

RECONCILING GAMEBIRD HUNTING AND BIODIVERSITY (REGHAB)

CONTRACT N°: EVK2-CT-2000-200004

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PROJECT WEBPAGE:

www.uclm.es/irec/Reghab/inicio.html

(Report on Workpackage 6 – Deliverables no 21 and 23).



Gamebird hunting and biodiversity conservation: synthesis, recommendations and future research priorities

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July 2002

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BACKGROUND

In many European regions, gamebird hunting is an important socio-economic activity in rural areas, involving millions of people, euros and hectares. Gamebird management has historically been performed in many areas, and hunting may thus be potentially beneficial to biodiversity, by promoting conservation and management of habitats within a strategy of “conservation through wise use of natural resources”.

However, in some cases there is a conflict between hunting and the conservation of biodiversity. This conflict appears when hunting is non-sustainable and intensive and, particularly, when predators are subjected to illegal or uncontrolled killing with the purpose of maximising game numbers. Predators (including raptors) are perceived within a large part of the hunting sector as an important limiting factor for small game populations, and thus as an enemy of hunters. In some cases, this perception has led to illegal control of protected species. As a result of such illegal activities, the protectionist movement sometimes perceives hunting as a detrimental activity for conservation. Now, many of the hunters, researchers and protectionists involved in these issues are keen to resolve this conflict, with the view that the efficacy of biodiversity conservation measures can only be sustainable with the consensus of both hunters and protectionists.

The REGHAB project arose within this context, and it was conceived as a forum where different stakeholders could gather to analyse and discuss the problem and its possible solutions. The project aimed to set up the basis for improving communication between opposing social sectors (hunters and nature conservation movements), to provide an updated, integrated picture of the state of the art to be used by key stakeholders, and to identify research priorities to obtain key information for a possible future resolution of the conflict. The project aimed thus to take the first step towards reaching long-term, sustainable solutions to reconcile gamebird hunting and biodiversity conservation across Europe.

The project involved members of the scientific community from five different countries (France, Spain, Portugal, UK and Finland), and also representatives of Spanish hunting organisations, and of small and medium-sized enterprises (ERENA, Portugal; and APROCA-CLM, Spain). Other stakeholders (other hunting representatives, conservation NGOs and government agencies) were invited to participate in the workshops organised throughout the project (see below), in an attempt to compile contrasting information, and discuss the polarised views of the problem.

Aims and structure of the project

The main objectives of the project were as follows:

- To provide a review of the costs and benefits of gamebird hunting to biodiversity in different European hunting regimes, under the different cultural, legal and socio-economic framework of the countries involved in the project.
- To review the conflicts between predator control and raptor conservation in Europe within the context of predator-prey interactions, and evaluate methods to reduce these conflicts.
- To develop and run a pilot test of new tools such as Multiple Criteria Decision Model for a specific biodiversity/gamebird conflict in order to test whether this is a useful framework for future conflict resolution elsewhere.
- To identify critical areas where information is lacking, and propose future research priorities.

The project was structured in 6 workpackages. The first three (Socio-economic, cultural and biological variation of gamebird hunting in Europe; Impact of hunting practices on biodiversity; and Predator-prey relationships in the conflict raptors-gamebirds) aimed to synthesise information on the following aspects:

- overall patterns of gamebird hunting throughout Europe, sustainability of gamebird populations and variations in the social and economic value of gamebird hunting.
- effect of habitat and species management on gamebird populations and on species other than gamebirds, and extent of each management practice in each country/area
- ecological background to understand the basis of raptor-gamebird conflicts.
- negative consequences that game shooting may have on raptor populations, either as a consequence of direct persecution or as a result of indirect poisoning.

The fourth and fifth workpackages of the project (Management tools; Development and deployment of a multiple criteria decision model for a specific biodiversity/gamebird conflict) aimed to evaluate in more detail potential solutions for the conflict.

- identify and evaluate the cost-effectiveness of potential management techniques for reducing raptor predation on gamebirds.
- develop and run a Multiple Criteria Decision Model for a specific raptor/gamebird conflict in order to test whether this is a useful framework for future conflict resolution elsewhere. This tool allows stakeholders to quantify and analyse their perceptions of the conflict and the acceptability of potential solutions. For this, we case study the conflict between the red grouse and the conservation of hen harriers in upland Britain.

