Simmons, P., Watt, A.D. and Jordan, A., 2016. The role of trust in the resolution of conservation conflicts. *Biological Conservation*, 195, 196-202.

Zubair, M., and Garforth, C., 2006. Farm level tree planting in Pakistan: the role of farmers' perceptions and attitudes. *Agroforestry Systems*, 66, 217-229.

APPENDICES

APPENDIX I. VISITOR SURVEY

Section 1: Basic Information

Researcher use only
*Group ID:*_____
Time: _____
Location: _____
Researcher: _____

1) **Age:**
   _____ years
2) **Gender**:
   Female □
   Male □
   Other □
3) **Highest level of education:**
   No formal education □
   Primary □
   Secondary □
   Apprenticeship □
   Higher education (college/university) □
4) **Employment status:**
   Full time employment □
   Part time employment □
   Student □
   Retired □
   Unemployed □
5) **Are you a member of a conservation/wildlife group or outdoor sports group?**
   Yes □
   No □
   If yes please state: _____
6) **Are you a resident within the Cairngorms National Park?**
   Yes □
   No □

   If 'no' answer the following:

   a. **For how many years have you been visiting the Cairngorms National Park?**
   _____ years □ First visit

   b. **How long are you staying for on this trip?**

   _____ days

   c. **How many times a year do you visit the Cairngorms National Park?**

   _____ times □ less than once

   d. **How far do you normally travel for a visit to the Cairngorms National Park?**
   _____ miles

7) Please highlight the main reasons for your visit to the Cairngorms National Park <u>today</u> (tick all that apply):

Watching wildlife □
Wildlife photography □
Landscape photography □
General Sightseeing/Just Relaxing □
Walking – high level □
Walking – low level □
Orienteering □
Dog walking □
Camping □
Wild camping □
Climbing / mountaineering □
Cycling / mountain biking □
Horse riding □
Visiting attractions (e.g. castles, museums, distilleries) □
Passing through □
Other (please specify) _____

8) How many adults and children, including yourself, are in your group today?

_____ adults (16+) _____ children (0-15)

9) Do you normally plan the exact route that you will follow before arriving at a specific area within the park when recreating in the woods?

Yes □ No □

Section 2: Knowledge and understanding

1) **Are you familiar with the Scottish Outdoor Access Code?**

   Yes □ No □

   a. **If yes then can you give a brief description of what it says with regards to the rights and responsibilities of the general public?**

   _____
   _____

2) **Are you aware of any rare or endangered species within the Cairngorms National Park?**

   Yes □ No □

   a. **If yes then can you name some of these species?**

   _____

3) **Are you aware that there are capercaillie in the Cairngorms National Park?**

   Yes □ No □

   If no then proceed straight to 'section 3'.

4) **How many capercaillie do you think are living within the Cairngorms National Park?**

   _____ individuals**.**

   Don't know □

   a. **How rare do you think capercaillie are in the UK?**

   Very rare □ Rare □ Common □ Very common □ Don't know □

5) **Are you aware that capercaillie are a threatened species in the UK?**

   Yes □ No □

6) **Where did you learn about capercaillie conservation in the Cairngorms National Park?**

   _____

7) **Are you aware of when you are in sensitive capercaillie habitat?**

   Yes □ No □

   a. **If so then how do you know this?**

   _____

8) **Are you aware of any British or European laws that relate to the disturbance of some ground nesting birds such as capercaillie?**

Yes □ No □

a. **If yes then can you briefly outline what you think these laws say about disturbance of ground nesting birds?**

_____
_____

9) **On a scale of 1-5, where 1 = minimal impact and 5 = life threatening, can you indicate how much impact you believe each of the following activities have on capercaillie populations in capercaillie habitat:**

Activity	How harmful (1-5)
1) Walking on marked trails	
2) Walking off marked trails	
3) Walking a dog on the lead	
4) Walking a dog off the lead	
5) Walking a dog off the lead off marked trails	
6) Mountain biking off marked trails	
7) Wild camping	
8) Skiing/snowboarding	
9) Watersports	
10) Horse riding on marked trails	
11) Deer Stalking	

10) **Can you state why some human activities may be harmful to capercaillie populations?**

_____
_____

11) **During which months do you think capercaillie are most sensitive to disturbance?**

January	□	**July**	□
February	□	**August**	□
March	□	**September**	□
April	□	**October**	□
May	□	**November**	□
June	□	**December**	□

Don't know □

Section 3: Beliefs and attitudes

On a scale of 1 to 5, in which 1 signifies "strongly disagree" and 5 signifies "strongly agree", indicate how you feel about the following phrases:

1) **The majority of people who visit the Cairngorms National Park will often venture off the marked trails.**

Strongly Disagree 1 2 3 4 5 Strongly Agree

2) **The majority of people who visit the Cairngorms National Park with a dog will walk with it off the lead.**

Strongly Disagree 1 2 3 4 5 Strongly Agree

3) **The majority of people visiting the Cairngorms National Park would want others to behave in a pro-environmental manner.**

Strongly Disagree 1 2 3 4 5 Strongly Agree

4) **Witnessing others recreating off marked trails in the woods would make me feel more comfortable to do the same.**

Strongly Disagree 1 2 3 4 5 Strongly Agree

5) **Witnessing others walking a dog off the lead would make me feel more comfortable to do the same.**

Strongly Disagree 1 2 3 4 5 Strongly Agree

6) **There are expectations placed on me as a user of the park to behave in a certain way.**

Strongly Disagree 1 2 3 4 5 Strongly Agree

   a. **These expectations are from other park users.**

Strongly Disagree 1 2 3 4 5 Strongly Agree

   b. **These expectations are from friends and family.**

Strongly Disagree 1 2 3 4 5 Strongly Agree

   c. **These expectations are from park staff.**

Strongly Disagree 1 2 3 4 5 Strongly Agree

7) **It is important to me that others approve of my environmental behaviours.**

Strongly Disagree 1 2 3 4 5 Strongly Agree

8) **It is important to me that individuals act in a pro-environmental manner.**

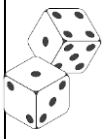
Strongly Disagree 1 2 3 4 5 Strongly Agree

9) On a scale of 1-5 please state how effective (1 being not at all effective and 5 being very effective) you think that each of the following conservation actions would be for protecting capercaillie and how much you would support each of them (1 being no support and 5 being a great deal of support).

Conservation action	**How effective (1=not at all, 5=very effective)**	**How much support (1=no support at all, 5=full support)**
Local education programmes.		
Season sensitive restrictions for keeping dogs on leads in certain woodland areas.		
Season sensitive restrictions for keeping on marked trails at all times in certain woodland areas.		
Signs with information in woodland.		
Do nothing.		

