



Introduction to Living with Environmental Change Pilot Review Reports

When establishing a major research programme such as 'Living with Environmental Change' (LWEC) with such clear relevance to the science-policy interface there is a need for identification of priority policy areas, reflection on the current baseline of evidence, exposure of knowledge gaps and hence the design of programmes of research. This need is now addressed, across many sectors, using a formal evidence-based approach. This approach is perhaps most familiar in the health services, social services and education but is now being actively used in environmental management.

The core methodology in evidence-based practice is the systematic review, involving a rigorous and objective assessment of the best available evidence on a question of concern to policy or practice. However, a systematic review is a significant investment of time and resources and, with the limited resources available it is probably not efficient to launch straight into a programme of systematic reviews without some prior estimation of their value. Consequently a funding scheme for pilot reviews was established.

The Pilot Reviews offer the opportunity to scope academic literature and public reports published on specific questions. It was intended that the reports of the reviews would: outline the existing data and highlight the trends and gaps in knowledge, contain details of the search strategy employed, provide critical appraisal of the quality of the sample of the studies and may produce a draft protocol for a full systematic review. It is hoped that the reports will provide a resource for stakeholders and follow the guidelines given for scoping studies on systematic reviews, which can be accessed at:
<http://www.environmentalevidence.org/Authors.htm>

The LWEC partners agreed six strategic objectives that will inform progress towards the design of the programmes of work that will make up LWEC. The first scheme funded the following reports and was in support of **LWEC Objective B - To manage ecosystem services for human well-being and to protect the natural environment in a changing world**. The LWEC partners were keen to support activities that cover both aspects of Objective B. These include the assessment of links and feedbacks between the natural environment, ecosystem services and human well-being; how these might continue to develop within environmental limits in the face of major environmental change; and how decision-making and local and national planning can take account of these links and feedbacks to help in the development of new social, environmental and economic opportunities. Each of the six reports that form the output of this first scheme provides an initial characterisation of the evidence base on their chosen subjects. This provides a

resource with which to judge the potential value of full systematic reviews and the likely need for primary research.

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Managing conflicts affecting biodiversity, ecosystems and human well-being in a changing environment



Pilot review for “Living with Environmental Change” Objective B (Environment)



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1. Background

Conflicts between the conservation of biodiversity and other human activities occur in all habitats and can impact severely upon socio-economic and biological parameters (Young et al., 2005b). In a changing environment with increasing pressure on biodiversity, these conflicts are likely to increase in importance and magnitude and negatively affect biodiversity and human well-being. It is therefore imperative to better understand the causes of these conflicts and ways forward to manage them effectively.

The drivers of conflicts between biodiversity conservation and human activities are numerous, but broadly fall under the following categories:

- Conflicts related to agricultural and forestry practices (usually driven by policy developments)
- Conflicts linked to other sectoral activities such as water management, energy sources, housing, mining and recreational activities.
- Conflicts linked to conservation policy including the designation and management of protected areas, and the protection of species and habitats

In the UK, many conflicts between biodiversity conservation and other human activities resolve around predator-prey interactions where either one or both species are a protected species, and where one species has a perceived adverse impact on a species or habitat and its associated human activity. Examples are the perceived conflict between hen harriers and grouse in moorlands managed for grouse shooting (Park et al., 2008; Thirgood et al., 2000), between the conservation seals and their potential impacts on fisheries (Bosetti and Pearce, 2003; Butler et al., 2008), between cormorants and their perceived impacts on fisheries (Carss et al., 2009), between the conservation of geese and their impacts on agriculture (Cope et al., 2003; Gill et al., 1996; MacMillan et al., 2004) and that of badgers and their impact on agriculture through the potential transmission of tuberculosis to cattle (Davison et al., 2008; Delahay et al., 2009; Krebs et al., 1998).

The introduction (whether accidental or deliberate) or reintroduction of species can also be at the root of many conflicts. The reintroduction of large carnivores in the UK, for example, may also engender a number of conflicts due to risks to humans and predation on livestock and as such would require extensive ecological and sociological research to determine possible risks and attitudes towards them (Wilson, 2004). Invasive species, for example, can cause conflicts between stakeholder groups, as well as highlighting conflicts between different legislative tools, e.g., those concerning biodiversity conservation and trade (Stokes et al., 2006). In addition, the expansion of existing populations can also cause conflicts, for example the impact in rural areas of gulls, which can be responsible for the transmission of pathogens and parasites through contamination of water sources and damages to buildings (Belant, 1997).

In terms of new or potentially growing conflicts, those linked with infrastructure are likely to become more important in the future as new housing programmes are developed across the UK, which could potentially negatively affect a range of mammal species and lead to human-wildlife conflicts (Baker and Harris, 2007). Likewise, developments such as quarries or funicular railways (Warren, 2002) could negatively affect biodiversity, often in environmentally sensitive areas. A major current conflict also exists between the development of wind farms and their impact on biodiversity (Fielding et al., 2006), particularly birds (Bright et al., 2008). This issue raises a number of important ethical questions, in view of the other environmental benefits of wind farms.

