Executive Summary:

HUNTING FOR SUSTAINABILITY - Summary

One of the main challenges facing conservation today is how to conserve biodiversity outside protected areas. This is recognised in the new EU Biodiversity Strategy to 2020. We draw on interdisciplinary research across seven countries in Europe and Africa to provide insight on the relationship between hunting and the sustainable management of biodiversity. Hunting is highly relevant to sustainability and the protection of biodiversity because it involves millions of people and hectares of land outside protected areas. Hunting fulfills many social, economic and ecological functions and this is recognised in the 'European Charter on Hunting and Biodiversity'. It is not just carried out for the purpose of sport or provisioning but is central to cultural and social relations in many communities. Although hunting can have negative consequences when a quarry species is over-exploited or is enhanced at the expense of species that compete with it, hunting and the associated management practices can be a force for nature conservation if carried out according to best practice. This is supported by substantial evidence that some non-target species in a hunted habitat can benefit from hunting under the right management conditions. These habitats are also valued by hunters and the public indicating that there are shared values on which to build consensus. In some cases, hunting may actually increase the value of quarry species because it provides revenue to local communities or funds to manage associated habitats. Our work suggests that there may be situations where a sustainable hunting quota, applied to sub-population of a threatened species, can be more effective in developing 'favourable status' than total protection.

Hunting is often considered a controversial topic and those involved in hunting often find themselves in conflict with other parties with different value systems. In order to realize the potential of hunting and hunters as stewards of the landscape we need to overcome the clash between traditional hunting institutions linked to property rights and the more recent environmental policies aimed at promoting the management of land for the benefit of wider society. Conflicts emerge over a variety of issues, including the morality of hunting, the welfare of shot animals, the management of predators or the impact of hunting on rare species. Many of these conflicts are long-standing with no clear path to reconciliation so insights from a variety of disciplines are required to fully understand the conflicts and consider alternative ways of managing them. Current policies for the sustainable management of biodiversity advocate an 'ecosystem approach' which aims to integrate an understanding of the ecology of ecosystems with the benefits it provides to society. Achieving this depends on engaging hunters and land managers at an early stage in order to develop adaptive or co-management strategies that address future challenges. Our results show that in many cases there is a trend for both the environmental lobby and hunters to move away from managing a single resource to the broader perspective of ecosystem or landscape scale management. This approach has the potential to remedy some of the problems related to the current management by overcoming the fragmented management structure where diverse owners (private and public, large- and small-scale) have different and potentially conflicting objectives. There are now effective techniques such as socio-ecological modeling and scenario analysis methods that can be used to bring hunters and environmentalists together to identify common ground and build consensus on the most effective future policies to support human well-being and building the capacity of hunting to safeguard our natural heritage. Our work has investigated the cultural, social and ecological dimensions to provide a more holistic understanding which can underpin new approaches to the sustainable management of our natural resources.

Project Context and Objectives:

Biodiversity underpins human existence on earth through the provision of goods and services for livelihoods and cultural, spiritual and aesthetic benefits. Despite these important functions, biodiversity is under increasing pressure from human activities throughout the world. Current rates of biodiversity loss are unparalleled in historical time despite widespread agreement across governments, non-governmental organisations and a variety of stakeholders over the importance of this issue. To date, the main strategy has been the creation of legally protected areas where biodiversity conservation is prioritized and human impacts are minimized. However, this approach requires large areas of people-free land and the political resources to protect them. Such large areas are increasingly rare globally due to the expansion of human activities. We therefore need to develop approaches to biodiversity conservation that work alongside activities such as farming, forestry and recreation. In other words, conservation objectives need to be integrated with the social, economic and cultural objectives of local people. In recognition of this, Common Agricultural Policy reforms could provide renewed opportunities for conservation in multiple-use landscapes. In addition, demographic and social changes are leading to increasing polarisation between urban and rural viewpoints about the role and use of biodiversity.

In this project we investigate the potential for sustainable use of biodiversity by focussing on an assessment of the social, cultural, economic and ecological values and impacts of hunting. Hunting provides a particularly valuable case study in the sustainable use of biodiversity because globally, it involves millions of people, millions of hectares of land, generates millions of Euros income and occurs across a broad range of ecosystems. Locally, it operates on multiple-use landscapes, cuts across ownership boundaries and involves many stakeholders with diverse management objectives. Hunting has important consequences directly for the harvested species and indirectly for non-target species due to hunting-related management activities. Hunting is an age-old relationship between humans and nature and can therefore act as a conduit for building effective policies for conservation. We use hunting as a lens though which to examine the wider issue of how people interact with biodiversity and seek ways to reconcile conflicts between people over hunting practices.

In the European context, hunting in some form is undertaken across virtually the entire continent, including both member and non-member states, and thus encompasses a wide range of socio-economic, cultural and environmental contexts. Hunting for subsistence – both legally and illegally - and trophy hunting as a form of ecotourism are widely undertaken in the developing world and here we will focus on two African countries as a contrast to Europe. Comparative studies of societies and environments that are very different from one another are useful to identify social and ecological mechanisms of a general nature as well as to develop mitigation strategies that are adapted to different conditions. The overall goal of the project is to assess the social, cultural, economic and ecological functions and impacts of hunting across a broad range of contexts in Europe and Africa. We interpret our findings in relation to current and future EU policy on hunting and biodiversity conservation and, more broadly, for the sustainable use of biodiversity. HUNT is structured into seven work packages across six case study regions in Europe and Africa.

The cultural meaning of Hunting (Work Package 1). Hunting is an extremely important mode of human-nature interaction and is therefore closely linked to cultural patterns and value systems. The objective of this work package is to investigate the meanings attributed to hunting by different social groups in different localities. Research on the wider meaning of hunting for hunters and non-hunters will yield knowledge that is useful for developing effective policy and practical management strategies. Our research has addressed the following issues. 1) The multiple meanings of hunting in

different localities and social groups; 2) Hunting as a driver of social relationships, lifestyles and culture in rural communities; 3) The discourse over why hunting is meaningful, ethical, necessary for management, intrinsic to human nature and what this tells us about general perceptions of human relations to other species; 4) Why are there different 'rules' for the killing of animals in different contexts, and what does this tell us about the meanings, perceptions and values linked to the wider human-nature relationship; 5) Why are certain hunting related practices valued as "indigenous knowledge" by some groups but regarded as cruel by others. Our approach is to use a comparative methodology to identify the social and symbolic functions of hunting in order to better understand how this influences sustainable biodiversity practices. Hunters, landowners, farmers, agencies, conservationists and other stakeholder groups as well as those not involved in, or opposed to, hunting were selected. We will conduct document analysis of texts that deal with hunting from hunters' organizations, environmental organizations, anti-hunting and animal rights groups, as well as from selected media. The insights gained from a better understanding of the cultural basis of hunting attitudes and values will allow us to offer advice on how different actors will respond to environmental and social change.

Institutions and hunting (Work Package 2). HUNT will contribute to a better understanding of how the environment can be governed in an age of globalisation and decentralised decision-making. The objective of this work package is to analyse how institutional arrangements and institutional change influence hunting. Institutions are the set of rules (formal and informal) and decision-making procedures that, in our case, define the practice of hunting, the role of hunters and guide interactions among the hunters in relation to biodiversity conservation. If poorly managed, hunting can lead to biodiversity loss (tragedy of the commons). Our objective is to investigate the barriers to developing effective institutions that can make hunting part of the solution to, rather than part of the cause of, biodiversity loss. International conventions on biodiversity have instigated increasing amounts of conservation policy at both EU and national level which can conflict with anthropocentric values such as hunting. We will investigate how legislation is transformed down the levels (the vertical dimension) and identify the important processes of institutional change that influence hunting. For example, how are European and global conventions translated into national and local regulations and to what extent do these clash with hunting institutions? By understanding this, we can make recommendations for appropriate policies at higher levels. Within an institutional level, for example at the local level (the horizontal dimension), we investigate how hunting is regulated (formally and informally) and how existing institutions foster or hinder hunting. We identify how managers recognise and deal with competing interests and polarised viewpoints and how this affects land management. For example, how does land ownership relate to owners' choices about management for hunting in our case studies? We have developed a joint framework for data collection and analysis, applied to a range of case studies in Europe and Africa. Through this approach, stakeholders in the different systems have been involved in identifying the potential to improve the management of hunting and biodiversity by changing institutional arrangements and developing more integrated policies. This allows us to comment on the likely effectiveness of current and proposed institutional structures at the EU level. At all stages the role of institutions is examined in their cultural, economic and environmental contexts.

Economics and Hunting (Work Package 3). Hunting is an economically important activity. The objective of this work package is to assess the economic importance of hunting and alternative forms of land use at a range of spatial scales. The value of hunting comprises not just the market values (such as the value of bushmeat in Tanzania or the value of grouse shooting lets in Scotland), but also the non-market value of hunting in relation to the habitats and biodiversity that land managed for

hunting produces. Non-market values can be estimated using both stated and revealed preference methods. Preferences are typically informed by more fundamental value-based arguments that capture the importance that individuals assign to procedural aspects of hunting or attributes of the species involved (rarity, endangeredness, or nativeness). Estimates of the values assigned to hunting allow us to compare the social benefits and costs of alternative land management options in a way which includes the implications for biodiversity conservation. It is important to recognise that alternative land management regimes, such as protected areas, often impose opportunity costs on local people by restricting options. Finding ways to accurately estimate these costs of conservation is a challenge, particularly in developing countries. This approach has increased our understanding of the economic value of hunting and wildlife and should help to inform the design and implementation of policy that takes into account the opportunity costs of those suffering losses from changes in land use, and will help guide policy makers in terms of the net social benefits of alternative land uses. A comparison of different disciplinary approaches to the question of the value that people hold for hunting and its alternatives is highly original, and will lead to increased understanding between research disciplines that commonly work in isolation.

Biodiversity and Hunting (Work Package 4). Game species are part of the underlying biodiversity. The extent to which game are managed for hunting varies considerably, from intensively managed private estates to unmanaged, subsistence hunting. First, we will consider what harvesting strategies are employed and build models to quantify the sustainability of these strategies. We develop a modeling approach that is far more powerful for decision-making than standard harvesting models because it addresses the major gap linking individual incentives to hunt in particular ways with manager values. These techniques have been adapted from fisheries to integrate management and biological dynamics into a single modeling framework. These 'operating models' are based on biological processes, the monitoring process, the management rules (e.g. a harvest quota), their implementation by the manager (see also WP2), and the degree of compliance by the harvesters themselves (see also WP1 & 3). In HUNT we have developed a generic operating model for use in hunting applications, and trial it in a range of the case studies to test the robustness of this framework as a tool for sustainable harvest management more broadly. Second, we will examine how game management influences various aspects of wider biodiversity. An argument used in defence of hunting practices has been that hunting supports the conservation of habitats which are beneficial to biodiversity. Whilst there is supporting evidence for this argument, uncontrolled hunting may lead to over harvesting, a change in land use and the loss of associated biodiversity. It may also involve management techniques that negatively affect biodiversity such as the illegal control of some predators or the introduction of non-native species and supplementary feeding in order to increase densities of game. We review current, global literature on the costs and benefits to biodiversity of different game management practices. We then compare biodiversity measures across a range of sites varying in hunting intensity – from conservation areas to areas where hunting is intensively managed. This work allows us to explore the impact of hunting on harvested species and also the cascading impacts of hunting on wider biodiversity, which is crucial for exploring ways in which policies can be developed to effectively conserve biodiversity outside protected areas.

Integration (Work Package 5). The role of hunting management as a conservation tool is increasingly recognised because of its social, cultural and economic and ecological importance and all of these values therefore need to be understood in order to integrate it into policy development. The objectives of this work package are to integrate the findings from the previous four WPs into the European policy context and its broader global application. Conflicts between hunting and conservation are partly due to different perceptions about the relationship between hunting activities and wildlife

conservation, and partly due to conflicts surrounding hunting practices. We will develop conflict reconciliation tools to include novel information from social sciences, economics and ecology (WPs 1-4). We use a Decision Modeling framework to identify how perceptions and perceived barriers to reconciliation vary among stakeholders. By including an understanding of people's motivations and perception of hunting we are developing an understanding of how they will respond to alternative management options and can explore how effective legislation is at producing the desired outcome for biodiversity conservation. In addition, a qualitative cost-benefit analysis framework has been developed to understand who gains and loses, by how much, and the overall impact of alternative management strategies. More specifically, we interpret our findings in relation to the following issues: 1) the management of legally protected predators in game areas; 2) the role of hunting in maintaining wilderness areas and associated biodiversity; 3) the impact of trophy hunting on endangered species and 4) the economic benefits of hunting in comparison to alternative forms of land use. This process will highlight perceptions, barriers and alternative management solutions that can influence trust and understanding within and between key stakeholders and policy makers. We develop a template for best-practice in the use of decision modeling techniques to aid the reconciliation of conflicts over the conservation of biodiversity.