Section 4: Activities during visit

In the following section you will be given a dice to inform each of your answers. This is in order to maximise the anonymity of your answers.



Instructions

Please roll the dice for *each* question separately. If the dice lands on a certain number then answer as stated below. *The first three questions are training questions to help you understand how this is supposed to work.*

1 = 'No'

2-11 = Answer truthfully

12 = 'Yes'

A. Have you ever walked through a woodland?

a. Yes □ No □

B. Do you know how to ride a bicycle?

a. Yes □ No □

C. Have you ever been on a trip to Antarctica?

Yes □ No □

1) During your current visit, have you walked off the marked trails?

Yes □ No □

2) During your visit have you found yourself venturing off a marked trail to view or photograph wildlife including capercaillie?

Yes □ No □

3) Is venturing off the marked trails an important part of how you recreate in the woods?

Yes □ No □

Only answer if you own a dog

4) During your current visit, have you let your dog off the lead?

Yes □ No □

5) During your current visit have you walked your dog off the lead after seeing a sign that required dogs to be on leads?

Yes □ No □

6) Is walking with a dog off the lead an important part of how you recreate in the woods?

Yes □ No □

Only answer if you own a mountain bike

7) During your visit have you been mountain biking through the woods with no marked or official trails?

Yes □ No □

8) Now roll the dice again and write down the number that you rolled.

_____

Did you feel comfortable answering these questions?

_____
_____

Was the process easy to follow and uncomplicated?

_____
_____

Did you feel that your answers to these questions were sufficiently anonymous?

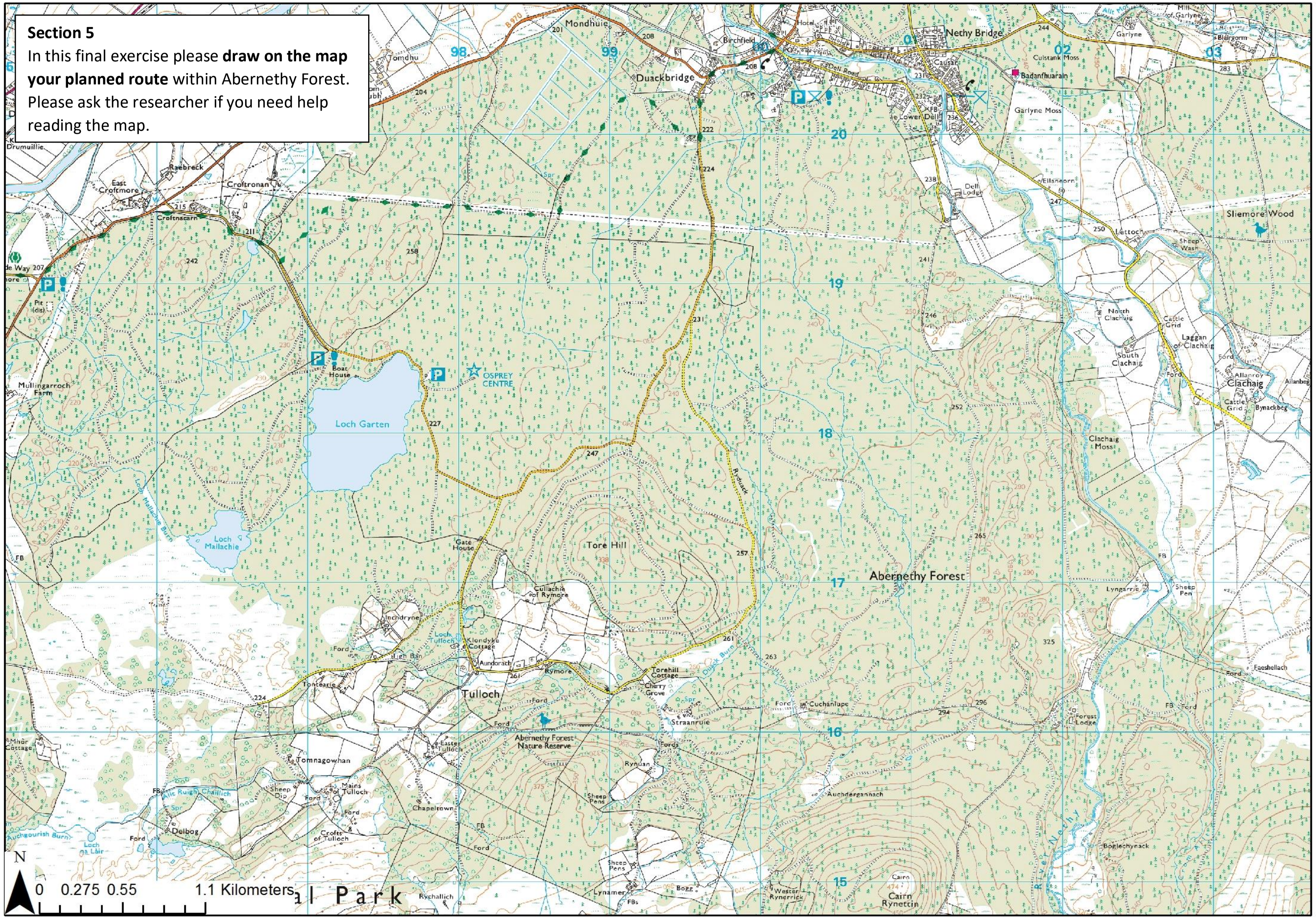
_____
_____

Do you have anything further that you would like to say about recreation, conservation, or protected species in the Cairngorms National Park?

_____
_____
_____
_____

Section 5

In this final exercise please **draw on the map your planned route** within Abernethy Forest. Please ask the researcher if you need help reading the map.



APPENDIX II. SURVEY INFORMATION SHEET AND CONSENT FORM

Outdoor recreation and conservation survey.

Thank you for taking the time to carry out this survey on outdoor recreation and conservation within the Cairngorms National Park. Today we will be asking you about your thoughts and opinions on outdoor recreation and certain conservation initiatives, as well as your own experiences. This survey should take 10-15 minutes to complete. All of your answers to these questions will remain strictly confidential and anonymous with no identifying information being stored. Feel free to stop the survey at any time. If at the end of the survey you do not wish for your answers to be used for research purposes, then the information that you have provided will be erased. Additionally if at a later date you wish to withdraw your consent then email Will Smith at w.r.smith@stir.ac.uk with the unique ID number provided and the data will be erased with no explanation required.

This survey is part of a doctoral research project at the University of Stirling and is funded by the Economic and Social Research and the Council Cairngorms National Park Authority.

Please sign below to state that you understand and agree to the above statements.

Signature

_____

Date

_____

Please take a note of your ID number or a photograph of this front page in case you would like to contact us later on about your survey.