The final workpackage aimed to summarise and disseminate the results to appropriate stakeholders. Within the latter, three workshops were carried out. The first one (held in Ciudad Real, Spain, in September 2001) presented and discussed the results of the first stage of the project (workpackages 1-3); the second one (held in Aberdeen, Scotland, in February 2002) presented and discussed the results of the second stage of the project (workpackages 4 and 5). The final one comprised the discussion and final synthesis of all information gathered, identifying possible solutions and areas where research is most urgently needed, and was held in Amboise, France, in May 2002.

This report is a summary of the results presented in the previous reports delivered during the project, where we highlight the most relevant conclusions of the project. Full details and original references may be found in the corresponding reports, as cited in the text.

Reports delivered

- Arroyo, B. & Beja, P. 2002. Impact of hunting management practices on biodiversity.
- Arroyo, B. & Viñuela, J. 2002a. Conclusions from Workshop I. Ciudad Real, 24-25 September 2001.
- Arroyo, B. & Viñuela, J. 2002b. Conclusions from Workshop III. Amboise, 30-31 May 2002.
- Arroyo, B. 2002. Conclusions from Workshop II. Aberdeen, 9-10 February 2002.
- Kenward, R. 2002. Management tools for reconciling bird hunting and biodiversity.
- Mañosa, S. 2002. The conflict between gamebird hunting and raptors in Europe.
- Martínez, J., Viñuela, J. & Villafuerte, R. 2001. Socioeconomic and cultural aspects of gamebird hunting.
- Redpath, S., Arroyo, B., Bayfield, N., Bacon, P., S. Thirgood & Gutierrez, R. 2002. Towards a resolution of the raptor-grouse conflict in upland Britain – the application of decision modelling with stakeholders.
- Valkama, J. & Korpimäki, E. Ecological background of the raptor-gamebird conflict: raptors as limiting factors of gamebird populations.

CONCLUSIONS FROM REVIEWED INFORMATION

Current patterns of hunting: socio-economic aspects and evaluation of gamebird populations (Martínez et al. 2002)

The number of hunters in the REGHAB countries has been stable or has decreased slightly in the last 20 years. Hunting is still mainly a male activity, and the mean age of hunters is relatively high; in fact, for the countries for which enough information exists, the hunter population appears to be ageing. This suggests that hunting may be, at least partially, a socially declining activity.

Hunters come increasingly from urban rather than rural environments. Thus, there is a decreasing connection between hunters and hunting habitats, and consequently a lower involvement in the conservation and management of these habitats, which may be a key aspect of the conflict.

Around 80 % of all animals hunted in REGHAB countries are birds, which thus constitute the most important hunting asset. Currently, more than four million hunters in the REGHAB area hunt over 76 million birds a year, with an average of 18.9 birds per hunter and year. Galliforms and thrushes are the most important hunted species.

Hunting is a relatively important economic resource in the rural areas, at least locally. Additionally, hunting may produce a shift in rural populations from the primary economic sector (production) towards the secondary (industry) and, especially, the tertiary sectors (services), given that hunting expenses in rural areas are directed mainly towards the latter. Within REGHAB countries hunting generates an economic turnover of at least 5000 million € although available information in this respect is imprecise and probably underestimates the real figures. It would be necessary to know in more detail to what extent the economic inputs generated by hunting provide benefits for the maintenance or improvement of natural systems, or even for the sustainability of hunting. However, such information has rarely been examined in detail, and gathering data about these issues has proved difficult.

In summary, gamebird hunting is an important socio-economic activity, although possibly declining and of a lower economic importance than other activities with a high impact on biodiversity, such as farming or forestry.

Most wild populations of gamebirds have decreased in recent decades. The main reason for these declines is the changes in the farming and forestry systems, including those promoted by the Common Agricultural Policy (CAP). In fact, a recent report from Birdlife International emphasizes that these changes are in general the main factor responsible for the decline in bird populations in Europe in the last 40 years. The acceptance of this problem by the European Commission is reflected in the increasing use of funds destined to agri-environmental measures. Within this context, there exists great potential for collaboration between hunters and protectionists. Such collaboration would more likely lead to a change in farming and forestry exploitation systems to others more respectful with wildlife, which would benefit populations of both game and non-game species.

As a direct consequence of the decrease in gamebird numbers (particularly in farmland), the hunting sector has increased releases of farm-reared birds into the wild. This has reached spectacular figures, for example more than 20 million pheasants are estimated to be released annually in the United Kingdom, as well as 3-4 million red-legged partridges in Spain.