Dissemination Work Package 6). The objective of this work package is to establish effective communication of the results with key stakeholders, policy makers and the wider public. HUNT has engaged with a broad selection of social groups and their governmental and non-governmental representatives. In particular we have focussed throughout the project on engaging with local actors and national level organisations. It is only in the final stages that we are able to synthesise our insights, recommendations and vision for policy makers at the EU level. The controversy surrounding hunting reflects the many interest groups with divergent views and entrenched positions and makes dissemination even more challenging. Target audiences include the scientific community, conservation professionals, interest groups and the wider public. An important conduit for dissemination and discussion about the relevance of our work is the HUNTing for sustainability conference (March 2012, Spain) attended by practitioners, policy makers and academics. As a legacy, we are providing readily accessible information such as policy briefs and popular articles which are all downloadable from our website. Through the website there are also links to a) the academic outputs with summaries and links to journal articles, b) summaries of the results from each cases study in a format accessible to practitioners, mangers and policy makers, and c) a series of best practice documents to share with future interdisciplinary researchers. Also we are publishing a popular book on Hunting which will be available as a download chapter by chapter.

HUNT case study regions.

- Scotland: Focuses on gamebirds and deer management on private and public sector estates in the uplands in relation to hunting related habitat and predator management.
- Norway/Sweden: Focus is on moose, wild reindeer, grouse and large carnivores (bears and lynx) on private and state owned non-agricultural wildlands, boreal forest and alpine tundra.
- Spain: Focus is on game-birds and impacts on non-game species on private and state owned land in relation to hunting management such as predator control and supplementary feeding.
- Croatia/Slovenia: Focuses on trans-boundary brown bear management in forested landscapes
- Ethiopia and Tanzania: Focuses on motivations for bushmeat and sustainability of trophy hunting in and around protected areas.

In each case study we established a National Consultative Group which has been engaged in some of our research activities as well as providing a forum for knowledge exchange.

Project Results:

Introduction.

Across Europe, biodiversity conservation commonly takes place in multiple-use landscapes alongside other activities such as farming, forestry and recreation. In these landscapes the likelihood of achieving biodiversity objectives is closely linked to how well these objectives can be integrated with social, economic and cultural objectives of local people. In this project we investigated the potential for sustainable use of biodiversity by focussing on an assessment of the social, cultural, economic and ecological values and impacts of hunting.

Hunting has provided a valuable case study in the sustainable use of biodiversity because globally, it involves millions of people as participants and beneficiaries, it is undertaken on millions of hectares of land, and it generates millions of Euros income, and involves multiple stakeholders with diverse management objectives. Hunting is also an activity often based on a shared resource that cuts across ownership and administrative boundaries. It occurs across a broad range of ecosystems and has enormous potential to benefit wider biodiversity and therefore act as a conduit for building effective policies for conservation. Hunting has important consequences for biodiversity both through the harvest of game species and the management activities that are undertaken to enhance these harvests. Hunting is deeply embedded in social structures and cultural patterns of a more general nature but it is also controversial and symbolic, playing a key role in the conflicts that characterise natural resource management around the world. Hunting can therefore serve as a focal point for the study of more general aspects of the relationship between humans and nature.

Hunting involves the killing of animals, and this very act leads to tension between different sectors of society. However, the legitimacy of hunting is also affected by many other factors, such as development trends in rural areas and cultural shifts reflecting large-scale societal change. It is essential to grasp such mechanisms in order to mitigate conflicts and ensure the legitimacy of management regimes aimed at sustainable hunting practices. In the European context, hunting in some form is undertaken across virtually the entire continent, including both member and nonmember states and thus encompasses a wide range of socio-economic, cultural and environmental contexts. Hunting for subsistence, both legally and illegally - and trophy hunting as a form of ecotourism are widely undertaken in the developing world and we have focused on two African countries as a contrast to Europe. Comparative studies of societies and environments that are very different from one another are useful in order to identify social and ecological mechanisms of a general nature as well as to develop mitigation strategies that are adapted to different conditions.

To embrace the complexity and multiple dimensions of hunting, the HUNT project addressed hunting from cultural, institutional, economic, and ecological perspectives.

THE CULTURAL MEANING OF HUNTING

Hunting is an extremely important mode of human-nature interaction. However, it is clear that how people think about hunting is closely linked to cultural patterns and value systems. To address hunting merely as an interaction between humans and animals, and manage it accordingly, will therefore miss essential dimensions of hunting as a social practice. In spite of this, hunting in modern societies has received limited attention from the social sciences.

INSTITUTIONAL ASPECTS OF HUNTING

Environmental governance, including the governance of hunting and biodiversity management, is growing increasingly complex, involving multiple actors with multiple interests at multiple levels from international to local. We thus set out to investigate how institutional arrangements and institutional change influence hunting. Institutions are understood here as the 'rules of the game'; both formal and infomral.

THE ECONOMICS OF HUNTING

Economics can help us understand conservation conflicts by quantifying who gains and loses from different management actions, and how large the benefits and costs are to different groups. Economics also helps us design better conservation policy, through modeling the effects of changes in incentives on people's behaviour. Finally, economics provides insights into the drivers of illegal hunting and land management behaviours, whether it be the poisoning of raptors on a Highland sporting estate, or illegal bushmeat hunting by low-wealth households in the Serengeti.

ECOLOGICAL ASPECTS OF HUNTING

Hunting and its associated management can be a strong driver in conserving biodiversity, because many of the objectives in hunting are shared with those of wildlife management and conservation at large. However, sometimes hunting has negative consequences on biodiversity, usually because certain management activities are carried out in unsustainable ways, and these are maintained because of economic or cultural reasons. Additionally, hunting may benefit certain species, but not others, and the overall benefit of hunting for biodiversity and conservation will depend on the relative value that is attached to different animal guilds or species in different contexts.

CASE STUDIES.

The programme of work developed a range of techniques and approaches to explore a rich diversity of case studies in Africa and Europe to capture a contrasting picture of social, cultural, economic and ecological variation within which hunting is conducted. These regions include two in northern Europe (Scotland and Norway/Sweden), one in southern Europe (Spain), one in eastern Europe (Croatia/Slovenia) and two in Africa (Ethiopia and Tanzania). A brief summary of the social, cultural, economic and ecological setting within which this research will be conducted is given below.

Scotland: Hunting is predominantly carried out on large, privately owned estates, where professional hunters (gamekeepers) are employed to manage wildlife harvests. The principal game species are red deer and red grouse in the uplands, and pheasants and roe deer in the lowlands. Deer and grouse are managed wild game, whilst pheasants are generally reared and released prior to shooting. This case study allowed us to investigate how biodiversity varies under differnt land management regimes. Key stakeholders included Game and Wildlife Conservation Trust. Royal Society for the Protection of Birds, Scottish Natural heritage and British Association for Shooting and Conservation.

Norway/Sweden: Here, hunting focuses on the non-agricultural wildlands that are made up of boreal forest and alpine tundra habitats. Hunting rights belong to the landowners who can sell hunting permits but quota setting is closely regulated. Most hunting is focused on wild ungulates, grouse and large carnivores. Scandinavian hunting is motivated largely by the traditional, recreational and meat values of the harvest. Our analyses focusses mainly on a number of representative study areas for which we have access to a range of background data and link these to the national and international institutional framework regulating hunting and biodiversity.

Spain: We focus on two study areas with contrasting situations with respect to biodiversity, Extremadura is a region with renowned biodiversity where as southeastern Castilla-La Mancha is an area where raptor conservation problems are well known. We have investigated how biodiverisy repsonds under different managment practices for gamebird shooting on landholdings in these two areas. Hunting rights belong to landowners who can also invest in a range of related management techniques aimed at increasing gamebird numbers. Existing databases for biodiversity have been augmented with field surveys. Information on management practices such as predator control, disposal of feeding or water points, game crops has been obtained from land managers and we have collected data on the socio-economic aspects of hunting.

Croatia/Slovenia: The focus here is on the forested landscapes that constitute the border between Slovenia and Croatia. This represents one of the most intact assemblages of large mammals in Europe with wolves, bears and lynx all present, along with red deer, roe deer and wild boar. Most of the area is subject to hunting. Hunting clubs rent hunting rights to hunt on public land. Our focus will be on large mammals, especially brown bears, which are hunted as a valuable game species in Croatia, and are controlled under a controversial derogation from the habitats directive in Slovenia. Results from this case study provide evidence to inform the debate on the relative merits of hunting and protection for the conservation of brown bears.

Ethiopia: Ethiopia is a country exceptionally high in biodiversity. However, most wildlife are under threat becasue from a range of causes including habitat loss, bushmeat hunting and subsistence hunting despite the existence of national parks and controlled hunting areas. The human and financial resources for protected area management is low. One source of income is from concession fees and trophy fees in the controlled hunting areas. However, reinvestment of hunting revenue into conservation or development is minimal or absent. Here we investigated a) the cultural drivers of hunting behaviour, b) the institutions around benefits sharing and c) the sustainability of trophy hunting ofr mountina nyala.

Tanzania: In this case we focus on the role and impacts of hunting in the Serengeti which is recognized as home to one of the world's last intact large animal migrations involving in excess of two million ungulates with the largest and most diverse guild of carnivores in Africa. The Serengeti is zoned into i) protected areas allowing only ecotourism, ii) game reserves allowing only trophy hunting and iii) community-based wildlife management areas allowing both trophy hunting and subsistence hunting. Income from ecotourism and trophy hunting supports the managmetn of the protected areas, however, the indigenous population, which is ethnically diverse and includes agro-pastoralists, pastoralists and hunter-gatherers engage in illegal hunting both for subsistence and for commercial sale. We provide some insights to inform more effective policy interventions.

The project was built on three important principles. First, the team developed common research frameworks for each discipline that formed the basis for work in each case study. Second, we invested substantial effort in building capacity across the project partners. Third, we recognised the added

value of integrating research across a range of disciplines within each case study. These principles facilitated integration and led to novel approaches from which new insights are continuing to emerge, as showcased at the a variety of past and forthcoming conferences.

Here, we present the key science and technical findings from the HUNT project in three sections: 1) Techniques, 2) Key findings and 3) Overview.

1. TECHNIQUES

Our interdisciplinary approach recognises that hunting has cultural, institutional, economic and ecological dimensions. Our aim was to develop a better understanding of these components in order to provide insight on the interaction between hunting and biodiversity of relevance to the development of sustainable policy and practice. In this section we summarise a range of techniques drawn from our multidisciplinary approach and outline lessons for best practice.

1. Investigating the cultural meaning of hunting.

Investigating this dimension of hunting requires a qualitative approach. Because of the limited knowledge on this topic we adopted a grounded approach in the sense that we did not presuppose a fixed theoretical framework, but rather identified topics that should be the focus for gathering information using focus groups, in-depth interviews and observation. Exploration of this material then led to identification of productive theoretical tools that could be applied to the analysis of various aspects of the material. This has generated a number of analytical paths or 'sub-projects' we pursued and are reported on in the following section.

In order to coordinate the approach across our case study sites and allow a comparative analysis we developed a common core interview guide. This was adapted locally for the particular situation in each of our national case studies. Essential to this exercise was the capacity building of researchers in each case study to conduct this type of qualitative research. This was facilitated by holding training workshops for colleagues across the consortium run by experienced social scientists. These workshops also allowed us to identify the case study specific issues and barriers and how to overcome these.

We targeted hunters, landowners, farmers, conservationists and other stakeholder groups. We also approached segments of the population that are not involved in hunting. We interviewed representatives of national or regional organizations and sought out activists from groups that were not necessarily present in a given locality, but which have made themselves felt in the struggle over the meaning of hunting, such as animal rights groups.

In some cases, investigating hunting cultures can involve interviewing people who may be engaged in illegal activities. The problem here is that the interviewees may be reluctant to provide responses that reflect what they actually do (this is relevant for both quantitative and qualitative research). This was an obvious challenge in our cultural and economic examinations of illegal bushmeat hunting in our African case studies but also in relation to illegal predator control in some of the European case studies. It is thus important to create the conditions for participants to be as open as possible. This can be facilitated by a) avoiding judgemental (especially negative) statements b) interviewers being seen to be independent and non-partisan and c) responses being anonymous and confidential. The use of local people to conduct the interviews rather than the researchers can substantially increase the

openness of the interviewees. Building on the approach above, we utilised novel quantitative approaches to allow participants to express their preferences and state their behaviours without explicitly admitting to hunting. For example, we used indirect questioning techniques such as the unmatched-count technique (UCT), to assess the prevalence of illegal hunting and identify sociodemographic characteristics of households participating in hunting. This approach had clear advantages over other indirect questioning techniques, as it minimized misunderstandings and confusion among respondents, but increased levels of trust and openness. By ensuring anonymity and minimizing question sensitivity, we increased survey response rates and willingness to report illegal activities.