ID number: _____

Contact details

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APPENDIX III: VISITOR SURVEY PILOT

Section 1: Basic Information

Researcher use only
*Group ID:*_____
Time: _____
Location: _____
Researcher: _____

1) **Age:**
   _____ years
2) **Gender**:
   Female □
   Male □
   Other □
3) **Highest level of education:**
   No formal education □
   Primary □
   Secondary □
   Apprenticeship □
   Higher education (college/university) □
4) **Employment status:**
   Full time employment □
   Part time employment □
   Student □
   Retired □
   Unemployed □
5) **Are you a member of a conservation/wildlife group or outdoor sports group?**
   Yes □
   No □
   If yes please state: _____
6) **For how many years have you been visiting the Cairngorms National Park?**
   _____ years
   a. **On average how many times a year do you visit the Cairngorms National Park?**
   _____ times
   b. **How long is your average visit?**
   _____ days
7) **How far do you normally travel for a visit to the Cairngorms National Park?**
   _____ miles
8) **Please highlight the main reasons for your visit to the Cairngorms National Park today (tick all that apply):**
   Watching wildlife □
   Wildlife photography □
   Landscape photography □
   General Sightseeing/Just Relaxing □
   Walking – high level □
   Walking – low level □
   Orienteering □
   Dog walking □
   Camping □
   Wild camping □

Climbing / mountaineering □
Cycling / mountain biking □
Horse riding □
Snow sports □
Visiting attractions (e.g. castles, museums, distilleries) □
Passing through □
Other (please specify) _____

9) How many adults and children, including yourself, are in your group today?

_____ adults (16+) _____ children (0-15)

10) Do you normally plan the exact route that you will follow before arriving at a specific area within the park when recreating in the woods?

Yes □ No □

Section 2: Knowledge

1) **Are you familiar with the Scottish Outdoor Access Code?**

   Yes □ No □

   a. **If yes then can you give a brief description of what it says with regards to the rights and responsibilities of the general public?**

   _____
   _____

2) **Are you aware of any rare or endangered species within the Cairngorms National Park?**

   Yes □ No □

   a. **If yes then can you name some of these species?**

   _____

3) **Are you aware that there are capercaillie in the Cairngorms National Park?**

   Yes □ No □

   If no then proceed straight to 'section 3'.

4) **How many capercaillie do you think are living within the Cairngorms National Park?**

   _____ individuals**.**

   Don't know □

   a. **How rare do you think capercaillie are in the UK?**

   Very rare □ Rare □ Common □ Very common □ Don't know □

5) **Are you aware that capercaillie are a threatened species in the UK?**

   Yes □ No □

6) **Where did you learn about capercaillie conservation in the Cairngorms National Park?**

   _____

7) **Are you aware of when you are in sensitive capercaillie habitat?**

   Yes □ No □

   a. **If so then how do you know this?**

   _____

8) **Are you aware of any British or European laws that relate to the disturbance of some ground nesting birds such as capercaillie?**

Yes □ No □

b. If yes then can you briefly outline what you think these laws say about disturbance of ground nesting birds?

_____
_____

9) On a scale of 1-5, where 1 = minimal impact and 5 = life threatening, can you indicate how much impact you believe each of the following activities have on capercaillie populations in capercaillie habitat:

Activity	How harmful (1-5)
1) Walking on marked trails	
2) Walking off marked trails	
3) Walking a dog on the lead	
4) Walking a dog off the lead	
5) Walking a dog off the lead off marked trails	
6) Mountain biking off marked trails	
7) Wild camping	
8) Skiing/snowboarding	
9) Watersports	
10) Horse riding on marked trails	
11) Deer Stalking	

10) Can you state why some human activities may be harmful to capercaillie populations?

_____
_____

11) During which months do you consider capercaillie are most sensitive to disturbance?

January	□	**July**	□
February	□	**August**	□
March	□	**September**	□
April	□	**October**	□
May	□	**November**	□
June	□	**December**	□

Don't know □

12) Do you feel that the spaces and resources available in the park are sufficient for you to recreate in the way that you prefer without having an impact on wildlife or habitats?

Yes □ No □ Don't know □

a. If no, then please say which space or resource is not sufficient?

_____
_____

b. What would you suggest could be done about this?

_____
_____

Section 3: Beliefs and attitudes

On a scale of 1 to 5, in which 1 signifies "strongly disagree" and 5 signifies "strongly agree", indicate how you feel about the following phrases:

1) **The majority of people who visit the Cairngorms National Park will often venture off the marked trails.**

Strongly Disagree 1 2 3 4 5 Strongly Agree

2) **The majority of people who visit the Cairngorms National Park with a dog will walk with it off the lead.**

Strongly Disagree 1 2 3 4 5 Strongly Agree

3) **The majority of people visiting the Cairngorms National Park would want others to behave in a pro-environmental manner.**

Strongly Disagree 1 2 3 4 5 Strongly Agree

4) **Witnessing others recreating off marked trails in the woods would make me feel more comfortable to do the same.**

Strongly Disagree 1 2 3 4 5 Strongly Agree

5) **Witnessing others walking a dog off the lead would make me feel more comfortable to do the same.**

Strongly Disagree 1 2 3 4 5 Strongly Agree

6) **There are expectations placed on me as a user of the park to behave in a certain way.**

Strongly Disagree 1 2 3 4 5 Strongly Agree

   a. **These expectations are from other park users.**

Strongly Disagree 1 2 3 4 5 Strongly Agree

   b. **These expectations are from friends and family.**

Strongly Disagree 1 2 3 4 5 Strongly Agree

   c. **These expectations are from park staff.**

Strongly Disagree 1 2 3 4 5 Strongly Agree

7) **It is important to me that others approve of my environmental behaviours.**

Strongly Disagree 1 2 3 4 5 Strongly Agree

8) **It is important to me that individuals act in a pro-environmental manner.**

Strongly Disagree 1 2 3 4 5 Strongly Agree

9) On a scale of 1-5 please state how effective (1 being not at all effective and 5 being very effective) you think that each of the following conservation actions would be for protecting capercaillie and how much you would support each of them (1 being no support and 5 being a great deal of support).

Conservation action	**How effective (1=not at all, 5=very effective)**	**How much support (1=no support at all, 5=full support)**
Local education programmes.		
Season sensitive restrictions for keeping dogs on leads in certain woodland areas.		
Season sensitive restrictions for keeping on marked trails at all times in certain woodland areas.		
Signs with information in woodland.		
Do nothing.		

Section 4: Behaviour during visit

In the following section you will be provided with a randomisation device "a dice in a cup" to inform your answers. For each question you will shake the cup to roll the dice. If you roll a 1 then answer "NO" to the question, if you roll a 6 the answer "YES" to the question and if you roll a 2, 3, 4 or 5 then just say what you actually did. This is in order to maximise the anonymity of your answers.