Strong differences between countries exist in relation to hunting patterns, main hunted species, and the socio-economic value of hunting. In this respect, it is worth highlighting the case of Finland, where hunting pressure and thus the economic importance of hunting is low. This is associated with the Finnish hunting culture, in which what is perceived as important is the action of hunting, not the capture of a great number of animals, and also the fact that hunting in this country is a widespread social activity: Finland is one of the few European countries in which hunting has not historically been associated with upper social classes. This is the only REGHAB country where almost no conflicts have been found between hunting and nature (and predator) conservation, which supports the notion that the root of the conflict resides in social and economic factors rather than on ecological factors.

Effect of management practices on biodiversity (Arroyo & Beja 2002)

Management for gamebird hunting is common in all REGHAB countries, the most common practices being predator control, habitat management and releases of farm-reared birds. Most management practices carried out for gamebird shooting interests have their desired positive effects on target gamebirds. However, sometimes these management practices, to be effective, have to be carried out correctly and intensively, which is not always achieved in the real world.

Predator control is common in all countries, and is practised as part of the management of all species that are commonly hunted. Only for species that are hunted in small quantities (mountain gamebirds in the UK, France or Spain), is predator control not carried out. Predator control is mainly directed at abundant opportunistic species, such as foxes, corvids and some mustelids. This management practice is highly beneficial for gamebirds (particularly when carried out intensively) as it often leads to increased breeding success and thus numbers available for shooting in autumn, and it also leads in some cases to increased breeding densities. It was less clear whether it is also beneficial for other species, although there is increasing evidence to suggest that it may provide local benefits to songbirds and ground nesting species such as waders.

Habitat management for gamebirds is common in most areas, but it is rare that such management is applied at the landscape level. Indeed, large-scale management only occurs in moorland managed for red grouse hunting in upland Britain, and in mixed areas of farmland, shrubland and Mediterranean forest managed for red-legged partridge in the Iberian Peninsula.

Habitat management (particularly when applied in farmland) is the practice that has the clearest positive effect both on gamebirds and on biodiversity at large. However, it is worth noting that any given management scheme is favourable to some species, and negative for others, so the global effect of management on wildlife depends on the conservation priorities of each area.

Additionally, the effect of habitat management practices is conditional upon the extent to which they are actually implemented for hunting purposes in the wider countryside. Quantitative information on the extent of such practices is lacking in many countries, particularly in Spain, Portugal and Finland. Hence it is difficult to quantify the benefits that arise directly from hunting habitat management.

An increasingly common management practice for gamebird species typical of farmland (partridges and pheasants) is the release of farm-reared birds. This activity is sometimes associated to benefits to game and non-game species. For example, it has helped in cases to recover declining game populations when carried out with other management practices, and in

the UK the release of farm-reared pheasants is often associated with habitat management, which benefit other wildlife, and would be absent if it were not for the shooting interest provided by the releasing. However, in many other cases this technique is only used to increase in the short term the number of birds available for shooting, and may have a negative effect on the sustainability of wild game populations in the long term. For example, some methods of release (such as those used traditionally in Spain) are extremely unsuccessful for population recovery. Additionally, the release of farm-reared birds may lead to overhunting of wild populations. Artificial selection in captivity may also spread genetic and behavioural changes in wild populations, and the release of farm-reared birds may lead to spread of diseases into the wild. In addition, because of the high sensitivity of farm-reared birds to predation, releases are usually associated with intensive predator control schemes, at least in southern Europe. Moreover, fewer economic resources are often invested in managing the natural habitats for the species or the maintenance of sustainable wild game populations where gamebirds are released. Releases are thus frequently associated with intensive hunting and unsustainable wild game populations. The latter is particularly true for red-legged partridges in the Iberian Peninsula. In summary, the increasing release of farm-reared birds to natural environments has not always contributed to the maintenance of wild populations, and it may even be detrimental in most cases.

Overall, it is clear that many management practices for hunting purposes, if they are implemented within the local ecological context and adapted to conservation priorities, are beneficial to biodiversity. This is particularly the case in areas of intensive farmland, and where hunting contributes to preserve habitats that would be replaced by others of less ecological value in the absence of hunting. In contrast, the increasing trend to hunting intensification in some countries, which is associated with large-scale releases of farm-reared birds and abandonment of other management techniques, may have less benefit or even be negative to biodiversity.