2.   Investigating the institutions and governance of hunting and wildlife management

The governance of wildlife for hunting is increasingly complex due to a combination of the influence of the global environmental sustainability agenda on regional and national policy and the multiplication of the number of stakeholders who want to have a say in these issues. One key method we utilised in order to investigate how governance in wildlife management interacts with hunting institutions is scenario analysis which is a well-documented and structured methodology. This method deals with the uncertainty and complexity of human-environment problems with a range of players, providing a platform to anticipate the impact on different stakeholders, should certain governance options pursued. Thus, scenarios are not about the likelihood of what will happen in the future, but instead provide the opportunity to evaluate a range of different possible futures. To date this method has not been used in the context of sustainable management of biodiversity

To build capacity across our partners and allow a comparative approach, we instigated project-wide training and pilot trials. Then, for five of our case studies, we explored the consequences of future scenarios for hunting practice. We held a series of workshops with a range of stakeholders with the aim of developing governance options for game management and hunting and evaluating possible and desirable future governance options in a systematic manner.

Our work highlights several key principles that are central for positive stakeholder engagement in research: The workshop setting and structure proved helpful in breaking down problems and confronting challenging issues, and there was evidence that it strengthened stakeholder networks through exchange of information and experience; the workshops provided an environment that allowed stakeholders to discuss scenarios at an abstract level which helped participants to not always toe their official organizational line and therefore explore potential alternative futures without consequence - all 'players' had an equal voice and could consider what they wanted from institutional change; the workshops also provided a platform to anticipate the impact on different stakeholders, should certain governance options be pursued. However, they also highlighted a gap between the language of the scientific community and that of practitioners and industry, which must be overcome in-order to co-construct and disseminate future research. Other issues with the method included dealing with the trade-off between meaningfulness of the process for stakeholder participants and methodological strictness which meant that we had to adapt the approach to each study area.

There were a number of common insights: 1. Because this approach deals with policy implications it is most effective when there is an actual current policy issue or period of uncertainty over institutional change. Timing the activity to such a 'window of opportunity'makes the process more relevant, ensures 'stakeholder buy-in' and increases the influence of any outputs. For example in our study case

Ethiopia, the upcoming revision of the legislation on revenue sharing from hunting provided an excellent 'window of opportunity' to review the governance of revenue sharing and explore the consequences of emerging options. 2. The outputs from the workshops were more likely to be influential if the stakeholders involved represented the broad range of interests and were influential on the policy process. 3. The method succeeded best when the process of co-construction of future scenarios was carried out with trust and transparency.

3.   Investigating people's preferences and values in relation to hunting.

Hunting does not just involve the quarry species but also involves the management of habitats and has impacts on other users of landscapes. We aimed to understand why hunters chose to act like they do and how other stakeholders respond to this. One approach is to use methods from ecological economics which have been used to understand and model the values and choices people make. The main approach we used in HUNT was the choice experiment (CE) method. CE are a stated preference method within a wider group of approaches known as choice modeling. The CE method defines a good (for example, the grouse shooting experience) in terms of its characteristics or attributes, which can take a number of different and often hypothetical values (levels). Respondents are asked to choose between a series of hypothetical choice alternatives where each alternative is a different combination of attribute levels. The choices respondents make indicate which attributes significantly influence their choices, the trade-off rates between the different attributes and implicit prices for each of the non-monetary attributes. Their interpretation is thus both as a relative and an absolute indicator of value. The statistical analysis of choice experiment data is based on the random utility model. We have employed the latest advances in CE analysis, allowing for preference heterogeneity in a number of ways, and using Bayesian efficient experimental designs.CE have recently emerged as a favoured method for non-market valuation due to their considerable flexibility, close links with economic theory and the multiple insights they can provide on the determinants of choice, on marginal values, and on the economic benefits of environmental policy. A key issue which emerged is that there remains considerable tension between the different stakeholders. For example, we wanted to investigate shooters' preferences for the style of game-bird shooting. Although shooters are interested in the number of birds they can shoot, our hypothesis was that they are also paying for other aspects of the experience, including the social, economic and ecological consequences of managing areas for game-bird populations and therefore these other attribute should be valued. To explore this we devised a choice experiment aimed at those involved in hunting. However, the conflict made it particularly difficult to reaching agreement with stakeholders on the design of our surveys, and in recruiting hunters to take part in the choice experiment. Despite considerable effort by members of the project to build bridges and communicate some actors felt they were not sufficiently consulted and therefore questioned both the method and our level of understanding of the system. Consequently, it was difficult to get shooters to respond to the CE, potentially limiting the results.

4.   Integrated social-ecological modeling for sustainable hunting

The management of hunted species is a complex process driven by interactions between the population dynamics of the species, the decision-making and behaviour of stakeholders and uncertainty at various levels of the management process and the natural system. Most harvest management models do not explicitly incorporate the social processes underlying harvester behaviour

and are used to predict optimum management actions to achieve a single objective. This may work when the system is relatively simple and harvesters abide by rules. However, it is more common that harvesting systems involve multiple stakeholders and severe uncertainties making it difficult to advise on a single best harvest policy. Instead, there is a need for an approach that can explore how to achieve management objectives under a range of potential states of the world.

One approach is called Management Strategy Evaluation (MSE), originally developed for fisheries management. It uses simulation models to compare the effect of alternative strategies for example different quotas, in relation to multiple and often conflicting objectives. We have expanded the MSE framework to include individual harvester decision making to make it more suitable for terrestrial conservation. It includes population dynamics model, an observation model (monitoring data) and a management model (quota setting rules). The aim is to understand and take into account the incentives of resource users to make recommendations for conservation. For MSE to be effective it needs to a) incorporate the inherent uncertainty in the dynamics of ecological and economic systems, in our measurement and understanding of these systems and in the devising and implementating rules to control harvesting; b) include knowledge of the motivations of hunters and how their decisions respond to incentives and regulations; c) be co-constructed with hunters, policy makers and researchers in order to model trade-offs between different objectives, and the perspectives of different stakeholders. Engagement should be done before the modelling starts, and throughout the modelling process, so there is a need develop strong collaborations from the start. The MSE approach can readily be integrated within an adaptive management framework so as to guide learning in the real world, but this usually needs more time than that available in a research project.

We explored the use of MSE in a number of cases studies of increasing complexity: For example, for mountain nyala in Ethiopia we have a good understanding of the decision making process used to set the quotas but we have less understanding of the monitoring process and the error in the abundance estimates. In the case of lynx in Norway, they can be in conflict with livestock husbandry and are subject to quota hunting . We have focused on the factors affecting the relationship between management decisions (quotas) and actual harvest off-take, on the appropriateness and accuracy of the current monitoring scheme, as well as the direct effects of harvest on lynx population dynamics. For Partridges in Spain the main uncertainty is the relationship between the number of captive-reared birds released, the sustainable quota for shooting and the estimated abundance of wild birds. Here, we are investigating the decision making process on how many to release, how to set the quota and the role of hunter demand in driving management practices.

5.   Investigating the decision making process

To meet competing demands from natural resources on a global scale, more integrated, ecosystem-based approaches to management are required. This involves recognising and managing trade-offs in order to avoid conflict. Multi-criteria Decision Analysis (MCDA) is a structured decision-support process that can facilitate dialogue between groups with differing interests and incorporate human and environmental dimensions of a conflict. Such an approach can evaluate how well alternative management options fulfill a range of criteria that reflect the values and objectives of stakeholders. The process helps to define the issues, represent the interests of stakeholders, determine their relative priorities, and quantify the effects of those priorities on the suitability of alternative management options in a transparent manner. The method can be flexibly used within a range of participatory approaches and adapted to form an important step in environmental decision making and conflict

resolution. MCDA is therefore a structured and transparent method of breaking down complex problems which, alongside facilitated deliberation, can produce a systematic and visual representation of diverse stakeholder perspectives. The process helps to avoid basing decisions on intuition or bias and can result in more effective and evidence-based strategies. It is increasingly used as a valuable decision-support tool, particularly for aiding negotiation towards management compromise and innovation, although an awareness of the limitations is vital before attempting to apply the technique with stakeholders.

In HUNT, MCDA was used as a framework for explore contrasting land management objectives to inform current policy priorities in Scotland which emphasise the need for an ecosystem approach in order to deliver environmental, economic, social and cultural benefits. However, there is little guidance on how to translate this into sub-regional land management decisions. We used the method with land managers to assess what environmental, social and economic benefits a wide range of current management types deliver. This provided a systematic approach for eliciting and discussing different values, management priorities and trade-offs amongst private, state and NGO land managers. For example, it indicated the trade-offs and synergies between sporting (hunting), biodiversity, carbon and renewable energy priorities in upland Scotland. In our case, the opportunity for structured discussion that MCDA provided emerged as a valued attribute amongst regional and national level participants. F or MCDA outcomes to be useful there should be an appetite for change, a willingness to act on the results and constructive dialogue. There are 6 steps in the MCDA process. 1. Stakeholder engagement. This needs to ensure a fair and balanced representation of individuals and organisations and careful explaining in order to engage participants at the outset. 2. Defining and weighting criteria. Criteria should be drawn from stakeholders directly as well as from policy and research. Each criterion should be clearly defined to avoid ambiguity in understanding the differing views and there needs to be similar numbers of criteria in each of the economic, environmental and social categories to avoid bias towards one particular dimension. 3. Defining management options. These can represent current management types, possible future scenarios or a gradient of management activity and may be co-developed with stakeholders. 4. Multi-criteria evaluation. This is a scoring exercise for each management options against the criteria and requires stakeholders to make trade-offs between multiple values. An iterative process with discussion and opportunities to rescore can improve the search for compromise. 5. Analysis and interpretation of results. Transparency should be maintained and all conclusions and interpretations should draw on discursive interpretation in addition to appropriate statistical analysis. 6. Communication of results. Visual methods are useful for representing uncertainty and managing differences of opinion and can form the basis for negotiating compromise about how to manage trade-offs for use in policy making and environmental planning.

6.   Investigating the winners and losers under different management options.

Conservation conflicts can occur as a result of land use designs, as those who gain from the targeting of land management at certain objectives will differ from those who lose out. Cost-Benefit Analysis (CBA) is a long-recognised and widely-used tool for assessing the social efficiency of policies and projects. It does this by assigning monetary values to benefit and cost flows. Such gains and losses can be both market-and non-market in nature; the latter can be difficult or controversial to value in monetary terms. For this reason, we designed a Qualitative CBA process which would allow stakeholders concerned with the management of upland sporting estates in Scotland to assess the gains and losses of different land management options identified in the Decision Modelling workshops. Using qualitative CBA avoids having to place monetary values on gains and losses, and

allows participants to identify what are counted as costs and benefits. The technique provided a systematic way of representing regional and hierarchical variations in the perceived gains and losses associated with different forms of land management, including various styles of hunting, conservation, forestry and farming. These frameworks provide an improved understanding of and capacity to deal with conflict over multifunctional land-uses by representing the range of priorities held by different stakeholders and their assessment of the capacity of different land-uses to deliver economic, social and environmental benefits, and so contribute to the development of more integrative policy instruments for ecosystem management and conflict resolution.

2.   KEY FINDINGS

Moralities of hunting

Talking about hunting often seems to mean talking about morality: Much of the public debate over hunting revolves around perceptions of moral acceptability of different types of and approaches to hunting. But what exactly is seen as moral, what is seen as a legitimate (or illegitimate) way of hunting? Technically, hunting can be understood as the shooting or killing of wild animals. There are however numerous examples of forms of hunting in which the act of killing itself does not seem to be the key motive for the hunt. If hunting is not primarily represented as the killing or shooting of wild animals, what then characterizes the hunters' ideas of 'true' hunting and 'real' hunters?

Based on interview material from five European and two African countries, we identified what may be termed a moral hierarchy, where motivations such as recreation and excitement are accepted by hunters and non-hunters, but only if the moral imperatives of meat consumption or responsible population control are fulfilled. Differences in evaluations of hunting practices were often not due to fundamental disagreements on moral values, but lay in the question to which degree these were observed in real life.

Norwegian and Scottish data shows that authentic hunters 1) are supposed to show modesty while interacting with their hunting companions, 2) prefer forms of hunting in which the prey has a fair chance to escape, and 3) should act like 'indians'; described as outstanding trackers, one with nature, noiseless and with a profound knowledge of nature. The ideal of holding back the shot is probably one element in the construction of some hunting communities' identity from the inside. It contributes to demarcate their community from the other not-so-authentic hunters.