1) **Have you ever walked through a woodland?**

   Yes □ No □

2) **Do you know how to ride a bicycle?**

   Yes □ No □

3) **Have you ever been on a trip to Antarctica?**

   Yes □ No □

4) **During your current visit, have you walked off the marked trails without knowing the potential consequences?**

   Yes □ No □

5) **During your current visit have you walked off the marked trails after seeing a sign asking visitors to stay on marked trails?**

   Yes □ No □

6) **During your current visit have you let your dog off the lead without knowing the potential consequences?**

   Yes □ No □

7) **During your current visit have you walked your dog off the lead after seeing a sign that required dogs to be on leads?**

   Yes □ No □

8) **During your visit have you been mountain biking through the woods with no marked or official trails?**

   Yes □ No □

9) **During your visit have you found yourself venturing off a marked trail to view or photograph wildlife including capercaillie?**

   Yes □ No □

10) **Is walking with a dog off the lead an important part of how you recreate in the woods?**

    Yes □ No □

11) **Is venturing off the marked trails an important part of how you recreate in the woods?**

    Yes □ No □

12) **Do you believe that Capercaillie conservation is a worthwhile goal in the Cairngorms National Park?**

    Yes □ No □

13) Now roll the dice again and write down the number that you rolled.

_____

Did you feel comfortable answering these questions?

_____
_____

Was the process easy to follow and uncomplicated?

_____
_____

Did you feel that your answers to these questions were sufficiently anonymous?

_____
_____

Do you have anything further that you would like to say about recreation, conservation, or protected species in the Cairngorms National Park?

_____
_____
_____
_____

APPENDIX IV. FOCUS GROUP TOPIC GUIDE

- Phase 1
    - Introduction
    - Hi everyone, can I just start by saying thank you for all agreeing to come along today and I'm looking forward to getting started.
    - But before we do there are a few housekeeping matters that I need to address.
        - Toilets
        - Tea and coffee
        - How long it will take and when we plan to finish
        - Ethics
            - Confidentiality
            - Non-traceable
    - Why we are here today?
        - I'm going to present some findings that I'd like to get your opinion on, and also hopefully get a bit of a discussion going about some of the issues in capercaillie conservation.
        - Just for the record, I know it seems formal to have a tape recorder but it's so that I can remember what we've been talking about. To make it a bit easier for the recording just talk to me like I don't know anything about the topic.
    - We'll be breaking our time up today into a number of sections
        - I've got some main questions here that I'd really like to discuss with you all and if there's something that you think should be included in the discussion then please feel free.
        - Firstly I'd like to get an understanding of your thoughts and understandings around recreation and capercaillie conservation.
        - Then I'd like to present to you some of my early results, some of which are fairly straight forward and others perhaps not so much set in stone and can be open to interpretation.
        - Finally it'd be great to have a wider discussion about some of the conflicts and synergies surrounding caper conservation and recreation.
    - Before we get started though can we all introduce ourselves?
        - I'm sure most of you know each other but just in case can you let us know who you are, what your role is, and perhaps a little bit of some of your most recent involvement with caper conservation, especially if it's with people. Just talk to me as though I don't know anything about the topic.

- Phase 2 - Extant understandings of tourism and capercaillie conservation
    - Do you mind if we mind map what each of you think are the biggest threats to caper populations in Scotland?
        - Where does recreation fit into this story?
        - Do you see some groups of recreationists as more of an issue than others?
        - How does anecdotal evidence play a role in conservation planning?
    - Where do you think caper conservation is working well in the park and where do you think there are concerns?

- Phase 3 – survey results
    - What are the implications of my findings on the conservation of capercaillie
        - Do the results from my survey corroborate what you already thought?
        - Do any of these figures surprise you?
    - Do these data sit well with your current perceptions of recreation within the area?
    - Now aside from the estimates of these behaviours I have also carried out some other analysis on the predictors of some of these behaviours.
        - Behaviour
            - Age still a factor
                - No longer gender
            - Awareness significantly predicts peoples engagement in extra trail activity
                - General awareness of rare species in the area discourages people
                - Awareness of capercaillie in particular draws people off the paths
        - Behavioural intent
            - Younger male visitors more likely to find extra trail activity important.
            - This bit I've been struggling with a little bit.
                - My hunch is that:
                    - People who feel like they are influenced by what other people do are more likely to value extra-trail activity.
                        - Perhaps people who recreate together influence each other?
                    - People who think that there are strong social pressures to behave in a certain way in the park are also more likely to value extra-trail activity.
                        - I think it means that the people who are putting across these 'pressures' are those who engage in these kinds of activities.
        - Would you have any examples of cases like these?
    - I'm interested in hearing what your thoughts are with regards to these findings.
        - Do any of these results surprise you at all or find one finding particularly interesting?

- Phase 4 – wider discussion
    - Where does caper conservation and recreation management sit within the recreation-conservation conflict?
    - How do you see capercaillie conservation and recreation management sitting together?
    - Policy
        - Aside from time and resources are there any barriers to effective capercaillie conservation that are rooted in policy?
    - Legislation
        - How does current legislation sit with you in terms of the work you are trying to undertake?
        - To my knowledge nobody has ever been convicted of an offence under the relevant legislation.

        - Why do you think this might be and do you think it is something that should either have more concrete legislation or be more heavily policed?
    - Support from other organisations
    - If funding and time were no object then would there be an ideal plan for capercaillie conservation?
        - What can be done with current restrictions that isn't being done
    - What is conservation for? Why do we conserve fragile species like capercaillie?
    - So, based on everything that we've spoken about so far can we narrow down what we think are the biggest sources of 'conflict' between recreation and conservation of capercaillie and perhaps how some of my survey results may or may not impact the way conservation is implemented?
        - Should we have targeted interventions or are more general messages that target the whole population more appropriate?
    - Final word: Is there anything that you'd like to bring up that hasn't been discussed or something that we have discussed that you think is particularly important?

APPENDIX V. FOCUS GROUP INFORMATION SHEET AND CONSENT FORM

Capercaillie conservation and recreation within the Cairngorms National Park – Focus group

What is this research project about?

These focus groups and participatory mapping exercises are part of a PhD research project being carried out at the University of Stirling looking to improve capercaillie conservation efforts within the Cairngorms National Park. In particular, it is interested in how recreation and capercaillie conservation coincide within the national park and the role that conservation organisations play in decision making and intervention implementation.

What will it involve?

Your participation will involve being part of a small focus group of 3-4 individuals from your organisation. During the focus group you will all take part in a participatory mapping exercise where as a group you will annotate a base map of an area of forest within the Cairngorms National Park alongside a discussion with your colleagues.