The recent greater access to the countryside through the Countryside and Rights of Way Act 2000 and the Land Reform (Scotland) Act 2003 has also caused some concern, with a

growing number of studies focussing on the impact of recreation on bird conservation (Bathe, 2007; Finney et al., 2005; Mallord et al., 2007) and potential conflicts that could be associated with an increase in recreational activities in environmentally important areas (Roe and Benson, 2001).

In terms of management of conflicts, a number of different approaches exist. These include:

- Political, economic and legislative means;
- Technical solutions: these can be the application of new technologies, changing management practices or land-use patterns, or applying spatial planning methods;
- Deliberative and participatory processes.

Although political and legislative tools can be at the root of many conflicts (Young et al., 2005a), they can also contribute to the effective management of conflicts. For example, agri-environment schemes have been suggested as a policy solution to promote more “environmentally-friendly” farming practices (Riley, 2008), thereby acting as a management mechanism to minimise the conflict between production-based agricultural methods and conservation of farmland biodiversity.

In terms of technical solutions, the role of scientific research can be very important. For example, in the hen harrier-grouse conflict, a number of technical solutions have been suggested including translocation (Watson and Thirgood, 2001), habitat management (Anderson et al., 2009) and supplementary feeding (Redpath et al., 2001). In the case of species that can be negatively affected by new developments, such as crested newts, translocation can be a technical solution, although research needs to be carried out to determine the long-term viability of such options (Edgar et al., 2005). Finally, scientific research can help in providing additional data to inform conflict management with the use of instruments such as models and mapping (e.g. Anderson et al., 2009; Bright et al., 2008; Eppink et al., 2004; Matthiopoulos et al., 2008).

Despite the potential contributions scientific research can make, scientists can also be at the root of many conflicts (Alphandery and Fortier, 2001), often seen by land managers and landowners as imposing management options (Chaineux and Charlier, 2003). Because of this and other more normative arguments, a number of deliberative and participatory processes have been developed to manage biodiversity conflicts. They include participation, co-management (Chase et al., 2000), and community natural resource management (Kellert et al., 2000). As with the other approaches to conflict management, a number of possible problems such as ‘consultation fatigue’ (Richards et al., 2004: 16) and disenchantment (Mosse, 2001) can develop and can lead, for example, to increased mistrust and suspicion amongst stakeholders (Mutamba, 2004). These arguments have led certain authors to imply that rather than acting as an empowerment tool, deliberative and participatory processes may only be a means to project implementation (Mahanty and Russell, 2002). Worse still, some authors contend that deliberative and participatory processes can be a highly formulaic and empty processes dominated by pragmatic policy interests (Mosse, 2001).

In view of the complexity of conflicts between biodiversity conservation and other human activities and in light of the fact that many of these conflicts are likely to increase in number or intensify through increased pressure on natural resources, it is essential to better understand every stage of the conflicts, from their creation to how they are managed. Through previous experience of conflict literature, a pilot systematic review, and an e-conference, the aim of this review was to collate the relevant published and unpublished literature on the topic of conflicts and their management and recommend steps, including recommendations for research, which could alleviate the impacts of such conflicts in a changing environment.

2. Review objectives

The questions addressed in this review were the following:

1. What is the impact of conflicts between biodiversity conservation and other human activities on ecosystems and human well-being, and
2. What mechanisms exist (or must be developed) to address these conflicts and lead to more sustainable ecosystem management?

Following directly from these questions, the specific objectives of this pilot review were to:

- a. Assess current research on the ecological, sociological and economic impacts of conflicts between biodiversity conservation and other human activities;
- b. Identify current research relating to public attitudes towards biodiversity and its management. This includes studies on public understanding of biodiversity, the values the public associates with biodiversity and ecosystem services, and public perceptions of changes in biodiversity;
- c. Investigate the current approaches used to combine human interests with biodiversity conservation objectives, including the applicability and appropriateness of these approaches, potential constraints, and lessons learned. Approaches investigated included political, economic and legislative means; technical solutions (the application of new technologies, changing management practices or land-use patterns, applying spatial planning methods etc.), and deliberative and participatory processes.

Knowledge gaps were identified throughout the reviewing process.

3. Search strategy

3.1. Sources:

The following databases were searched:

1. ISI Web of Science (including ISI Web of Science and ISI Proceedings)
2. ScienceDirect
3. Directory of Open Access Journals
4. JSTOR
5. Copac

All references retrieved from these databases were added to an EndNote library.

The following internet searches were also carried out to complement the above searches:

1. Google Scholar (<http://scholar.google.com>)
2. Scirus (<http://www.scirus>)

The first 50 hits for both search strings were retrieved and added to an Excel spreadsheet in the case of Google Scholar and the End Note library in the case of Scirus results. These were then reviewed and cross-referenced against the results from the databases. All results found to be inappropriate to the search question and duplicates were deleted.