For many hunters the idea the idea of caring for the wildlife and the land is crucial to their understanding of what hunting is about. The basic thought is that since humans have already interfered with nature; nature also needs to be managed – not only for people's sake, but for nature's own sake. This engagement with wild animals is thought of as part of a deeper unity with nature, which means being part of nature in physical sense. Hunters claim that if humans are to be part of nature, we must also engage with it, e.g. as predators, but also as caretakers, stewards.

The idea of hunters as stewards contributes to the moral justification of hunting, and, importantly, underpins a symbolic appropriation of the land where hunting takes place. Despite differences, hunters and conservationists share many thoughts and values. The idea of stewardship that many hunters nourish, points to a potential platform for increased cooperation between the two groups. This could potentially provide a platform for building a consensus that might prove valuable also from a management viewpoint and help break down conflict.

Access to hunting, and emerging commercialization of hunting that may affect cost and access, are crucial issues in a Scandinavian context, where hunting in principle has been open to everybody at a very low cost. Norwegian hunters who are not landowners often think of themselves as being morally in possession of the land where they hunt. Their attachment to the land is often strong, and their knowledge about their hunting grounds extensive. Moral appropriation of the land, regardless of legal property rights, is a strong factor in collective identity constructions in rural areas. This notion of possession is tied to an emotional belonging that is both widespread and deep. It may create barriers towards outsiders, but at the same time it appears to yield a commitment to stewardship and conservation that could rival that of the legal landowners. However, it may also lead to opposition against the emerging commercialization of hunting that an increasing number of landowners now engage in, and which is currently encouraged by the authorities.

Young hunters and reproduction of working-class culture

We know that hunting is a practice that carries significant cultural meanings. What is the role of the cultural dimension when young people first encounter the world of hunting? Participant observation and interviews with young hunters in two semi-urban areas demonstrated that for some youngsters with a working-class background and working-class occupational prospects, hunting may be an arena for the reproduction of typical working-class culture elements.

The hunting culture these boys meet is typically informal, collective, comprises a certain element of physical masculinity and – not least – it represents a 'productivist' perspective on human relations to nature and entails the mastery of 'tools'. These cultural traits correspond to core elements in a typical male working-class culture. However, economic and social change has eroded its material basis, and reproduction of significant culture elements increasingly takes place in the sphere of leisure. This includes a certain element of 'cultural resistance' against norms and regulations seen as imposed from above and embedded in a dominant middle-class culture, without respect for the practical knowledge of 'ordinary people'. The young hunters contested the ban on lead shot and the protection of raptors, to some extent by taking the law into their own hands.

The finding goes against popular notions of class-less, free-floating identity projects in the so-called post-industrial era. It also shows us that understanding opposition to hunting regulations and dominant norms related to hunting cannot be understood outside a wider cultural context: They are not simply disagreements about technical issues.

Bushmeat hunting in western Serengeti (Tanzania) and the Omo valley (Ethiopia)

Illegal hunting is often addressed by increased law enforcement and the creation of monetary or material incentives. However, informal rules could help to reduce illegal hunting and were explored here. In the recent past, clan-specific social norms worked as taboos and prohibited the hunting of certain species. Also the use of certain techniques was seen to inflict misfortune on the hunter. However, these rules have been eroding for a number of reasons: People need more cash as they move from a subsistence to a market economy, and cultural and ethnic groups are mixing due to local migration, education, increased intermarriage. Traditional religious beliefs are replaced by modern religion, e.g., Christianity, and traditional authorities, such as elders, are not respected anymore.

Informal institutions can be powerful tools to constrain bushmeat hunting, but are vulnerable to social change. As previously active norms might be impossible (or not desirable) to restore, alternative social norms that fit with a modern society should be considered. Conservation interventions should pay attention to those areas where hunting is currently limited due to social norms that are still in place, as these will likely change in the near future.

Bushmeat hunting around Serengeti is usually described as an activity carried out by men, in order to obtain meat and cash. However, interventions that offer alternative means of cash income or protein have often not yet had the expected success. We learnt that women play an important role in bushmeat hunting. While they actively hunt only occasionally, women play a strong indirect role by actively encouraging men to go hunting through a variety of mechanisms. Interventions that aim to address bushmeat hunting should not only focus on men, but also take the role of women into account.

In Ethiopia, women also played an important role in male hunting activities by actively encouraging hunting through a variety of (often ritualised) verbal and non-verbal means. However, the stark decline in wildlife meant that such rituals would nowadays only rarely be carried out. Second, whilst hunting was important to establish relationships between people, it did not seem relevant for developing relationships with nature or wildlife, or developing knowledge about the natural environment. Ironically, this strong focus on social relations might contribute to the disappearance of hunting and its social functions.

Our study raises the question of whether a greater awareness of the social importance of hunting and its likely future demise, partly due to overhunting, might help local people to develop more sustainable hunting practices – for example, to abandon the use of automatic rifles. In any case, the social importance of resource use practices (such as hunting), human-nature relationships and the ways knowledge about the environment is developed, need to be understood to create a meaningful basis for conservation and development interventions.

Large scale policy changes and their impacts on sporting and game management discourses

A large part of the Scottish countryside is traditionally managed for shooting and stalking. However, recent policy changes at both national and European levels reflect an increasing diversity of both public and private land management objectives. This has resulted in the creation of new formal institutions governing land and game management, and the inclusion of actors from both the public sector and NGOs who have previously not had much say in countryside matters.

New institutions governing wildlife management, such as the Convention on Biological Diversity, EU directives and their translation into national policy, seem to have developed in parallel to the formal and informal institutions that have previously governed game management in Scotland. They appear poorly reconciled with existing institutions, such as property rights to the land, and are thus not necessarily effective. Game managers and their organisations consider public interests to be increasingly influential. Some of them feel 'under siege' and see their activities threatened and their rights compromised by growing public claims to the countryside and its wildlife. Game managers argue that recent policies for game management are generated by international, non-local or urban actors who lack 'true' knowledge of the way the countryside works. They contend that they, as game managers, hold the appropriate knowledge – a knowledge that cannot be acquired, e.g., through college studies. However, this line of thinking has an exclusive and irrefutable character: Because

appropriate knowledge cannot be obtained by outsiders, they are by definition not (and will never be) entitled to have a say in countryside matters.

The lack of reconciliation between traditional and more recent institutions combined with a strong discourse that asserts knowledge-based claims of game managers could explain why recent conservation policies have so far had a comparatively limited influence on Scottish land management. Both factors need to be addressed if tensions between sporting and institutionalised conservation are to be resolved.

The multifunctionality of hunting

In many contemporary societies, multiple functions are connected to hunting. Here, we use the concept of multifunctionality to analyse the interactions between these functions, and the interplay between the institutions governing these. Through a comparative analysis in eight study sites in Europe and Africa our study provides insights into the tensions emerging from the multifunctionality of hunting. We investigated differences and similarities between all study cases to assess the complex patterns of institutional interplay.

We found that, increasingly, complex institutional arrangements have developed to reconcile tensions between the multiple functions of hunting that manifest themselves as perceptions of over-hunting (or over-management) or under-hunting. These include, for example, committees, area designations for multifunctionality, and certification schemes. However, these have so far, not necessarily succeeded in addressing multifunctionality. We suggest that the following aspects should be better recognised: 1) Social functions of hunting for local people need to be given more attention, 2) Where institutional systems have developed in parallel – and seem to be neither vertically nor horizontally integrated – they should be actively reconciled, 3) A move from a single-species to an ecosystem approach would contribute to an institutionalisation of the multifunctionality of hunting, game management and other activities, and help to create institutional synergies at the horizontal level, addressing issues of under-hunting, and possibly also over-management, 4) The problem of over-hunting might more appropriately be addressed by (a) a better recognition of the functions of hunting for local people and (b) an improved implementation and enforcement of existing arrangements, such as Wildlife Management Areas.

Managing large ungulates in Europe - the need to address institutional challenges of wildlife management

The management of large ungulates in Europe has received a lot of attention recently, due to the large numbers (>15m) and rapid increases in many of the 20 species that live in European countries. A number of management alternatives have been suggested to tackle this issue, such as the landscape approach via the European Landscape Convention (ELC) or ecosystem management through the Convention of Biodiversity (CBD) are suggested as solutions. The study builds on an institutional analysis of the standards and the operational guidelines of the ELC and the CBD.

The two approaches show many similarities, but differ in their focus on either contextual factors affecting landscapes (ELC) or maintenance of ecosystem processes, functions and services (CBD). The two approaches could be regarded as complementary rather than competing. Although some of

the management problems will be solved through the implementation of these approaches, they do not give any guidance on how to coordinate across scales and levels to generate collective action. Furthermore, complex property rights systems often constrain the required collaboration and coordination among actors involved in the management of wildlife. However, the robustness of the governance arrangements is strongly dependent on voluntary efforts – and thus also to the various incentives of different actors - to establish collective action for the conservation and sustainable use of natural resources.

In conclusion, the implementation of landscape management or ecosystem-based management, as suggested by the ELC and the CBD, will require new institutional solutions to deal with coordination across management units and management levels.

Revenue sharing from wildlife tourism and hunting in Ethiopia

Local people often bear the cost of protected area designations, including controlled hunting areas, as they forego income from alternative land uses. In many places across the world, revenue sharing schemes have thus been developed, based on the assumption that people will support wildlife conservation if they receive tangible benefits from it. We analyse here the governance processes of a scheme that aims to share revenues from trophy hunting and wildlife tourism in Ethiopia.

The revenue sharing scheme was established in 2007, and it was thus too early to assess its impacts on conservation-related attitudes and behaviour All study participants welcomed the scheme and saw it as work in progress. Four areas of the current legislation and implementation practice were seen to require improvement: 1) Information on the detail of the scheme was lacking among many actors; 2) Roles and responsibilities of the actors were imbalanced – district governments were very influential whereas local communities tended to be passive; 3) Accountability was compromised, as limited provisions had been made for monitoring and evaluation, and 4) Disbursement of the shares was usually not associated to hunting or tourism, and overall revenue was too limited to have an impact.

The areas identified for improvement reflected the evaluation criteria for co-management, as presented in the literature. However, one fundamental difference lay in the connection between resource and revenue: While in co-management arrangements, this connection is usually at the centre of community and government activities, a revenue sharing scheme such as the one examined here does not establish a close link between resource use and the amount of revenue disbursed to the different actors. This disconnect constrains the potential positive effect of revenue sharing on resource users' behaviour.

Our analysis of governance processes now informs the government's current revision of legislation and implementation practice. It seems unlikely that the scheme will lead to attitude and behaviour change among the local population in the future, given the missing connection between conservation-relevant behaviours and the amount of revenue distributed. This might be addressed by a turn towards co-management of the protected areas, where responsibility for wildlife is shared between government and local communities. However, at a political level, formalised revenue sharing as in this scheme might help to make the monetary value of wildlife conservation visible, thus providing arguments against land conversion

Challenges associated with introduction of an ecosystem-based management system: A diagnostic analysis of moose management in Sweden.

Swedish moose (Alces alces) management has over the years gone from a situation where open access and unrestricted demands lead to over-exploitation, into a situation characterized by an abundance of moose. Whilst high numbers of moose are preferred by hunters, they damage forests through browsing, causing conflicts between the hunters and forest owners. In attempts to resolve the disputes, the Swedish government is introducing a new local ecosystem-based management system. In this study we focus on how this shift, from managing a single resource to the broader perspective of ecosystem management and discuss to what extent it will contribute to conflict resolution. We used a diagnostic approach to analyse a specific critical case of moose management.

Four key findings emerged: 1) the diagnostic approach has helped us to understand the complex interrelationships between social and biophysical factors at different levels of analysis. This has provided insights into the strengths and weaknesses of the current and new moose management systems in Sweden; 2) the new management system, introducing a new management level covering the ecosystem of a moose population, clearly has the potential to solve problems related to the current mismatch of ecological and social scales arising from the moose being a migratory species and the institutional and organisational patchwork of property units; 3) some problems that are not dealt with appropriately will probably be transferred from the current system to the future one. These problems relate to complex property rights system, representation of hunters and land owners across the whole management system, and the fact that the new management system is a mix between formally regulated management levels (national, regional and ecosystem-based) and voluntary based management (local), and 4) without the establishment of cross-scale linkages based on trust and reciprocity, the new management system will experience the same difficulties as the current system, and will not contribute to resolving conflicts.

In conclusion, the introduction of ecosystem management will possibly remedy some of the problems related to the current management of moose in Sweden. However, the fragmented management structure, where diverse owners (private and public, large- and small-scale) have different and potentially conflicting objectives, is a challenge to the introduction of more holistic and overarching management principles such as the ecosystem approach.