Why have I been contacted?

You have been contacted because you work for, or are associated with, a conservation organisation currently operating within the Cairngorms National Park, and your input would be of great value to this research project.

How to I take part?

You can contact me, Will Smith, by email: w.r.smith@hotmail.com, or phone: 07773469531.

When and where will this focus group take place?

The focus group will happen at a date and time that is convenient for you. They will take place either in a private room at you place of work or at the Cairngorms National Park Authority offices in a private function room.

How long will the focus group take?

This focus group and mapping exercise will likely take between 30 minutes to an hour, but may vary slightly.

What will happen to the information I provide during the focus group?

With your consent, the discussions will be recorded and then transcribed, and the data provided by the mapping exercise will be converted into a digital format and further analysed alongside previously collected data on visitor behaviour. All of this will be done by me and no other party will be involved.

The recordings, transcription, mapping data, and consent forms from the focus group will be kept in a secure location at the University of Stirling. You are free to contact me at a later date to request the transcriptions for amendments that you would like to make.

Will my taking part in this study be kept confidential?

Your taking part in this study will be completely private and confidential. All data gathered will be attributed to a pseudonym and no identifying information will be attached to any output from the research.

What if I decide not to take part or if I change my mind?

You do not have to give any data or take part in any discussion that you don't want to and are free to leave the focus group at any time without giving a reason. You can change your mind at any point until 1 January 2018 by contacting Will Smith by email or phone, and all data associated with your part of the focus group will be erased.

What will happen at the end of this research?

The research will contribute to a PhD research project and also result in academic publications.

This research also aims to provide guidance to the Cairngorms National Park Authority on how to effectively manage recreation for capercaillie within the national park. It is hoped that this will improve capercaillie conservation, and conservation efforts for other fragile species in national parks.

Who is organising and funding this research?

This survey is part of a doctoral research project at the University of Stirling and is funded by the Cairngorms National Park Authority and the Economic and Social Research Council.

Contact details

Researcher:

William Smith
W.R.Smith@stir.ac.uk
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FK9 4LA

Faculty contact:

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01786 467691

Primary supervisor:
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Senior lecturer
Faculty of Social Sciences
University of Stirling

Secondary supervisor:
Prof Nils Bunnefeld
Nils.Bunnefeld@stir.ac.uk
Associate professor
School of Biological and Environmental Sciences
University of Stirling

Consent form

By signing this form, you are agreeing to participate in the study outlined in the information sheet provided, and that you understand what your participation entails.

By signing below I agree that:

1. I confirm that I have read the information sheet for the above study and have had the opportunity to ask questions.
2. I understand that I am able to contact the researcher at any point with further questions.
3. I understand that this focus group will be digitally recorded and later transcribed and that I can request a copy of this transcript.
4. I understand that the information I provide will be confidential and anonymous and that any direct quote or information taken from this focus group will not be linked to any identifying information but instead under a pseudonym.
5. I understand that I can request edits to be made to the transcript in order to ensure confidentiality.
6. I agree to take part in the above study.

Please sign below:

Sign

_____

Date

_____

APPENDIX VI. GUEP ETHICAL APPROVAL FORM

General University Ethics Panel (GUEP)

Ethical Approval Form

UNIVERSITY of STIRLING

SECTION A: Applicant details

A1. Name of applicant (principal researcher): William Smith
A2. Email address: w.r.smith@stir.ac.uk
A3. Faculty affiliation: Social Sciences **Division/Research group: Social Surveys and Statistics**
A4. Designation: **Research postgraduate** ☒ **Staff** ☐
A5. RESEARCH POSTGRADUATES ONLY **Programme of study:** PhD sociology **Supervisor name:** Dr Madhu Satsangi, Dr Nils Bunnefeld
A6. STAFF ONLY **Job title:** Click here to enter job title
A7. Details of additional internal applicant(s): **Not applicable** ☒ **Name:** Click here to enter name **Faculty:** Choose Faculty **Division:** Click here to enter text **Post held:** Click here to enter text **Hrs/week on project:** Click here to enter text *Copy and paste the above to add further applicants*
A8. Details of additional external applicant(s): **Not applicable** ☒ **Name:** Click here to enter name **Institution:** Click here to enter text **Post held:** Click here to enter text *Copy and paste the above to add further applicants*
A9. Is ethical review by an external body required? **Yes** ☐ **No** ☒ **If YES, at what stage is this at?** Choose an item
A10. Type of review required: **Light touch** ☐ **Full review** ☒ *Although the GUEP will determine what kind of review is required, you may request a light touch review if you think it is justified. Please refer to the ESRC Framework for Research Ethics for examples of research that would normally require full review.*
A11. Supporting documentation: Please submit all applicable documents with this form: Participant info sheets ☒ Consent forms ☒ Risk assessments ☒ Data collection instruments ☒ Interview schedules or topic guides ☒ Participant recruitment materials ☐ Other ☐ Please specify: Click here to enter text

FOR ADMINISTRATIVE USE ONLY:
Ethics application reference numbers: GUEP/Select year**/**Add unique number**/**Choose review type
Application complete, signed and dated ☐ **Date received by GUEP** Click here to enter a date
Fieldwork risk assessment required ☐ **Date risk assessment completed** Click here to enter a date
GUEP decision **Date** Click here to enter a date
Approved ☐ **Approved subject to minor amendments** ☐ **Major amendments required** ☐ **Rejected** ☐
Requires interim review ☐ **Proposed date of interim review** Click here to enter date **Requires final review** ☐

Details of required amendments/reason for rejection:

Click here to enter text

SECTION B: Project details

B1. Project title: Environmentally sensitive behaviours and capercaillie (*Tetrao urogallus*) conservation in the Cairngorms National Park

B2. Project funder: ESRC/Cairngorms National Park Authority

B3. Project start date: 01/10/2015 | **Project end date:** 01/10/2018

B4. Short project description:

This research project will look to examine the level of awareness amongst visitors to the Cairngorms National Park of capercaillie conservation, and how their levels of awareness and values determine if and when they engage in pre-defined environmentally sensitive or insensitive behaviours in certain areas (Abernethy and Glenmore). This will involve in situ surveys, participatory gis exercises, and elite interviews with conservation staff, policy makers and researchers within the park.
The specific research questions are:
1. What are the current patterns of behaviour and use of space within the Cairngorms National Park in relation to capercaillie conservation?
2. What are the current levels of awareness and values amongst visitors to CNP of capercaillie conservation issues and how does this impact behaviour?
3. How can these behaviours best be influenced to increase capercaillie productivity and what are the most effective methods for doing this?
4. What are the different conservation paradigms amongst conservation groups within the Cairngorms National Park? i. How does this affect how capercaillie conservation initiatives are implemented?