Raptors and gamebirds (Valkama & Korpimäki 2002; Mañosa 2002)

Gamebird populations often experience high predation levels, and this is often cited as the main cause of mortality. This is the general pattern for these species, which are usually well adapted to this predation pressure. Predation may, however, have a considerable impact on game populations in situations where these populations have declined for reasons other than predators, or when the densities of generalist predators, such as foxes or some corvids, are high.

There is very little scientific information on the effect of predation by raptors on most gamebird populations, and in most cases, it remained unclear if mortality caused by raptors was additive or compensatory. However, the few existing studies have shown that, in certain circumstances, raptors can cause a significant decrease in the number of birds available for shooting in the autumn. The better examples of research showing how raptor predation on gamebirds can reduce hunting bags or, in some cases, limit gamebird populations, are found in some studies conducted on red grouse in Scotland, grey partridge in France, pheasants in Fennoscandia, or tetraonids in boreal forests. In all these cases, predation by hen harriers or goshawks may be of concern. It is, however, uncertain that raptors cause substantial losses to hunting bags as a general rule. Predation by raptors may be a relatively minor factor in limiting gamebird populations when compared, for example, with changes in habitat quality. On the other hand, little attention has been paid to the indirect potential positive effect that some raptors may have on game populations by preying on, for example, corvids, or by displacing other raptor species.

In some areas of upland Britain, Spain and France, managed for grouse hunting, red-legged partridge or grey partridge respectively, there is a demand for regulated control of some species of raptors.

The conflict between hunting and raptor conservation may arise more frequently in areas where gamebird populations are subject to other limitations, such as deterioration of habitat quality, lack of food supply, disease, or over-shooting, and where birds of prey are not limited by nest site availability and have alternative sources of food. Also, when occurring, the effect of raptor predation may be sharper and more difficult to solve where gamebird shooting depends on wild breeding or restocked populations than where releases for immediate shooting are performed. The conservation paradox is that the latter requires least habitat conservation.

It is difficult to say how important is deliberate or unintended killing of raptors in relation to other mortality causes, because of the bias associated with the analysis of mortality data gathered in different ways. Compilation from many sources indicates that illegal killing of birds of prey (deliberate or not) as a result of gamebird conflicts is still taking place in many areas of Europe. Comparison with similar sources of information in the past indicate that killing of raptors is much less common, intense and persistent than in previous decades. The decrease in illegal raptor control has occurred partly as a result of the legal protection of these species and partly as a result of heightened awareness of conservation issues. This decrease has also been helped by the decline in hunting activity in some areas. In most areas where illegal killing of raptors occur, it is most probably opportunistic, i.e. killing takes place during the hunting season, and is not deliberately aimed at reducing raptor predation. Deliberate killing of birds of prey for the sake of gamebird preservation only takes place in areas where game bird shooting is one of the main, if not the major, land use.

Not all species of raptors are equally sensitive to illegal killing but, because offenders often do not distinguish between raptor species, even a low frequency of illegal killing may have a considerable impact on vulnerable species. Even in areas where the conflict between gamebirds and birds of prey is not strong, the effect on the conservation of raptors may be considerable, because the killing involves many species, irrespective of their conservation status. Of particular concern is the situation in Spain, where deliberate killing of raptors is not a widespread management activity but may involve extremely endangered species such as the Bonelli's eagle, the Spanish imperial eagle, and the bearded vulture.

Also of much concern is the fairly widespread use of poisons to reduce the populations of mammalian predators and corvids, which cause the unintentional death of many raptors in Spain, Britain, France, the Netherlands, Greece or Slovakia, among other countries. Some scavenger species such as the red kite, the bearded vulture, the imperial eagle or the Spanish imperial eagle are of much conservation concern in this respect, and urgent action must be undertaken to eradicate the indiscriminate use of poison in the field. Allowance of use of selective methods to control corvids and mammalian carnivores should be considered as a potential alternative to reduce the illegal use of poison and the subsequent non-deliberate killing of raptors.

The current scenario of low intensity of deliberate raptor killing may change in the future, as forestry and agriculture become less profitable. The increased socio-economic relevance of intensive gamebird shooting, along with the increase of some predator populations and the maintenance of strict protection of some species, may lead to an upsurge of widespread and intense illegal raptor control unless hunters are adequately informed about how to address predation problems in an environmentally sensible way, and protectionists consider regulated predator management as a potential technique to regulate abundant generalist predators.