The socio-economics of hunting

Economics of hunting in Scotland. The overall focus of the economics research has been the implications of different ways of managing heather moorland on shooting estates, in terms of the intensity of management. Intensity can be thought of as an index of the effort (inputs) applied to a piece of land or in terms of expected outputs of grouse. Two choice experiments were undertaken with members of the Scottish general public, focusing on the conflict between management of red grouse and conservation of hen harriers. We found out that Scottish citizens are willing to pay for increases in both hen harrier and golden eagle populations on moorland by changes to current management. The majority of respondents wanted a change away from the current means of managing conflicts. In a choice experiment on non-hunting recreational users of one moorland area – the Cairngorms national park – we explored the preferences of visitors for changes in landscape appearance, bird populations and employment on sporting estates. Trade-off rates were calculated for each pair of attributes, and these showed that recreational visitors would be willing to trade off a

reduction in employment on sporting estates for a large enough increase in moorland bird populations. However, other things equal, visitors preferred options which maintained or increased employment.

We then undertook a choice experiment on hunters. We found that the average hunter prefers driven grouse shooting, as opposed to walked-up shooting, more waders rather than a decrease, fewer raptors, and lower prices, but is indifferent to the variations in landscape quality in the experimental design. Using a latent class model to allow for different groups of hunters by preference, we found evidence of 4 such groups in the data. This shows that there exists a significant sub-set of hunters (43% of the sample) who would prefer (and thus be willing to pay for) a less intensive shooting experience with higher wader numbers. Almost all hunters, however, prefer scenarios with fewer raptors, an indication of concern over competition for grouse.

From a policy perspective, the results are of interest as they quantify the general public's willingness to pay for changes in birds associated with moorland, and also indicate that public support would likely follow proposals to reduce negative impacts of land management on biodiversity (and thus would support positive impacts). If PES schemes were introduced on moorlands aimed at increasing biodiversity, this study provides some evidence for the likely economic benefits from such a policy.

Economics of hunting in Tanzania. In Tanzania, we focused on illegal bushmeat hunting in the Western Serengeti. Two stated preference exercises were undertaken. In the first, we surveyed households to investigate their willingness to exchange different livelihood options, including bushmeat hunting, employment and cattle ownership. We also included measures of the risks of illegal hunting. We were able to quantify the rates at which the average household would be willing to exchange a reduction in the time spent hunting per year for increases in cattle, wages from outside employment and access to micro-credit schemes. However, we also found important variation in the attitudes to risk and in the value of a week's hunting across households. One factor explaining this variation was household wealth. The policy implication is that a range of factors need to be taken into account in designing interventions to reduce illegal hunting, including the need for reliable alternative sources of income. Interventions will also need to be differentiated across households for maximum effectiveness.

A second stated preference exercise modeled households as buyers of illegally-hunted bushmeat, and investigated the likely effects on their buying behaviour of (i) increases in the price of bushmeat and (ii) reductions in the price of two protein substitutes, namely chicken and fish. Our results quantify the likely reductions in household bushmeat demand through changes in either the own price of bushmeat or in the price of substitutes. For example, we found that a 1% change in bushmeat price leads to a decrease in the quantity of bushmeat demanded roughly equal to 0.7-0.9%. A 1% decrease in fish price is associated with 0.4% decline in the quantity demanded for bushmeat, while a 1% decrease in chicken is related to a decrease of bushmeat demanded of about 0.3%. This suggests that either alternative protein source could be promoted as an alternative to bushmeat.

Economics of hunting in Spain. In Spain, a hedonic price exercise looked at the determinants of market prices for a day of red-legged partridge hunting experience. It was found that there is no significant difference between the price for a hunting day of farm-bred partridge and a hunting day of wild partridge, thus reflecting some equilibrium in the market. Since the average number of partridge hunted in a typical day tends to be higher when the birds are farm-bred, results are according to expectations and to the focus groups conducted, i.e. that hunters value a wild partridge more than farm-bred one.

A second study was conducted in Spain, involving a choice experiment survey among hunters, to explore the implicit value of some characteristics of the partridge hunting estates. Results suggest that the average maximum willingness to pay (WTP) for hunting an additional farm-reared partridge was of near 10 euro in 2012 values (9.95 euro). However, the marginal WTP for hunting a wild-stock partridge rose to circa four times more (38.72 euro). The difference in WTP for a walked-up shooting day with or without the opportunity of hunting other game, like rabbit or hare, for example, is estimated in 177 euro. Hunters would like to pay relatively more for a day in a hunting estate of central Spain that contains Mediterranean scrub (ca. 140 euro for a day). In contrast, the WTP for a site that contains important non-game fauna is near three times less: 55 euro. Results are potentially useful to estate managers and policy makers with an especial interest on nature conservation.

Economics of hunting in Croatia. A Croatian application, consisting of a hedonic price exercise for bear hunting trophies, was conducted in 2011. Among other things, results show that, on average, hunters from outside Croatia spend 135 euro extra per bear hunted than the Croatian nationals. Also, hunters are more likely to spend more money if the hunting unit is strong in complying with legality aspects and facilitates the documentation for exporting the trophy, which tend to increase the WTP of the hunters in some 60 euro per bear.

Gamebird management and biodiversity.

We reviewed the literature to assess the impact of gamebird management on biodiversity and conducted research to explore these relationships across gradients of management intensity in Scotland and Spain.The literature review revealed that many management practices that are implemented to benefit game bird yields are positive or benign for non-game biodiversity, but there are clear exceptions including illegal predator control and release of exotic species for hunting, and more data are required to fully understand the trade-offs.

Our research in the Scottish uplands showed that overall bird species richness nor diversity was strongly influenced by upland management objectives (red grouse shooting, deer stalking, sheep production, or conservation), management activities (prescribed burning, predator control), nor estate habitat diversity. However, bird community structure was significantly affected by management for red grouse shooting and prescribed burning. Ground nesting birds tended to be associated with estates managed for red grouse shooting and on those estates that carried out more prescribed burning, whereas, for example, Corvid spp tended to tended to be associated with non-grouse estates. The implications of these results is that there is no one type of managment that maximises biodiveristy but differnt managmetn objectives are associated with differnt speices. Therfore, a diversity of managment approaches can lead to maximising biodiversity at a landscape scale.

Estates dedicated to small game (mainly red-legged partridges) in the Iberian Peninsula are mainly farmland areas mixed with varying degree of natural vegetation areas. Management carried out to benefit partridges includes provision of supplementary food and water, predator control, the provision of game crops, or the release of farm-reared partridges. Our studies have shown that: 1) in central Spain the commercialization of hunts is associated with more intensive management and to estates with a higher proportion of natural vegetation, thought to be associated with higher nature value in farmland areas; 2) in Portugal, areas managed for hunting contained higher densities of birds of conservation concern, higher densities of steppe birds and other ground-nesting species than areas not managed for hunting of similar habitats. They also contained higher densities of partridges and

rabbits, which in turn was reflected in higher raptor densities, although raptor abundance was proportionally lower than expected in those estates with higher gamekeeper densities, which suggested that illegal control could be occurring; 3) in central Spain, supplementary food benefited granivorous steppe birds like sandgrouse, and fox control benefitted non-granivourous steppe birds like little bustards. Management, notably of habitat and supplementary food were reflected in higher partridge densities, which in turn were associated with higher raptor richness, but not densities.

Small-scale partridge releases were apparently inefficient at increasing partridge abundance or bags, but large-scale partridge releases, such as those carried out in intensive estates, although having a direct positive impact on harvest and thus estate economics, were negatively associated with steppe bird abundance or raptor diversity, suggesting lower biodiversity value of that type of management.

Broadly, our results suggest that, in Iberian farmland, game management activities (in particular, habitat management, predator control or food enhancement) directed at wild red-legged partridges have positive effects on other farmland birds of conservation concern. However, these benefits disappear when management is intensive and based on large-scale releases of farm-reared partridges. Thus in commercial red-legged partridge estates there is a tension between the need to balance economic sustainability with environmental sustainability.

Social-ecological modelling for improved sustainability of hunting across divergent systems

Making conservation decisions to benefit species, habitats and people is challenging due to the complexity and the limited knowledge that characterises interlinked, social-ecological systems. We developed a new approach for modelling the sustainability of interventions in social-ecological systems that extends an existing framework from fisheries science and makes it more appropriate for situations with multiple interventions, multiple users and compliance challenges. This makes the framework more appropriate for many small-scale terrestrial systems in developing countries, more easily integrated into adaptive management and very flexible.

Bear hunting in Croatia/Slovenia. People respond to changes in the management of wildlife with changes in their attitudes towards these species, especially if they are hunted and cause conflicts; a more centralised bear management led to more support for limiting bear numbers but overall attitudes remained positive due to the bear's cultural importance, and associated use and bequest values. Economic analysis of stakeholders for the same case study shows that joining the EU in 2013, which will stop trophy hunting, will result in economic losses for bear managers. This suggests that hunting will not be economically viable and this might lead to lower compliance and thus higher poaching rates. The change from a hunted to a protected bear population might threaten a so far socially and ecologically sustainable hunting system.

We revisited the habitat selection of brown bears in Slovenia and Croatia in relation to natural and human dominated features in the landscape. Proximity to supplemental feeding stations and availability of large forest patches (> 5000 hectares) were the best predictors of brown bear habitat selection. Feeding stations are shared with red deer, another important species for hunting, but the future of these feeding stations is uncertain without income from brown bear trophy hunting. Without feeding stations, brown bear might roam more widely which might increase levels of conflicts with local people.

Mountain nyala hunting in Ethiopia. The quality and quantity of information (e.g. monitoring) determines the ability to make informed decisions. Our case study on mountain nyala, an ungulate endemic to Ethiopia, showed that the 10 years of monitoring data currently available is sufficient to make informed decisions, but that the system is currently hampered by large uncertainties in the precision of monitoring and the unknown rate of population loss (e.g. poaching or habitat loss).

Bushmeat hunting in Tanzania. In the case study on monitoring impala and wildebeest in the Serengeti, the spatial distribution (clumped vs even) and the monitoring effort have been shown to interact to determine the bias and precision of the monitoring data. This approach is crucial when developing long term monitoring plans to manage wildlife. The extent of bushmeat hunting in Tanzania is largely uncertain. We used indirect techniques to estimate that the percentage of households engaged in bushmeat hunting was around 19% in the dry season and 13% in the wet season.

Lion hunting in Africa. African lions have decreased over the last decade across Africa despite theory predicting that age limited trophy hunting could be sustainable. We developed a new model for sustainable trophy hunting that includes harvest rule that sets the maximum searching time until a kill and that is robust to a large range of uncertainties. This model that uses data that would be readily available for a range of trophy hunted species (time spent before an animal is killed) to develop simple yet robust rules for sustainable harvesting. Thus, this approach should be widely applicable.

In conclusion, this modelling approach, incorporating human decision making in the dynamics of harvested systems allows us to consider transparently the tradeoffs of different conservation actions for different stakeholders and based on different performance metrics. Moreover, more transparency has been shown to contribute to conflict resolution and builds trust between stakeholders who may have very different objectives.

3.	OVERVIEW

HUNTING FOR SUSTAINABILITY.

One of the main challenges facing conservation today is how to conserve biodiversity outside protected areas. Much of this land is privately owned and its extent means that conservation is hard to subsidise and enforce. Attempts to conserve biodiversity on private lands, such as through agri-environment schemes, have had mixed success. An alternative approach is to work with landowners and others who may be willing to conserve biodiversity in return for other benefits. Attempts to develop EU policy to deal with this issue currently include the New Biodiversity Strategy, the Sustainable Wildlife Use Initiative, revision on the implementation of the Birds Directive and a policy focussed on Law Enforcement. In particular, a considerable amount of effort has been invested in developing guidelines for sustainable resource use in general, and sustainable hunting in particular. Most relevant among these is the 'European Charter on Hunting and Biodiversity' which was adopted by the Council of Europe in 2007. Hunters are therefore highly relevant to sustainability and the protection of biodiversity because hunting involves millions of people and hectares of land outside protected areas. Habitats can either be directly managed for quarry species or more indirectly, hunters can operate over a range of habitats where alternative land-uses take priority, including forestry and agriculture. Hunting provides a potentially valuable conservation policy tool as hunters are interested in the provisioning and recreational services that land can provide, and the associated management practices can provide benefits for biodiversity by helping to achieve favourable conservation status for

habitats and species, enhancing ecosystem services, dealing with invasive species, and strengthening stakeholder involvement in monitoring and in conservation. However, hunting can also have negative consequences when a quarry species is over-exploited or is enhanced at the expense of other species that compete with it. We briefly summarise the main insights into the benefits and costs associated with hunting in relation to sustainability and biodiversity in the light of current policy.