B5. Provide a brief justification for the proposed study:

The western capercaillie (*Tetrao* urogallus) is an iconic ground nesting bird currently resident throughout much of the Palearctic ecozone including areas in Scotland (Picozzi *et al* 1996; Duriez *et al* 2007). The resident population within Scotland has been in severe decline since the 1970's from over 20,000 to just 1200 individuals, 80% of which are confined to the Spey valley in the Cairngorms National Park (Ewing *et al* 2012). These declines have been due to a number of factors such as climate change and habitat loss (Moss 2001). However, further compounding these issues is the impact of human disturbance in the form of extra-trail activities or disturbance from dogs ranging further off marked trails (Storch 2013). This study aims to better understand the current dynamics in the Cairngorms National Park surrounding visitors' recreational behaviour and human disturbance of capercaillie. For a more detailed discussion of capercaillie conservation status see appendix 1.

B6. What are the study's main objectives and expected outcomes?

This study aims to further understand recreationist's behaviours surrounding the conservation of a fragile species. More specifically focusing on ways to improve capercaillie conservation efforts within the cairngorms national park by investigating conservation related behaviours, both beneficial and detrimental. In particular the research will work to inform and address the priorities of the Cairngorms National Park Authority as outlined in the capercaillie framework (CNPA 2015b), namely reducing disturbance of capercaillie from recreational activities and improving the awareness and ownership of a potential flagship species. This research will also look into the socio-political 'landscape' that makes up the different conservation organisations within the national park and how different paradigms and epistemologies effect how capercaillie conservation initiatives are discussed and implemented. This research has broader scope with potential to inform further research into fragile species management and conservation. This research project will further contribute to academic literature by exploring the interface between social sciences and natural sciences, and conservation management.

B7. Does this project involve fieldwork? (see definition)	Yes ☒ No ☐

B8. Please summarise the potential ethical issues and how they will be addressed:

1. The potentially sensitive nature of behavioural data.
Although human disturbance is not thought to directly impact capercaillie productivity it is thought to affect their movement within the habitat showing preference for quiet undisturbed areas and avoiding heavily used tracks. With this in mind the Cairngorms National Park has previously issued a number of signs to encourage individuals to keep dogs on leads and stay on marked trails in certain areas of sensitive woodland. As such, some behaviours, such as recreating off marked trails and letting a dog off the lead in some areas, may be seen by conservationists and some members of the outdoor community as undesirable.
In addition it is stated in section 5 of the Wildlife and Countryside Act (1981) that:
"If any person intentionally – (a) disturbs any wild bird included in schedule 1 while it is building a nest or is in, on or near a nest containing eggs or young; or (b) disturbs dependent young of such a bird, he shall be guilty of an offence and liable to a special penalty."
In this instance capercaillie are in schedule 1. Although this states that disturbing a schedule 1 bird is an offence it is only so if the individual has done so with intent. In addition the data received on visitor behaviour will not in itself be indicative of capercaillie disturbance and only provide data on the behaviours undertaken, and so will provide no evidence of whether a disturbance event (accidental or not) actually occurred at any point.

These data will be collected in two stages. First, data on what behaviours respondents have engaged in will be collected through part of a survey in the form of yes no questions (appendix 2). These data will be fully anonymous with no identifying information being collected at any time in the survey. Also, because these data will be collected using the randomised response technique the respondent will be offered extra security in that the researcher will not know whether their responses are in fact true or not but will gain a more reliable result from the aggregate. All surveys are voluntary and informed consent will be gained through an information sheet at the start of the survey that will state that the respondent has the right to withdraw from the study at any time and contact details of the researcher and project supervisor will be given along with a unique number associated with that particular survey in case the individual later on wished to retract their responses.

The second part of collecting behavioural data will involve the participants being asked to download a smartphone gps application (mapmywalk) and record their route (appendix 3). These gps data will be sent to me via the sharing function in the app after which I can view their route online and download the data.
All identifying information associated with the gps data (email or name) will be removed from the dataset to ensure that no individual could be identified from the working data or the study results. A master copy of raw data will be kept on a password protected USB drive and stored in a locked filing cabinet in the researcher's office.

With these data there is also the potential that the participant may forget to stop their application and have it record their route else where such as home of a place of work. This would only become an issue if the participant then proceeded to send me this route and it was used inadvertently used for analysis. To avoid this becoming an issue, all gps data will be clipped to the study areas, the extent of Abernethy Forest and Glenmore Forest Park, as soon as it is received there for removing any data that may lead elsewhere. Again these individuals will receive an information sheet where they are told that the gps exercise is completely voluntary, that they are free to withdraw at any time and a reassurance of confidentiality. They will also be given the researchers and project supervisors email as a contact to ensure continuing consent and they can request that their data to be withdrawn from the study.

2. The possibility that someone will reveal to me that they have intentionally disturbed a capercaillie (ie committed an offence with regards to section 5 of the Wildlife and Countryside Act 1981)

During the survey there will be no questions that ask about anything that could incriminate individuals with regards to committing an offence as per section 5 of the Wildlife and Countryside Act 1981. This is because I will be asking about visitors' behaviours and not the intent behind those behaviours, whereas an individual is only considered to have committed an offence if they "intentionally – (a) disturbs any wild bird included in schedule 1 while it is building a nest or is in, on or near a nest containing eggs or young; or (b) disturbs dependent young of such a bird". If a respondent says that they have committed an offence of this regard then I will keep their response confidential and anonymous, as with the rest of the data, so long as no harm is being done or due to be done to the individual or the local endangered species. If there is future intent then I will inform the local ranger service of a potential threat without giving any information as to who the respondent is. This is because the ranger service will then be aware of any potentially deleterious behaviour and can react in the way that they deem to be most appropriate, without incriminating the respondent to something that they may not carry out.

B9. Is further scrutiny required at a later date (e.g. where the research design is emergent)?	**Yes ☐** **No ☒**

If YES please provide details

Click here to enter text

B10. Will external contractor be involved (e.g. transcription services, interpreters, fieldworkers)?	**Yes ☒** **No ☐**

If YES comment on their compliance with ethical requirements:

There is the potential for a small number of field workers to be assisting on this project to carry out the surveys. They will receive training in all of the survey methods that will be employed and will be fully informed of the research, and any and all potential ethical issues. They will also be thoroughly familiar with the exact methodological procedure and the ethical guidelines put in place to protect both respondents and researchers. If they do not appear to fully understand these issues and procedures then they will not be invited to take part in the study.