LOOKING FOR SOLUTIONS

Management solutions to reduce conflicts between raptor conservation and gamebird hunting (Kenward 2002)

Conservation of biodiversity in Europe still means, for many people, the preservation of species and habitats. The emphasis on "protect and reserve" is a response to several factors, including historic over-hunting of some species and management of predators through extirpation, perceptions of hunters as elitist, romanticising of "nature" and growth of a nature protection industry. Protection legislation has been useful as an educational tool, for signalling that society views loss of biodiversity through extirpation of species as unacceptable, and for drawing attention to the needs of rare species. However, rigid protection tends to hinder the application of human resources from hunting to maintain or promote biodiversity, to promote conflicts that waste human resources without benefiting biodiversity and to result in illegal predator management that reduces biodiversity.

On the other hand, there is a substantial lack of information on many aspects of the conflict under analysis, which makes it difficult to reach stable and long-term solutions. For example, there is a lack of information about the predation impact of raptors on game species in Mediterranean countries, where some of the species of raptors more vulnerable to illegal killing are found. At the same time, very little is known about the effect of culling on raptor populations. In that situation, it is difficult to define optimal strategies for the management of the potential conflict between gamebird hunting and birds of prey.

Various management tools may maximise the positive effect of hunting on biodiversity, whilst reducing the conflict with conservation of protected raptors. These tools may be ecological, sociological or economic.

Tools to reduce losses of game by protected or rare predators are needed in cases where a real (not just perceived) problem exists. These management tools include ways to reduce predation through, for example:

- exclusion of predators (useful in the case of release pens, not so much for wild populations);
- habitat management to reduce vulnerability of prey (creation or maintenance of refuge sites);
- reducing the density of predators through non-lethal mechanisms such as deterrence or translocation of broods or adults of raptors to areas with no conflict;
- the provision of alternative (diversionary) prey to predators;
- promoting the presence of top predators, which may limit the abundance of smaller-sized often more problematic predators, through intra-guild predation or exclusion.

If these ecological techniques are not effective, then consideration need to be given to more intrusive techniques, such as the elimination of particular problem individuals, or allowing some limited and regulated control through a quota system. All parties should agree that complete extirpation of predators is unacceptable and to use only selective and humane methods that cannot easily extirpate predators locally (e.g. live-trapping, egg removal), and respect agreed quotas with zoning to minimise the areas in which removal is permitted. The possibility of establishing local programmes of raptor population control such as these would be acceptable to most parties only if the following conditions are met:

- the existence of information that proves that raptors are affecting the biological or economic viability of the hunting system.

- other solutions have been tried or evaluated and have turned out to be inapplicable, inefficient or ineffective.
- local control poses no significant risk to the viability for the raptor population in a wider context
- within the area where control is applied, hunting is clearly sustainable and managed in a way that provides environmental and social benefits.

Current available data show that very few species of raptors create real problems to gamebirds (these include primarily goshawks and harriers in certain cases). To allow the management of predation by these species would help to reduce or eliminate indiscriminate killing of other species of more vulnerable status that are often not-guilty of reducing hunting bags.

In addition to these “ecological” tools, sociological and economic tools should also be considered. For example, a flexible tax system that might benefit those that successfully maintain populations of threatened predators and that penalises those that do not promote habitat and species conservation. Another alternative that could be considered in the case of some problematic raptor species, such as goshawks, could be to allow some regulated commercialisation of their offspring to falconers, which would stimulate maintenance of populations in hunting areas due to the high economic value that goshawks may have for falconry, thus compensating for the loss of hunting revenue that this species may cause, and promoting goshawk conservation.

A final level of sociological tools should help to avoid resource-diverting conflicts, by encouraging cooperation between hunting and other conservation interests. A concept that consumptive and non-consumptive sustainable use of the components of biodiversity should pay for conservation, developed by IUCN and incorporated in CBD, can replace protect-and-reserve conservation. Engaging all interests through a "user-pays" principle provides a pragmatic basis for conservation of multi-use countrysides. In this sense, and as indicated above, collaboration between conservation movements and the hunting sector to promote farming management favourable to gamebirds and associated species may be a promising line for solving the conflict at its origin: the decline in gamebird populations.