(1) Hunting has multiple functions. As well as the impact of hunting on the behavior, ecology and demography of the target species, it also carries social and economic functions which need to be taken into account if policies aimed at changing or influencing hunting practice are to be successful. For example, the style of hunting and the persistence of these activities in some societies are maintained because of the role it plays in social relations. In addition, hunters can see themselves as integrated into nature, taking the place of predators to regulate animal populations in order to maintain them in good status. Our African case studies demonstrate that social taboos on hunting certain wild animals are breaking down and this is linked to an increase in illegal bushmeat hunting. Learning from these institutions may help preserve social norms that protect wildlife. However, although hunting may be crucial to developing human to human relations in some communities our work in Ethiopia, shows that this may not depend on a human understanding of the species and the habitats in which they occur and may lead to overhunting. Thus any attempt to change hunting practice needs to understand this function and the implications of any change for society as well as wildlife.

(2) Hunters as stewards of the landscape. In many systems, hunters promote the idea that humans have a responsibility to manage nature and that they are caring for the wildlife and the land. So, although the recreational and sporting aspects are important, these are often balanced against other purposes such as population control and meat production. The relative strength of these motivations affects the acceptance of these activities by non-hunters. Hunters therefore often regard themselves as conservationists and despite differences of opinion with environmental NGOs and policy objectives, this should provide a platform for building consensus and trust over management practices. Of relevance to this is the demand from the policy sector and from hunting organisations for a move away from a single-species based protection policies to an ecosystem approach .If this was achieved it would contribute to an institutionalisation of the multifunctionality of hunting, game management and other activities, and help to create consensus on tackling under-hunting, and possibly also excessive harvesting of pseices of conservation or commercial importance.

(3) Institutional conflict. Hunting is an age-old practice and many regulations and institutions have developed to maintain hunting as a legitimate activity. Many of these are linked to property rights. However, there is a clash with more recent environmental legislation because this often aims to achieve public objectives on private land by imposing responsibilities on land owners that are not necessarily consistent with their private objectives. There is an element of cultural resistance to the top-down imposition of these newer policies which are seen as emanating from a sector of society with a poor understanding of nature. If current policies are to succeed, there needs to be a process of engaging with the hunting sector at an early stage in order that there is buy in to policy development, consequences of policies are properly evaluated and implementation is effective. At the same time, the private sector needs to understand the wider benefits provided by nature to society and the impact that hunting practices can have on these.

(4) Recognize the value of modelling and scenario approaches. To help address the issues in (3) above, we have explored a range of new decision support tools aimed at helping decision makers to explore the consequences of different management strategies to help provide an objective basis for actions. For example, the emergence of modelling environments that allow the integration of social and ecological systems offers the possibility of developing holistic tools to evaluate the relative sustainability of alternative management strategies. This provides a mechanism for incorporating human decision making into the dynamics of harvested systems and allows us to consider transparently the tradeoffs of different conservation actions for different stakeholders. This can contribute to developing trust between stakeholders with very different objectives. Similarly, the scenario analysis method can help explore the consequences of different policy options and potential future scenarios for the objectives of different stakeholders. This method provides a means of structured discussion about a range of possible futures in a non-confrontational environment and can help to bring together all actors by recognizing common threats as well as opportunities that could be mutually beneficial. The scenario method highlighted a consensus on the need to move from a single species to an ecosystem approach in Scotland, for example.

(5) Protecting species or populations. In general, outside protected areas, conservation policy relies on protecting a species. Whilst this has had notable successes in bringing some species back from the brink of extinction, it can be a victim of its own success. For example, our work on brown bears has shown that in Croatia bears are a valued trophy species providing income to rural areas which supports habitat management for other hunted and non-hunted species. Here, conflicts between bears and people are rare. However, in Slovenia, which shares the same bear population, bears are subject to protection under the Habitats Directive and whilst the population persists, there is a lower level of social acceptance (or social carrying capacity) for bears and consequently substantial levels of compensation for human-wildlife conflicts are paid out. Our work suggests that protection should be based on assessment of the ability of the local bear population to provide a sustainable harvest. If a harvest is possible, this would increase the value of the species and therefore protect it and the habitats in which it exists. . If the principle of assessing the need for protection on a population basis rather than a species basis is adopted, this may help in other situations where species of conservation concern are in conflict with people. However, current policies based on protection make this difficult. This is echoed in our work in Africa where big game trophy hunting has high market value yet is often threatened because of conflict with the land-uses of local people. However, we have shown that local behavior may change with more tolerance of wildlife and its impacts if the value of trophy hunting is shared with local communities. This has more chance of success if the benefits accrued are linked to the wildlife resource by the communities that gain from this revenue

(6) Values and preferences that drive hunting. In many cases hunters are driven by more than the opportunity to shoot large numbers of the quarry species. Our work with game-bird shooters in Scotland shows that other aspects of the experience are important. This suggests that marketing other aspects of the shooting experience such landscape characteristics; the benefits of hunting on non-target species and the role hunting has in local economies can promote sustainable hunting practice. Our work also shows that the public also value the effects of hunting management such as the benefits to biodiversity such as wader populations in Scotland and Steppe birds in Spain. However, they are in favour of any strategies that would help to increase raptors densities on land managed for gamebirds. In the case of illegal

bushmeat hunting, understanding the preferences of hunters indicated that for interventions to work, the wealth of the households needs to be taken into account and the demand for bushmeat could be reduced by providing cheaper alternative sources of protein in some cases. This would however need to take into account any social role that bushmeat hunting plays (see 1 above).

(7) Consequences for biodiversity. Our work investigating the impact of management practices associated with hunting on biodiversity shows that in many cases there are benefits. For example, gamebird shooting (e.g. grouse in Scotland and partridge in Spain) is often associated with increased diversity and abundance of other bird species. However, if game management is very intensive there may be detrimental effects for some species. At a regional scale, if the diversity of landscapes, habitats and species is to be maximized then there are winners and losers under any land-use type, therefore planning at an ecosystem level to encourage diversity of management on a broader scale may be more effective than blanket protection of particular species or habitats This, however, requires significant investment in collaboration and planning to seek consensus on what diversity is acceptable where in the landscape, given the differing objectives of the many managers likely to be involved.

(8) Ecosystem approach and management. No game species lives in isolation from its ecosystem which consists of a diversity of human and non-human components. Sustainability of any harvest of a game species must be measured against the impacts this has on the wider ecosystem, and the impacts that other ecosystem components have on the species in question. This has been recognized in concepts such as adaptive management and co-management. However, this has rarely been implemented in practice. In Sweden, we investigated an initiative to move away from managing a single resource to the broader perspective of ecosystem management. Our findings suggest that this scale of approach has the potential to remedy some of the problems related to the current management of moose by overcoming the fragmented management structure where diverse owners (private and public, large- and small-scale) have different and potentially conflicting objectives

In summary, hunting is a widespread and diverse activity that fulfills many social, economic and ecological functions. It is not just carried out for the purpose of sport or provisioning but is central to cultural and social relations in many communities. Whilst there are clearly cases where species have been overhunted and need protection, hunting and associated management practices can be a force for nature conservation if carried out according to best practice, which must be adapted to recognize local and national objectives and institutions. In some cases, hunting may actually increase the value of quarry species and this can lead to sustainable populations in a more effective way than total protection. There are now effective techniques that can be used to bring hunters and environmentalists together to build consensus on the most effective future policies to support human well-being by recognises wider ecosystem linkages and protecting the underpinning biodiversity whilst building the capacity of the role of hunting and its culture as steward of many of our landscapes Crucial to the success of biodiversity policy objectives in the wider countryside is the engagement of hunters and land managers at an early stage in order to develop adaptive or co-management strategies consistent with an ecosystem approach.

CONFLICT MANAGEMENT

Hunting is often considered a controversial topic and those involved in hunting often find themselves in conflict with other parties with different value systems. Conflicts emerge over a variety of issues, including the morality of hunting, the welfare of shot animals, the management of predators or the impact of hunting on rare species. Many of these conflicts are long-standing with no clear path to reconciliation. They involve multiple dimensions, including cultural, institutional, economic and ecological ones and so insight is required from a variety of disciplines to fully understand the conflicts and consider alternative ways of managing them. They cannot simply be understood from one paradigm alone.

The HUNT project provides diverse insights into conflicts over hunting.

(1) Despite differences and conflicts over issues such as predator management, hunters and conservationists share many thoughts and values. The idea of stewardship that many hunters nourish, points to a potential platform for increased cooperation between the two groups that might prove valuable in breaking down conflict.

(2) Conflicts go beyond disagreements about technical issues. They are about people and their values and cannot be fully understood outside a wider cultural context.

(3) Hunting often has important social functions and a greater awareness of this might help people develop more sustainable hunting as a basis for conservation and development interventions.

(4) New conservation institutions such as the CBD and EU directives have developed in parallel to the traditional institutions that have previously governed hunting. For example, in Scotland these institutions appear poorly reconciled and have had comparatively limited influence on Scottish land management. There is a strong discourse amongst hunters asserting that these new institutions do not have true knowledge about how the countryside works. Addressing that discourse and reconciling institutions is required if tensions between sporting and institutionalised conservation are to be resolved.

(5) Choice experiments provide insight into conflict management. We used these techniques to explore aspects of the conflict between hunting and conservation over raptors in Scotland. We found out that whilst the public are willing to pay for increases in both raptor populations and wanted a change away from the current means of managing conflicts, hunters prefer fewer raptors. We also used this method to gain insights on the motivations for bushmeat hunting and the drivers of consumption which could help design effective intervention strategies to reduce bushmeat hunting.

(6) Socio-ecological modeling, which incorporates human decision making into the dynamics of harvested systems allows us to consider transparently the tradeoffs amongst of different conservation actions for different stakeholders. Such increased transparency contributes to conflict resolution and builds trust between stakeholders who may have very different objectives.

(7) Multi-criteria decision analysis (MCDA) is a structured decision-support process that can facilitate dialogue between groups with differing interests and incorporate human and environmental dimensions of conflict. This can avoid intuition- or bias-driven decision

processes and so result in more effective and evidence-based decisions. For example, work in Scotland highlighted tensions and trade-offs between hunting, biodiversity, carbon management and renewable energy. MCDA provides a valuable decision-support tool, particularly for aiding negotiation towards management compromise and innovation, although an awareness of the limitations is vital before attempting to apply the technique with stakeholders.

In summary, many of the conflicts around hunting are long-standing and challenging to resolve. However, applying modelling and scenario approaches have the potential to help they can still be effectively managed these tensions to minimize conflict and allow the participants to develop shared understanding and build on their common interests.

Justin Irvine & Steve Redpath. June 2012.

Potential Impact:

Strategic impact

Background

The last 40 years has seen a dramatic increase in the global awareness of the biodiversity crisis as the impacts of human activities have become more and more apparent. With this awareness has come an increased commitment to halt the loss of biodiversity (for example the recent 2010 goals and the EU Biodiversity Strategy to 2020). Despite this commitment success has been patchy and the question of how to achieve these goals still needs addressing. During this period there has been a constant development of biodiversity conservation paradigms which have swung between the philosophies of separation (focus on conservation within protected areas and excluding people) to integration (focus on biodiversity conservation in multi-use landscapes). The idea of sustainable development became mainstream following the publication of the World Commission on Environment and Development (Brundtland Commission) report 'Our Common Future' in 1987. This has led to the current conservation paradigm of recognising the connection between the needs of people and the conservation of biodiversity that have been encapsulated in the Convention on Biological Diversity (Rio Convention 1992). As a result there is now a widespread understanding that humans are an integral part of a global ecosystem. Our co-dependency was underlined even more in the title of the Millennium Ecosystem Assessment's final report 'Ecosystems and human well-being'. The result of this evolution of philosophies is that sustainable use has become one of the dominant paradigms within the conservation discourse. Increasingly, this approached is articulated in terms of the Ecosystem Approach (CBD 2004) which recognises the need to understand the biological processes, the services and goods they provide and the people who depend upon them.

In a world where our knowledge concerning both the present status and the ecology of most natural resources is imperfect there is always uncertainty concerning the impact human use will have on both the resource being used, and the wider ecosystem within which it is imbedded. There are many historical and recent examples of how exploitation has resulted in massive population declines, and even extinctions, of species that constituted valuable resources – e.g. within the field of fisheries management. There are also plenty of examples of how changes in the abundance of one species, or a certain functional guild, can trigger cascading effects throughout entire ecosystems. Only increased ecological knowledge, the development of better decision making tools that embrace uncertainty and the widespread use of the precautionary principle will allow sustainable use to be achieved. The pressure on biodiversity is further complicated by relentless environmental change including the climate, the rapid expansion of urban areas, dramatic changes in the shape of rural environments. Where there are conservation successes this can also lead to increased conflicts, for example in the expansion of populations of raptors and mammalian large carnivores. The challenge that HUNT has tackled is to understand how people interact with their environment using hunting as a lens by developing new approaches and processes in order to create more successful strategies for the sustainable use of natural resources that humans depend upon.