B11. Has this proposal been subject to any external ethical review process?	**Yes ☐** **No ☒**

If YES please provide details:

Click here to enter text

SECTION C: Research involving human participants

C1. Does your research involve human participants? **If YES please answer the following questions. If NO proceed to SECTION D.**	**Yes ☒** **No ☐**

C2. Please provide details of the intended participants:

Who?
Visitors to the Cairngorms National Park who are recreating in Abernethy Forest and Glenmore Forest Park. Also Conservation staff working at the Abernethy and Glenmore sites.

How many?
Visitor Surveys and GPS data: This study will aim to gather between 150 and 200 survey responses from visitors. A previous power analysis has estimated a sample size of 139 would be required so between 150 and 200 should be a large enough sample. A similar number of GPS routes will be gathered.
Park staff interviews and participatory mapping focus groups: Due to the small size of conservation groups within the national park, I will look to interview 3-4 individuals from the RSPB, Forestry Commission, and the Cairngorms National Park Authority. In addition the participatory mapping exercise will consist of three separate focus groups from the three organisations, each with 3-4 individuals.

Identification and recruitment:
The research will be conducted over a number of periods in the capercaillie breeding season and when chicks are still dependent on their mothers (May-September) to line up data collection with when the birds are most susceptible to disturbance events. This is also in line with when the park experiences the highest number of visitors, in particular during July and August (CNPA 2015a).
Visitor Surveys and GPS data: Participants for the visitor survey and GPS exercise will be identified and recruited by employing an in situ purposive sampling approach to identify individuals who would be recreating within the forests of Abernethy or Glenmore. The researcher will be positioned at key 'honeypot' areas where visitors will tend to disperse from to recreate within the forest. These locations will be the Osprey Centre and Forest Lodge in Abernethy, and Glenmore Lodge car park and Glenmore Visitor Centre in Glenmore Forest Park. Participants will be approached by the researcher and invited to take part in the study. There will be a portable table with coffee and tea urns to as a small thank you to participants for taking part.
Park staff interviews and participatory mapping focus groups: Participants for this stage of research will be identified from each of three groups working in conservation within the Cairngorms National Park. These groups will be the RSPB (Abernethy), Forestry Commission (Glenmore) and the Cairngorms National Park Authority (park wide). These individuals will be approached through their respective organisations and will be asked whether they would be interested in participating in an interview and/or a participatory mapping focus group. This has been identified as a suitable way forward after conducting some initial reconnaissance meetings with key informants at these different organisations.
The surveys and GPS exercise will be thoroughly piloted in situ in April 2017. Any consistent feedback regarding respondent experience will be acted upon appropriately and any necessary amendments will be made before data collection takes place.

C3. Does the proposed research involve vulnerable groups? e.g. children under 18, people with learning or communication difficulties, patients, people in custody, people engaged in illegal activities such as drug taking	**Yes ☐** **No ☒**

If YES please provide details:

Click here to enter text

C4. Please detail the methods of data collection:

Survey (appendix 2).
Participants will be approached in situ at one of the study areas and asked if they would like to take part in a confidential, anonymous and voluntary survey. These potential respondents will be given and information sheet and confidentiality form, if they agree to take part in the survey they will sign two forms, one to take away with information about the study, researcher and project supervisor contact information and a unique ID number, and one for the researcher to keep as a record of consent. This survey will be carried out by a researcher in the form of a structured interview and will likely take between 15-20 minutes at the most. These surveys will be carried out on paper and later the data will be transferred onto a spreadsheet. These surveys will gather data on basic respondent information, their history of recreation in the Cairngorms National Park, respondent knowledge of conservation in the park, attitudes and norms the respondents hold regarding conservation and recreation, and their behaviour during their visit through indirect questioning techniques. There will be a mixture of quantitative and qualitative data with the majority being quantitative.
GPS exercise (appendix 3).
Participants will be identified and approached in the same way as with the survey. They will be handed an information booklet with an information sheet about the research, terms of confidentiality and anonymity, and a step by step guide on how to record data and send it to the researcher. Participants will download a free to use smartphone GPS application called 'mapmywalk'. They will follow the instructions on the hand out to create an account, record data, and 'share' their route with the researcher via email stating the activity that they were taking part in. This data can be extracted from the link sent to the researcher in the form of a tcx vecor file containing gps interval data with time stamps. These data will be extracted and stored on a password protected external hard drive in a secure cabinet in the researcher's office. The working data set will not contain any personal or identifying information.
Key informant interviews (appendix 4).
These interviews will be undertaken face to face with the researcher and will be semi-structured following an interview topic guide. Qualitative data will be collected on their previous experience and current role in conservation, their thoughts on recreation and capercaillie conservation within the Cairngorms National Park, and the conservation paradigm they identify with most strongly. These interviews will be digitally recorded and later transcribed by the interviewer. Both the digital recording and transcriptions will be kept in a locked cabinet in the researcher's office. For the working data all identifying information will be removed and a pseudonym will be assigned to each interview.
Participatory mapping focus group (appendix 5, 5.1 and 5.2).
These focus groups will take place with 3 different conservation groups operating in the park (RSPB, Forestry Commission, and Cairngorms National Park Authority), and will consist of 3-4 members involved in capercaillie conservation. The participants will be invited to take part, given an information sheet and confidentiality form. A large A1 basemap of both Abernethy and Glenmore forests will be used. The participants will be asked to discuss and draw on the basemap with marker pens specific areas that are particularly important for capercaillie and other endangered species, areas that are problematic for different user groups, and potential 'sacrificial' areas that could be used to draw attention away from the most sensitive habitat. They will also be encouraged to discuss these points in depth. A digital audio recording will be taken of the exercise and later transcribed. Both the recording and transcriptions will be kept in a locked cabinet in the researcher's office. A photograph of the annotated basemap will be taken and the annotations will be converted into polygon shapefiles in a gis package.

C5. Please give details of procedures for informed consent (including information provided and methods of documenting initial and continuing consent) – consent forms must be attached to the application.

Informed consent will be gained in the surveys (appendix 2) in the form of a signed consent form detailing the conditions of consent with an information sheet attached. Each survey will be assigned a randomly generated unique ID number so that the respondent can get in touch at a later date and request that their data be erased. This is highlighted in the consent form, of which there are two, one for the researcher to keep a record of consent and one for the respondent to take away with researcher and project supervisor contact information.
For the GPS exercise (appendix 3) the participants will be given a booklet that includes a detailed information sheet and conditions of consent, along with a step by step guide to completing the exercise. Due to the nature of data collection whereby a number of information booklets will be given out and not everyone will return data informed consent will be given via email when the respondent shares their data with the researcher. This is all detailed in the conditions of consent, where the respondents are also told that they are free to contact the researcher to request their data be erased at a later date. In addition, the researcher will engage with the respondents before handing out the information booklet to verbally outline the information and conditions of consent, the individual will be asked if they are willing to participate and will only be handed the information booklet if a positive response is given.
The key Informant interviews (appendix 4) and participatory mapping focus group (appendix 5) will include an information sheet and confidentiality form at the beginning which the respondents will be required to sign if the interview/focus group is to go ahead. Again they will be informed that all participation is voluntary and data can be erased at a later date.