Acceptability of solutions and development of trust (Redpath et al. 2002)

The implementation of potential solutions to conflicts will not be effective unless those solutions are acceptable to both game managers and protectionists. One way of evaluating the acceptability of the different options is to quantify perceptions of the stakeholders through techniques such as Multiple Criteria Decision Models. This technique allows attitudes of stakeholders towards different options to be evaluated, thereby identifying those options that are acceptable and, more importantly, those for which a consensus may be reached.

Decision models enable a combination of criteria to be evaluated simultaneously. Views may be extremely polarised in relation to single criteria, but when several equally important issues are combined, the results may be unexpected. The process also provides a clear audit trail, which shows how results were achieved and which helps the participants understand better their own and the other stakeholders' positions. Finally, the participants had immediate, real time feedback on the results. Immediate feedback about other's positions may help to reduce the tendency to maintain preconceived positions. People usually tend to slip back into previously held ideas, whereas after immediate feedback and discussion they may be more likely to change – or at least be more receptive to change. In addition, the use of a neutral framework (i.e., a computer model) allows personal animosity or tension to be reduced. In other words, people allow

themselves to be objective because they are partially dealing with a neutral system rather than a perceived adversary.

The technique was applied to a particular example (the hen harrier – red grouse conflict in upland Britain), where five grouse managers (GM) and five raptor conservationists (RC) gathered for a weekend to discuss different options for managing harriers on grouse moors. There was clear divergence between the groups as to the most favoured options. Grouse managers valued quota schemes most highly and with highest within-group agreement (because of being the cheapest technique to implement, and the most likely to produce the desired results in the shortest time) followed by the use of deterrents and supplementary feeding. In contrast, raptor conservationists preferred harriers to be allowed to breed freely (the option that fulfils the protection laws most closely) followed by the use of supplementary feeding, and the level of within-group agreement for these options was also high. Amongst RC there was less agreement over the quota schemes with a wide spread of scores presented. Both groups gave habitat manipulation a low score, with GM expressing the view that the timescale for this technique to be effective was too long and that the technique was unlikely to be very effective in reducing harrier numbers. RC were also concerned about the potential impact of habitat manipulation on wider biodiversity in the uplands. One technique that was scored relatively highly by both groups was supplementary feeding. However, GM were concerned that this technique had not been fully tested in the field and there were still concerns over the long-term impacts of feeding on the numbers of harriers and other predators. GM considered that this technique was unlikely to be widely accepted until further research was completed. These doubts were reflected in the wide variability of scores for this option in the GM group, despite the overall high rank. Lastly, neither group favoured the management option for keepers setting the density of harriers. GM considered that it would be preferable if a government agency were involved in managing harrier densities in a sustainable way for grouse shooting.

The application of this technique facilitated communication between the opposing groups and allowed both sides a better understanding of the perceptions of the other group. It was perceived by the participants to the pilot study that the process highlighted the room for compromise and common ground. There was also general agreement among the participants that the process had helped move individual positions in the issue. Importantly, they also felt that this was a valuable process in which others should be engaged. The latter suggests that the development of this type of technique could be useful at a larger scale for searching and implementing acceptable solutions in other contexts.

Nevertheless, part of the problem in implementing and developing acceptable solutions arises from the lack of trust between stakeholders (Arroyo 2002). For example, participants in the Multiple Criteria Decision Model carried out during the project considered that despite potential agreement concerning the best management options, the lack of trust between stakeholders would prevent its implementation. Development of dialogue and collaboration between stakeholders is thus essential for the implementation of sustainable solutions, and there will be little hope for a long-term solution to the conflict until there is more understanding and trust between opposing groups.

During one of the workshops several examples showed that such collaboration is possible and currently happening at a local scale in some countries (Arroyo & Viñuela 2002b). Such examples should stimulate collaboration in other areas.

FUTURE RESEARCH PRIORITIES

As outlined above, and detailed in the corresponding reports, there is a substantial lack of information about several relevant aspects of the conflict which are critical for the resolution of this kind of conflicts at local and larger-scale levels. Thus, the main research priorities for the near future should be the following:

Socio-economic aspects of hunting

In some countries (particularly in southern Europe), there is not enough information on hunting bags and gamebird numbers, which is critical to identify whether hunting is sustainable.

- In these countries, effort should be put into improving systematic data collection.

There is not good information about the economics of hunting, particularly when considering the whole economic value of ecosystems.

- There is a need to analyse economic turnover of hunting within a large context: the ecosystem, including interrelationship between different activities developed on the same areas (hunting, farming, tourism, forestry...).