In addition to the technical challenges there are also a range of social challenges. This is underlined by a growing realisation that protected area networks alone will not succeed in conserving all biodiversity. This is in part because of spatial limitations of such a policy on the ecology of many species but also because protecting an area imposes a governance system that can conflict with local people's traditional rights of access and resource utilization. Thus for both ecological and social reasons, there is a recognition that the sustainable conservation of biodiversity can only be served by

focussing on developing sustainable management of the matrix of human-dominated, multi-use landscapes within which protected areas are imbedded in addition to the protected areas. This requires the development of a new conservation paradigm – that of coexistence. On one level this requires that human societies learn to live and coexist with the presence of biodiversity in the landscapes where they live, work and play. However, it also forces the realisation that human societies are diverse, and hold differing cultural, spiritual and ethical views concerning their interaction with the natural world. Different cultures may have very different views on the way resources should be used, and even if they should be used at all. In other words the biodiversity conservation agenda has to understand the traditional and long-held cultural norms as well as the emerging animal welfare and animal rights movements if it is to build on the limited successes to date. Central to this approach is the recognition that we need mechanisms to mitigate conflicts between social groups as well as finding ways for all groups to coexist with biodiversity.

The result is that while most actors agree on the overarching need to achieve sustainable use of resources and achieve sustainable, functioning ecosystems, there is much debate about how to go about achieving this objective, both in terms of technical management tools and strategies aimed at the economic, social and cultural levels. In order to make progress towards sustainability there is a need to conduct interdisciplinary research through case studies that can shed light on the issue. HUNT emerged as a response to 'ENV.2007.2.1.4.3' Biodiversity values, sustainable use and livelihoods'. Thus the overarching goal of the HUNT project was to meet this call's expected output that 'The activity should assure a constructive engagement with a broad selection of social groups and their governmental and non-governmental representatives in order to enable serious consideration and uptake of information generated from this work to improve their capacity to design policies that take into account the true social (economic and non-economic) value of biodiversity'.

HUNT has been investigating the relationship between hunting and biodiversity in order to produce new knowledge on the social economic and ecological impacts of hunting and inform the development of sustainable policies. Hunting is an enormous activity and is arguably one of the largest scale examples of the consumptive use of terrestrial biodiversity. It is a legitimate land-use activity and just within Europe it involves millions of individuals directly, and many times this number indirectly, provides a valuable resource in the form of meat and skins, recreational opportunities, employment and income for landowners. On estimate from the Federation of Associations for Hunting and Conservation of the EU estimates that hunting has a total economy of 10 billion euro. In addition it provides an outlet for people to explore one of the oldest traditions and most direct interactions that humans have ever had with respect to biodiversity. Hunting is also very controversial as it involves the death of animals that are often regarded as charismatic (e.g. red deer in Scotland, lions in Tanzania, bears in Croatia). Because hunting has positive and negative connotations and impacts, it has provided a perfect focus to explore the diverse issues addressed in this call. We have attempted to reach the goals of this call by providing a detailed analysis of hunting as a case study in the sustainable use of biodiversity. HUNT was designed to investigate the interaction between hunting and biodiversity from a number of perspectives: (1) the social, cultural, and institutional values and impacts of hunting in a series of diverse case studies from Europe and Africa;(2) the values associated with hunting and its management compared to alternatives; (3) increasing our knowledge of what constitutes ecologically sustainable hunting; (4) exploring the effects of hunting and its management on non-target species in habitats managed for hunting; (5) developing harvest tools to enhance sustainability of target species; (6) facilitating dialogue between stakeholders, authorities and the public about hunting as a sustainable activity; (7) identifying trade-offs and complementarities between hunting and other land management objectives to address

material and social conflicts and (8) provide evidence to support national and international policy development. The main outputs from HUNT have been summarised in relation to i) each workpackage, ii) for each country case study and iii) in relation to best practice and can be downloaded from the HUNT website. The impact and potential impact of these outputs are described in detail below.

Impact on policy

The results from HUNT have clear implications for policy development. Broadly, they have identified motivations and agendas of the various relevant actors. Following on from this, the benefits of hunting activities have been identified and the costs of not hunting recognised. Furthermore we have identified the ecological and biodiversity consequences of different forms of hunting and hunting governance. As such HUNT results can now be used to structure debate and provide a common platform of objective knowledge on which decisions can be made.

European Policy

European biodiversity conservation policy is a complex structure with national and international laws, agreements and conventions. On a super-national level most European countries have signed the Convention on Biological Diversity (CBD) and the Washington Convention on Trade in Endangered Species (CITES). On a specifically European scale over 44 countries are signatories to the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention), while the 27 EU member states are also subject to Council Directive 79/409/EEC on the Conservation of Wild Birds (Birds Directive) and Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (Habitats Directive). In addition, all EU policy is meant to move towards sustainable development – enshrined within the European Sustainable Development Strategy ('Gothenburg Strategy'). All of these pieces of legislation aim to provide a balance between conservation and sustainable use, for example the Habitats Directive states: 'Whereas, the main aim of this Directive being to promote the maintenance of biodiversity, taking account of economic, social, cultural and regional requirements, this Directive makes a contribution to the general objective of sustainable development'. Although hunting is a legitimate land-use, its implementation is limited by the overall conservation objectives of the Directives that aim to achieve Favourable Conservation Status for target species and by the specific Annex designation of some species that protects them from most forms of normal exploitation. This can lead to conflicts between management for hunting and management for biodiversity. HUNT has provided insights into this conflict by increasing our understanding of the motivations for hunting, the trade-offs and complementarities between hunting and other land uses and an understanding of when hunting can be a force for conservation as well as recognition of when hunting is unsustainable.

Thus hunting is central to controversies surrounding the Habitats and Birds Directives which include (1) What actually constitutes an operational definition of the 'Favourable Conservation Status'; (2) The issue of species protection in cases where species that are rare in some areas are abundant in other areas; (3) What forms of use constitute a 'non-jeopardisation of conservation efforts' (Birds Directive)? (4) Under what conditions should derogations from strict protection be given under Article 9 of the Birds Directive and Article 16 of the Habitats Directive? These issues often involve discussion of the 'no satisfactory alternatives', 'serious damage' and 'judicious use' conditions. (5) Can de facto hunting be carried out on strictly protected species under derogation clauses (both

Directives)? (6) Should hunting be carried out inside Special Protection Areas or Natura 2000 sites (both Directives)?

Despite the existence of a range of EU guidance documents, conflicts with the hunting community persist leading to frequent hunting related cases in the European Court of Justice, (the ultimate authority on interpretation of European law). Although the Bern Convention does not have the same authority or sanction possibilities, there have been many cases where hunting related complaints have been brought to the secretariat and where cases have been opened against specific countries as a result. Partially in response, the Bern Convention secretariat launched an initiative to formulate a European Charter on Hunting and Biodiversity which was presented at the Bern Convention in 2007. This document presents both an overall philosophy for hunting that is compatible with biodiversity conservation goals and some principles for how to achieve this in practice. There are plans to update this soon and any revision will be able to draw on the wealth of results emerging from the HUNT project. At a national level, member states can implement the directives as they see fit and this can involve more restrictive legislation than the directives demand. This can lead to intense conflicts e.g. the ban on fox-hunting with hounds in the UK.

The HUNT project is based on the premise that although many of the controversies are fronted as a debate about ecological facts, the ultimate source of controversy may be more deep-rooted and embedded in more general cultural and societal tensions, for example, landowners rights in relation to public objectives for supporting and regulating ecosystem services, or the increasing conflict due to the urban - rural divide. The findings from the HUNT project have a clear relevance to policy at a European and national levels because the multi-faceted approach can inform these controversies by investigating the cultural, economic and ecological components of the conflicts. The impacts of our work are broad ranging. For example, we have specific examples relating to the sustainability of hunting on population size such as our work on harvest models which has provided concrete tools for guiding sustainable quota setting taking into account regulations and hunter behaviour. On the other hand we have a range of fundamental insights into the wider human-nature relationships that provide an understanding of the role hunting can play in social relations and therefore the motivations for hunting which should be taken into account when devising policies designed to change or reinforce behaviour.

Thus the insights from HUNT can help management authorities respond to these conflicts in a more constructive way, and will also help NGOs and other actors to navigate this complicated terrain without creating unnecessary conflict. The results are made more valuable because they are derived from a comparative approach based on very different countries both within and outside the EU frameworks which have allowed us to explore the effects of institutional structures, governance and policy on hunters of very different socio-cultural backgrounds. In particular we have produced valuable new knowledge on the limitations of current vertical or top-down regulatory arrangements in achieving biodiversity conservation because of the conflicts with local objectives and cultural practices. This can be compared with horizontal issues resulting from conflicts between local actors with diverging objectives for the same land holding. This is of direct use in future planning of environmental policy within the EU. For example, the results from HUNT will be directly useful for management planning on Natura 2000 sites as they make decision on what activities, such as hunting, should be permitted. Furthermore, the EU biodiversity strategy to 2020 aims to manage biodiversity outside the protected areas. Much of this land is influenced by hunting or subject to hunting objectives. Thus HUNT insights into the consequences of hunting for biodiversity and the role hunting plays in social structures are important if support of sustainable hunting practices is to be targeted correctly in order to work with hunters in achieving these goals.

African Policy

African conservation policy is also influenced by national and international regulations and pressures. Internationally it is mainly the CITES agreements on trade that influences use, although most countries have signed the Convention on Biological Diversity. Nationally, laws vary widely from country to country. Africa differs in at least two ways from the European situation. Firstly, the large, mainly rural based, human populations are putting enormous pressure on natural resources, which in turn is leading to a very urgent and polarised debate about how to balance the conservation of biodiversity against the human needs for natural resources, and about how to distribute the costs and benefits from protecting biodiversity. The resulting debate has focused on the dichotomy between protected area vs sustainable use paradigms, and even within the sustainable use paradigm there are heated debates about who should have control (Community Based Conservation vs central control) and which resource uses are most acceptable and relevant to an area (ecotourism, subsistence use or trophy hunting). Secondly, African conservation policy is greatly influenced by countries and interest groups outside Africa who put pressure on nations through funding and the CITES system. The international debates around ivory trading are a classic case. Other lesser known examples are debates about the export of leopard and lion trophies from Tanzania. The implication is that even when a given country has a healthy resource that can potentially be exploited, it may be hindered from doing so by external groups who do not feel the costs or forego the benefits. The result is that African conservation policy is very controversial, with the African savannah becoming a battle ground for a wide range of global and local interest groups with a wide range of values.

A current controversy that is raging within African hunting and conservation circles is how best to ensure that trophy hunting is sustainable, both in terms of the target species and wider biodiversity. Calls for a hunting certification scheme are intensifying, and there are potentially useful lessons to be learnt from the European experience that we could add to this debate. As Europeans are among the primary consumers of trophy hunting in Africa, our understanding of the meaning of hunting to them, and particularly to people in emerging nations like Croatia and Slovenia, who are likely to be future consumers of African hunting, will be extremely valuable. The IUCN - World Conservation Union – has developed Best Practice in Sustainable Hunting, and has an on-going interest in hunting tourism because of a premise of 'use it or lose it' which argues that by allowing a species to be hunted according to best practice, this gives value to the species and it is therefore likely to be managed sustainably by those who realise its value. HUNT results provide insights on the sustainability of protected populations versus those that are harvested. In particular, the brown bear populations of Croatia and Slovenia provide useful evidence for policy makers.

Our work on developing robust models for harvesting strategies that allow the consequences of regulations (for quotas) as well as hunter behaviour to be explored will be of use to wildlife managers in Africa as well as in the EU when devising management plans. However, much of the hunting in Africa is associated with subsistence livelihoods. In relation to this, European aid policy is more and more tied to Poverty Reduction Strategy Plans (PRSPs) drawn up by recipient governments. In countries such as Tanzania, subsistence and local commercial hunting are key parts of the informal economy, and as such do not enter into government financial planning. This means that the contribution of hunting to these economies is systematically undervalued, and hence that PRSPs do not recognise its importance in the rural economy. We have investigated subsistence and bushmeat hunting to understand the motivations for it in order to understand better the type of interventions that could be tried in order to improve the livelihoods of these people by reducing their impact on the quarry species which are often of poor conservation status. This work has direct implications for international development policy such as the European Strategy for Sustainable Development (Dec

2005) which sets out the EU policy for Sustainable Management of Natural and Environmental Resources and the EU Development Policy: an Agenda for Change (Oct 2011) which promotes economic development provided it does not damage the environment, biodiversity and natural resources. Thus an understanding of how to influence people to adopt more sustainable hunting whilst alleviating them from poverty fits with the EU development policy of promoting a 'green economy' to generate well-being by investing in natural capital and reducing unsustainable use of natural resources.