All information sheets will contain information regarding the research aims, details of research funders, researcher and project supervisor contact details, conditions of consent, and how the data will be stored. They all state how participation is voluntary and that data can be withdrawn at a later date to be erased.

C6. Please detail the methods of data analysis and data storage (see Guidance on Research Data):

The data collected form the surveys will be transferred into a digital format in an excel spreadsheet. This digital dataset and the original paper surveys will be kept in a secure and locked cabinet in the researcher's office. All survey data will be aggregated into a single dataset, and as a result no data would be attributable to any one person. These data will be analysed using a variety of statistical techniques ranging from simple descriptive graphs to more complex regressions and modelling techniques. The small amount of qualitative data in the surveys will be analysed using thematic analysis, drawing out commonly occurring themes and keywords.

The data collected from the GPS exercise will be downloaded from a link sent by the participant and converted into a workable format for GIS software. This will likely be in GPX or KML format as these file types are recognised by popular GIS packages such as ArcMap or QGIS. All data will be collected in a master file that will be stored on a password protected external hard drive and kept in a secure and locked cabinet in the researcher's office. A working data set will be extracted from the data in this file and will remove any and all identifying information related to the participant such as names or email addresses. These working data will be kept on the researcher's personal computer. Analysis of these data will take on a number of stages. First the data will be imported into a GIS software in the form of line and point data. Following this the data will be split into different subgroups dependant on type of recreation that was undertaken during the visit (mountain bikers, dog walkers, walkers). A 10m buffer will be created to account for any inaccuracies in the GPS data. This GPS data can then be intersected with the buffered path network within the forest to identify on-trail movement and off-trail movement. Density analysis will also be carried out to identify hotspots of areas that are used the most by the different user groups.

Interview data will be collected by notes taken by the researcher during the interview and an audio recording. The recording will be transcribed by the interviewer and both digital recording and transcript will be stored in a secure and locked cabinet in the researcher's office. From the transcribed data a working dataset will be created where all identifying information will be removed and a pseudonym will be used in its place. Analysis of these data will involve coding and a grounded theory approach, this is so

that the coding list will develop alongside and throughout successive stages of analysis. These codes will allow for a narrative to be developed both on an individual and organisational level.

The spatial data produced during the participatory mapping focus groups will be imported into a digital format using a GIS package. This will be analysed with the spatial data collected in the earlier GPS exercise carried out by visitors. These data can be spatially analysed and weighted overlays can be made to create a raster file showing areas of high visitor usage and high conservation priority, as highlighted by the focus groups. The original maps and raw digital data will be kept in a secure and locked cabinet in the researcher's office. Audio data will be processed, stored and analysed in the same way as the data form the elite interviews.

C7. Please detail the measures that will be taken to ensure confidentiality, privacy and data protection:

In the information sheets accompanying all data collection tools will have assurances of strict confidentiality and measures that will be taken to assure anonymity. The aggregation of the survey and GPS data will give full anonymity in any results as any and all identifying information will be removed from the data before analysis. In addition the nature of the indirect questioning techniques used assures further confidentiality and anonymity as not even the researcher/interviewer will know their true response. The only possible identifying information of the GPS exercise would be their email address, this information will only ever be stored by the researcher in a locked cabinet to which no other individual will be given access to. In addition the surveys will not collect identifying information but will instead assign a randomly generated id number to each respondent that they can later use as a reference to have their data erased by contacting the researcher via email or telephone.
The data from the interviews and focus groups will be processed so that no identifying information will be present in the working dataset. All raw data, audio recording and raw transcriptions, will be kept in a secure and locked cabinet in the researchers office at the University of Stirling. No individuals or organisations will be referred to by their name but will instead be given a pseudonym which will be used for results and output from the research. In addition due to the nature of analysis, any quotes used in results or outputs will likely be paraphrased. The participants of this stage of research will be given contact details if they later wish to have their data withdrawn and erased, or if they would like to ask for amendments to be made to what they have said.
Data will be stored by the research for as long as is necessary for research purposes and will be suitably and effectively erased at the end of the study.

C8: How will the results from this study (including feedback to participants) be disseminated?

Results from this study will be presented in a confidential and anonymous format and will encompass a large portion of my PhD thesis. The results will be presented in a number of ways, including a final doctoral thesis, academic publications, and academic presentations. Any individual involved in the research can request any output that contains data provided by them. All findings from this research will be shared with the co-sponsor, the Cairngorms National Park Authority, in an anonymous and confidential format. They will receive no raw data containing personally identifiable information and will receive results and findings in a number of ways such as written papers, presentations, and personally in meetings.

SECTION D: Research involving or impacting on animals

D1. Does your research involve animals?	**Yes** ☐ **No** ☒

If YES please also submit an application to the University AWERB (click here) – these applications can run in parallel.

SECTION E: Data protection, copyright and other considerations

E1. Does the proposed research involve accessing records of personal or confidential information?	**Yes** ☐	**No** ☒
If YES please give details: Click here to enter text		
E2. Does the proposed research involve the recording of participants through the use of audio-visual methods?	**Yes** ☒	**No** ☐
If YES please give details: **Interviews and focus groups will be audio recorded and then transcribed.**		
E3. Does the proposed research involve the remote acquisition of data from or about human participants using the internet and its associated technologies	**Yes** ☒	**No** ☐
If YES please give details: **Yes, collecting GPS data via a free to use smartphone application**		
E4. Does the proposed research involve accessing potentially sensitive data through third parties?	**Yes** ☐	**No** ☒
If YES please give details: Click here to enter text		
E5. Does the proposed research involve reproducing copyrighted work in published form (other than brief citation)?	**Yes** ☐	**No** ☒
If YES please give details: Click here to enter text		
E6. Does the proposed work involve activities which could temporarily or permanently damage or disturb the environment, or archaeological remains and artefacts?	**Yes** ☐	**No** ☒
If YES please give details: Click here to enter text		
E7. Does the proposed work involve a potential conflict of interest or raise ethical issues regarding the source of funding or where publication of research data may be restricted?	**Yes** ☐	**No** ☒
If YES please give details: Click here to enter text		

By signing below (digital signatures accepted), you certify that the information provided is true and correct to the best of your knowledge. Please return your form in Word to guep@stir.ac.uk

RESEARCH POSTGRADUATES

Applicant's signature: **W R Smith** **Date:** 13/03/2017

Supervisor's signature: **Date:** 13/03/2017

STAFF

Applicant's signature: **Date:** Click here to enter a date