There is very little information about how economic turnover generated by hunting affects the maintenance or improvement of natural systems, or even the sustainability of hunting itself.

- It would be necessary to analyse the effect of hunting economic turnover on the ecosystem.

There is a lack of information on the cultural or sociological roots of illegal predator control that may explain the striking differences in the level of killing found between neighbouring areas. For example, Extremadura in south-western Spain holds a dense and varied population of raptors apparently suffering few problems of illegal killing or poisoning, while in neighbouring areas (Andalucía, Castilla-La Mancha, and Portugal) raptor populations have strongly declined, and illegal raptor killing may be a relatively important problem.

- Research on the sociological, economic and cultural roots of raptor illegal control and poison use is necessary to understand possible ways of solving the problems.

Farming and gamebirds

There is strong evidence that modern farming and forestry practices are responsible for the decrease of gamebird populations. However, the changes associated with modernisation of practices are numerous, and it is not always possible with current information to identify which are the key elements on which we should act.

- There is a need to further investigate the effect of different farming management techniques on gamebirds.

Effect of gamebird management on biodiversity

Information about the effect of management for gamebirds on species other than game is very scarce, and available data are sometimes contradictory.

- There is a need to investigate the effect of hunting management practices on species other than the target game, preferably at a large geographical scale and on the long term. The ultimate aim of this research would be to identify the most favourable management practices for biodiversity, in order to promote them.

There is very little information about the real levels of implementation of different hunting management practices and their intensity, and quantitative information on the extent of such practices is lacking in many countries, particularly in Spain, Portugal and Finland. Even if detailed experimental studies demonstrate the beneficial effects of management on biodiversity, it is not possible to quantify these benefits in most contexts.

- It is thus necessary to quantify the extent of management practices on hunting areas at regional levels. The ultimate objective of this research would be to determine the influence of management on biodiversity in real, not experimental (or best-practice) conditions.

More research should be carried out on the effect of gamebird releases on game and non-game populations. It is necessary to develop research on the following aspects:

- potential genetic pollution and the spread of maladaptive traits
- spread of diseases and parasites from farm-reared birds into the wild
- potential ecosystem and community-level effects of artificially increased densities of released species
- effects on overall biodiversity of hunting systems based on releases versus the sustainable exploitation of breeding populations

Predation and predator control

There is little information about the effect of predation by raptors, or even predators as a whole, on gamebird populations, particularly in areas, such as southern European countries, that hold complex predator and prey communities.

- There is an urgent need to develop further such studies, to determine the functional and numerical responses of raptors to gamebird populations in species and environmental conditions other than those already evaluated in the existing studies. The study of the effect of predators on gamebirds, particularly on red-legged and grey partridges (the most important gamebird species on farmland) should be one of the key topics of future research. These studies should include the evaluation of the effect of intraguild predation (predators preying on other predators), the effect of alternative prey on predator density and predation rates, and the influence of non-breeding predators, which can sometimes be numerous, on game species.

Very little is known about the effect of culling on raptor populations. It is therefore difficult to define optimal strategies for the management of the potential conflict between gamebird hunting and birds of prey. .

- It is necessary to maintain monitoring schemes of raptor populations, especially in areas where conflicts with hunting interests are expected, to improve our understanding of the effects of legal and illegal predator control on raptor populations

Research on the efficacy of different methods to limit predation on gamebirds is very limited

- It is thus necessary to develop new methods and test existing ones to decrease predation in hunting systems.

In some countries, there is a need for efficient and selective methods of legal predator control, to replace invasive, non-selective and illegal methods commonly used (particularly poison set up for foxes and corvids)

- It is thus important to research on the efficacy of different selective methods for predator control, and develop new ones when necessary.

Sociological tools

There is little practical information on the socio-economic tools that may be used to solve or prevent these conflicts, while maximising conservation benefits from hunting.

- More work is needed on socio-economic tools to aid biodiversity in Europe through hunting, and to solve gamebird hunting/raptor conservation conflicts.
- There is a special need for organisational tools that encourage hunters to help conserve biodiversity and that motivate other conservationists to cooperate with hunters.

More research needs to be done together with sociologists to find ways to improve communication and trust between stakeholders.