Impact on society

The process that leads to a given issue being discussed within the technical context of legislation or ending up in court often stems from an underlying social discourse about the legitimacy or extent of a given activity. Although evidence from scientific research cannot determine the rights and wrongs of a given activity, it should aspire to inform and structure public debates. In the context of HUNT we have aspired to inform public discourse about hunting through : (a) contributing to a shared knowledge base concerning specific issues, such as the state of the resource, the sustainability of its exploitation, the impact on wider biodiversity, the economic costs and benefits of the activity and the consequences of potential alternative land uses; (b) generating a wider perspective on specific hunting related issues and reduce the degree of polarisation by presenting results from a diverse set of case studies representative of the diversity of hunting; (c) structuring the discourse into its ecological, economic, social, and cultural components. (d) creating a forum in each case study where stakeholders and management agencies can interact to discuss policy and private objectives in order to foster understanding, reduce tensions and recognise complementarities where win-win situations can be developed, and (e) directly influencing policy at national and international levels. We have developed a web based portal for accessing the results of HUNT. The overall message from HUNT: that hunting, if carried out appropriately can be a force for conservation will be supported by summaries and links to the results based on either the work package topics; the country case-study summaries; or the best practice documents allowing access to policy makers and practitioners interested in different issues, scales and approaches to easily find the results of relevant research within HUNT.

Why an international approach?

Europe is a diverse continent, with a wide range of ecological, cultural and socioeconomic situations. Hunting reflects this, as can be seen from the diverse hunting activities and styles that are present across the continent. From country to country, the proportion of the population that hunts, the accessibility to game species, the potential for alternative land-uses, the composition of the hunting community and even the motivation to hunt vary widely. This is highlighted even more when hunting in Africa is exemplified in our two contrasting African case studies. Our research has demonstrated that this diversity needs to be addressed and considered if successful interventions to improve the sustainability of hunting activities are to be devised. Although there are certain common elements associated with hunting and its relationship to biodiversity, society and livelihoods which have been drawn out through the application of a common methodology across the case studies, there are also context dependant forms of knowledge which may vary in relation to species and habitats involved. Of course, within this project it has not been possible to address every type of hunting in each country to the same level of detail, but because of the diversity of our case studies, there are insights from a

diverse set of contexts to which most systems and style will have some commonality in some respects. For example, common elements that have emerged are the way in which hunting can influence social structures and relationships which is as true in Scandinavia as it is in Ethiopia. Another example is the governance of hunting in relation to landowner rights where more state control can lead to lower hunting quotas but also less value for example, the range of game-bird shooting systems across Europe and North America. It is also clear that there is a case for revising species protection rules so that it is individual populations that are protected when needed and not the whole species. This would allow hunting and therefore value to be attached to a species if its population can be harvested sustainably, for example the brown bear population which is protected in Slovenia but its management involves substantial compensation payments compared to Croatia where it is hunted and compensation payments are negligible. Conversely, if a protected species is not valued it can cause conflict with other legitimate activities and protection may not work, for example, raptors and game-bird shooting in Scotland and Spain. Hunting for trophies is clearly not an activity related to the provision of meat, however, it adds value to a species and this can help to promote management that enhances the species populations and their habitats. Whilst this works in the case of brown bears in Croatia, because of the trickle down of benefits to local land managers, this also has the potential to protect biodiversity in African countries provided a link between on the ground benefits and trophy hunting can be established as demonstrated in our work with stakeholders in southern Ethiopia. Thus by examining how hunting can impact on biodiversity using a range of institutional, cultural and environmental contexts we have been able to produce a range of insights that should be of relevance to policy makers at EU and national level.

Relationship with other research activities, going beyond the state-of-the-art

One particular area where we have attempted to go beyond the state of the art is to bring together fisheries harvesting models with the knowledge on the cultural and institutional drivers of hunting behaviour to develop management strategy evaluation models of quarry species populations (e,g Mountain Nyala in Ethiopia, bushmeat hunting in Tanzania and Bear hunting in Croatia and Slovenia, as well as lynx hunting in Norway). Integrating the human dimensions into ecological models (referred to as integrated social – ecological models) is a major development of wildlife models aimed at ensuring sustainability. The success of this work depends on the quality of the insights from the social scientific research on hunting culture and governance and HUNT has benefitted from a suite of novel insights provided in WPs 1 and 2. This is an example of where HUNT has simultaneously focussed the insights of a range of disciplines on the same case studies so as to generate a multi-dimensional view of these cases, highlighting the complexities inherent in real-world hunting management and informing the discourse over conflicting (often local versus policy level) objectives.

Wider conceptual impacts

Overall, during the immediate post project period, the findings from HUNT will be synthesised to address two main concepts. Firstly, we will draw on the results to analyse what we can say in relation to the debate about the sustainability of hunting in relation to the balance between consumption vs conservation. This will be of direct relevance to the Convention on Biological Diversity and the principles of the Ecosystem Approach which essentially promote the consideration of the functions of biodiversity in an ecosystem, the benefits it provides and the people which depend on it. Second we

will assess lessons from our interdisciplinary approach and engagement with stakeholders in order to inform the design of future interdisciplinary projects.

The use and dissemination of foreground

Our approach has been to tailor our outputs for a range of audiences including the research community, land managers, hunters, conservationists, and the wider public . Throughout our communication activities we have attempted to establish a certain 'brand' for the HUNT project by being very careful to use our logo at every available opportunity.

Scientific community

We view our role as scientists a knowledge brokers and the value of any knowledge we generate or collate depends on our credibility as objective and unbiased actors. Whilst we recognise all actors have a perspective, we have built a degree of trust with our stakeholders which is important in getting messages and results considered, particularly if they are controversial. One of the main mechanisms to ensure the quality of research outputs is the process of peer-reviewed publications, therefore a vital prerequisite for our dissemination work is to ensure that our research is reviewed by our peers through publication in scientific journals and presentations at international conferences. Publication in English in international journals also allows our results to reach a wider audience, ensuring that maximum value for money is obtained. Thus although we recognise that results and messages need to be disseminated as soon as possible, any pre-publication dissemination comes with the caveat that it is a draft until it is fully published through the peer review system. So far the HUNT project has produced 22 articles that are printed, 3 more are accepted and regarded as 'in press', 14 more have been submitted, and advanced drafts of another 16 are being circulated among the authors. We have made major use of scientific conferences to present results to our peers as they emerge, with HUNT researchers holding over 60 oral presentations and 15 poster presentations at various conferences around the world. Because of the significant time delay in peer-reviewed publication, we have produced 7 technical reports that can be freely downloaded in pdf format to go alongside journal articles. These will be available from our website under a number of categories to assist cross-referencing between outputs. The bulk of our outputs have been in discipline specific journals and conferences although we have also produced a number of interdisciplinary publications.

One key success of the project was the conference held in March 2012. This was held over three days with delegates invited from the policy and practitioner sectors as well as the usual academic actors. The conference provided an outlet for some of the HUNT research but about half the presentations were from researchers outside HUNT, thus the conference provided a forum for the research community in this area. The third day was policy focussed and provided us with the opportunity to debate our work with EU and national level policy makers and hunting sector representatives. From this we have raised the profile of the research and individuals will now be able to access and digest the results of our work in different formats on our website. HUNT researchers have also been active at a range of other conferences in recent years, including the International Union of Game Biologists in Barcelona in 2011.

Conservation and Wildlife Management Professionals

We recognise that there needs to be practical guidance for managers and decision makers on managing land sustainably for multiple public and private objectives. In particular, there is growing interest in the implementation of the Convention on Biological Diversity's Ecosystem Approach as a sustainable decision making process (in relation to the Malawi and Addis Ababa Principles). Examining our results in the context of an ecosystem approach will be a valuable contribution to the global discourse on sustainability. During HUNT many of the researchers have come into frequent contact with conservation and wildlife management professionals at many levels from European to local. This contact came about in many ways, including various on-going policy development processes and not least the various National Consultative Groups (18 meetings were held). In the post-HUNT period we shall continue our dialogue with the European Commission and national management agencies to ensure a flow of results to the policy makers and practitioner organisations using our website as the main tool. Several workshops were organised for professionals, and many presentations were held to target these groups at national levels. For example, in the case of bears in Slovenia and Croatia and lynx in Norway, HUNT researchers have made many presentations to the authorities responsible for the management of these species. In Norway, one of the tools developed during HUNT was formally used by the Ministry of Environment during the process of dealing with a controversy over lynx quotas. At a European level an example of an action was participation in a workshop held at the EUROPARC conference in Italy in 2010 which directly discussed the issue of hunting in conservation areas. HUNT presentations have been central in several forums attended by officials from the Bern Convention and DG Environment, and the issue of hunting will be central in a stakeholder forum being convened by DG Environment during 2012-2013 to explore conflicts associated with large carnivore management. We have also ensured that HUNT is featured in Insight and Research*eu magazines with a broad circulation among policy makers and professionals at a European level.

Students

Apart from HUNT researchers holding lectures for students, a number have taken their theses on HUNT related topics. In total, 8 masters students have completed their theses and 3 more masters theses and 2 PhD theses are almost ready for delivery. In addition, to these several of the HUNT staff were postdocs or early career scientists. Therefore we hope that we have managed to ensure that some of the experience of working on a large interdisciplinary project of this nature has been passed on to the next generation of researchers.

Interest groups

Effective communication is as much dependent on the process involved as in the messages delivered. In each of the country cases studies we have established a national consultative group to ensure that there is dialogue between the broad range stakeholders with an interests in hunting or who are affected by hunting practices. Membership includes conservation NGOs, practitioner organisations, land-owner organisations and government agencies. This diverse membership has allowed the contrasting points of view to be deliberated by the group as a whole in a non-confrontational atmosphere. In some cases, although these organisations and individuals interact with each other in relation to policy development and implementation, they rarely sit down all in one room together to

explain their standpoint and discuss the evidence. Members of these groups have been appreciative of this opportunity and we would hope to ensure continuity of this approach if continued funding was found. In many countries the knowledge held collectively by this group has been utilised in research activities from contributing to text for surveys through to engaging in workshops over land-management options or scenario analysis. Therefore we have gained constructive input into the design and execution of some of our project activities which will help to increase interest and acceptance for the project's findings across the sector. We have used many opportunities to interact with the hunter's European level organisation FACE in the hope that increasing an awareness of our research at this level will allow results to trickle down to the national and local level hunters.

The public

Although the media is crucial to reach a wide public, it presents a serious challenge in terms of communicating complex messages in an objective fashion. Coupled with the time-lag in producing published scientific outputs it is only now that we are able to promote our messages to the public. To date we have not managed to reach the mass media to the extent which we had desired. However, over the course of the project we have produced fact sheets on each case study and have produced an electronic popular book summarising the results of the project and structured as a series of short stand-alone essays each addressing a particular topic covered by HUNT. This is currently available as a draft. In the coming month this will be formatted and distributed through the internet. In order to communicate the full complexity of our results in a serious and reliable manner we will use every opportunity to write popular articles in our own words for relevant magazines. So far we have had articles in several online popular science e-magazines, namely forskning.no and sciencenordic.org, as well as several hunters' magazines. As relevant scientific articles are published we shall avail of media services such as Alpha Galileo to attract the attention of science journalists to our results. The extent to which we have been able to use open access publication will also help in this process, as it gives the journalists and interested public's access to the source publication.

The website

The continual growth of the web as an information source makes a project website indispensable. HUNT has established a project website that has been active throughout the project and has been updated with news items, publications and events as the project has progressed. From now on the main front page provides the overall message from HUNT and a series of links arranged in three main categories to satisfy a number of goals on different levels. First, there is a set of links based broadly on the work packages and disciplines in the project that will take the reader to a summary of the main messages and then on to the primary publications and outputs associated with this research area should the reader want to delve deeper into the research. Second, there is a series of links for each country cases study. For each country there will be a set of summaries of the research carried out which can all be downloaded individually or as a whole. Again there will be links to peer-reviewed published material, reports and policy briefs. Third, there will be a section of links to best practice guidance on a range of methodological topics that have been undertaken during HUNT which will provide insights for future projects that may want to utilise or modify the methods and tools we have developed and used. Thus the web site can be a portal for policy makers, practitioners and the general public and depending on the level of details sought; the user can drill down through the levels to the

source research material. This format will allow us to update the content as new outputs become available. We have additionally been experimenting with the use of social media, such as Twitter and Facebook as means of attracting attention to the website's content and to attract attention to updates.

Communication after the project's end

It may seem paradoxical but most of the communication of the project's results is likely to occur in the period after the projects end, as scientific papers become available, and as the overarching conclusions from HUNT are disseminated. This is typical for all research projects of this nature. The website will be maintained by its host institute, the Norwegian Institute for Nature Research for at least 5 years, and will serve as a dynamic focus point for disseminating our products.

List of Websites:

http://fp7hunt.net