- More trials of Decision Models need to be carried out in other frameworks, as well as carry out sociological research with stakeholders.
- Quantification of perceptions of different systems under different stages of knowledge (southern and northern Europe)

RECOMMENDATIONS

1) The agriculture changes that occurred during last decades in Europe, many of them promoted by the Common Agricultural Policy (CAP), are the main reason explaining the decline of gamebird species. This is at the root of the conflicts between gamebird hunting and predator conservation. The hunting and protectionist sectors have a clear scope for collaboration in this respect. The European Commission should promote a framework for collaboration between these two sectors, as well as considering changes in the CAP that may help to promote recovery of wild populations of gamebirds, because hunting may be a good alternative to intensive farming, providing economical inputs to rural communities and promoting preservation or improvement of habitats.

2) Another issue at the root of the conflict is the increase in the populations of some predators due to protection in past decades, which are perceived as incompatible with the high shooting bags required in some systems to maintain the economic and social profits of the hunting activity. This economic and social importance of hunting in some areas (usually easily identified at a geographical scale) must be recognized. The conservation of predators may cause economic damage to game exploitations, and the owners or managers should be compensated in some way. The European Commission should promote financial support to game exploitations using “wise use of resources and good hunting practices” proved to be important for wildlife conservation, including endangered predators. The best way to do this would probably be through a flexible tax system, increasing tax charges to game exploitations that do not provide benefits for biodiversity conservation (e.g. intensive hunting lands with artificially increased game densities obtained by releases, and that do not make efforts to preserve habitats or non-game species), and reducing tax charges in hunting lands that successfully maintain populations of threatened predators and provide benefits for biodiversity.

3) There is a need to find a compromise between hunting and predator conservation interests, but it is unlikely that a single solution will be appropriate all across Europe. European regulations should be flexible enough to allow this geographical variation in solutions, because too strict regulations may worsen the problem instead of helping to solve it.

4) There can be a lack of coordination between farming and hunting if the managers of game are not the owners or managers of the land (e.g. farmers). In some cases it seems that money generated by hunting is used by farmers, but agriculture often works against game preservation. A European Rule regulating rights and obligations of landowners/farmers with respect to managers hiring hunting rights should be considered, and more specifically a legal framework about damages induced by game species to cultivations, in some countries paid by the hunters, but not in others. Governments should provide at least partial financial support to pay for these damages, at least when game species are a critical resource for the conservation of endangered predators (e.g. rabbits for Iberian lynx or Spanish imperial eagle) but viewed as agricultural pests.

5) Legal predator control must be considered as an acceptable management practice, provided:

- i) it is necessary to maintain the economic sustainability of hunting,
- ii) this hunting activity is proved to be useful to maintain or improve habitats, and
- iii) predator control does not threaten predator populations.

In this respect, the facilitation of selective methods for controlling predator populations is a good option to avoid the illegal use of massive non-selective methods such as poisoning, which is causing serious problems for raptor conservation in some countries. Legislation to allow the

use of such selective methods is still lacking or too restrictive in some countries (e.g. Spain), and should therefore be improved.

6) Releases of farm-reared game birds have experienced a dramatic increase during recent decades, reaching in some cases impressive levels (millions of birds released per year and country). In some cases releases may be associated with good management practices promoting biodiversity conservation (e.g. pheasant in UK), but in others, the cost of releases for biodiversity conservation may be higher than the benefits (e.g. red-legged partridge in Spain). Overall, the ecological effects of releases on the ecosystems are poorly understood. Thus, stricter control of releases should be implemented, such as requesting mandatory marking (rings, transponders, etc.) allowing traceability of released animals.

7) The European Commission should create a new organisation, or make better use of already existing ones (such as IUCN), to maintain and improve communication between hunting and other conservation organisations at a European level, as well as communication among other stakeholders, such as farmers and farming organisations, the tourism industry, etc. This organisation should have technical personnel able to provide guidelines for management at a European level, such as hunting pressure on migratory species or monitoring the abundance of game species. This would allow an early detection of possible conflicts and hence look for solutions before they reach a dangerous or irreversible stage.

8) Critical information on key aspects of the conflict or the impact of game management on biodiversity are still lacking. The European Commission should support research on priority areas (as specified above).

ACKNOWLEDGEMENTS

This report reflects the joint work of all REGHAB partners. Particular thanks are due to Nicholas Aebisher, Arjun Amar, Pedro Beja, Elisabeth Bro, Robert Kenward, Santi Mañosa, Steve Redpath and Jari Valkama for their input at different stages of the project and comments on the manuscript.