Two search strings were used to address the questions listed in the objectives:

- ((conservation OR biodiversity management OR wildlife) AND (conflict* OR dispute*) AND (UK OR United Kingdom OR Scotland OR Wales OR Ireland OR Britain OR England OR British Isles)) and;

- ((biodiversity OR wildlife OR human-wildlife) AND conflict* AND ("conflict manage*" OR communicat* OR participat* OR legislat* OR law* OR polic*))

In addition, the terms “conflict” and “dispute” were searched in an existing EndNote library that was the basis of the BIOFORUM project review (Young et al., 2003).

3.2. Study inclusion criteria

Table 1. Definition of the components of the pilot systematic review question 1:

Subject: Ecosystem health and human well-being	Intervention: Conflicts between biodiversity conservation and other human activities	Outcomes: Negative impacts on biodiversity and humans
Species status Ecosystem services Habitat status Human well-being as defined by the MA: includes the basic materials for a good life (including livelihoods), freedom of choice and action, health, good social relationships, a sense of cultural identity, and a sense of security	EU-level policy conflicts (CAP, CFP, Natura 2000, WFD) Predator-prey conflicts: fish-eating species and fisheries, protected species and agriculture (e.g. geese), raptors and hunting Introductions of alien (non-native species) Infrastructure-linked conflicts: siting and impacts of wind turbines and other new energy sources, mining, housing developments, transport infrastructure Local & national level protected areas and species Species re-introductions (wolf, beaver, wild boar, white-tailed eagles, osprey, goshawk, red kite) Recreation & tourism activities responsible for degradation or disturbance Conflicts linked to agricultural, fishery & forestry practices (e.g. acidification of rivers through forestry practices, loss of habitat for species such as corncrake from agricultural practices)	Species decline (e.g. loss of corncrakes due to intensive agriculture) Negative impacts on ecosystem services, e.g. loss of pollinators and impacts on livelihoods, food-chains etc Habitat degradation or loss Impact on livelihoods (including loss of livelihoods through stopping of a certain activity that is deemed to have negative impacts on biodiversity) Impacts on human health (parasites/disease, noise, air and light pollution) Animal welfare issues (e.g. culling of seals) that can impact on emotional well-being Impacts on beneficial human activities such as walking and nature recreation

Table 2. Definition of the components of the pilot systematic review question 2:

Subject: Conflicts between biodiversity conservation and other human activities	Intervention: Conflict management mechanisms	Outcomes: Change in the intensity or frequency of the conflict
EU-level policy conflicts (CAP, CFP, Natura 2000, WFD) Predator-prey conflicts: fish-eating species and fisheries, protected species and	Political and/or legislative (e.g. mediation, changes in policies or laws development of new policies or laws, prosecutions) Economic means (incentives,	Acceptance of conflict management mechanism (e.g. acceptance of management plan measures) Collectively agreed plans and

<p>agriculture (e.g. geese), raptors and hunting</p> <p>Introductions of alien (non-native species)</p> <p>Infrastructure-linked conflicts: siting and impacts of wind turbines and other new energy sources, mining, housing developments, transport infrastructure</p> <p>Local & national level protected areas and species</p> <p>Species re-introductions (wolf, beaver, wild boar, white-tailed eagles, osprey, goshawk, red kite)</p> <p>Recreation & tourism</p> <p>Conflicts linked to agricultural, fishery & forestry practices (e.g. acidification of rivers through forestry practices, loss of habitat for species such as corncrake from agricultural practices)</p>	<p>compensation)</p> <p>Collaborative management: consultation, participation, mediation, Alternative Dispute Resolution, natural resource management, management plans</p> <p>Practical solutions (e.g. supplementary feeding, research)</p> <p>Communication</p>	<p>decisions</p> <p>Positive biodiversity changes</p> <p>Increased communication efforts</p> <p>Better relationships between actors</p> <p>Increase in trust between actors</p> <p>Collective learning of issues and perspectives</p>
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Geographic scale was an issue in determining which articles to retain. It was agreed at the beginning of the review that we would look at the UK scale to determine the range of conflicts between biodiversity conservation and human activities occurring in the UK, but that we would not restrict the geographical scale in the second question, i.e. regarding management measures. During the selection of articles however, a judgement was made on each individual article regarding the appropriateness of management measures with regards to their application to UK-based conflicts.

Exclusion criteria:

Articles were not included if they:

- Were not specific to biodiversity (i.e. any articles that were linked to environmental protection, environmental health etc were not included)
- Involved less than two human actors. In this respect, we adopted the definition of biodiversity conflict developed by White et al (2009) as “conflicts between people about wildlife or other aspects of biodiversity, as opposed to human-wildlife conflicts which are defined as occurring whenever an action by humans or wildlife has an adverse effect on another”.

3.3. E-Conference

An e-conference was carried out from 11th-15th May to better understand conflicts currently affecting biodiversity in the UK and to learn and share experiences from scientists and practitioners from across Europe regarding ways in which to manage such conflicts. The main aim of the e-conference was to gain a more complete picture of conflicts than those published in peer-reviewed or grey literature. Indeed, many conflicts mentioned by participants were

occurring now, and were being dealt with by practitioners who were unlikely to publish their experiences, not being in the academic field and not always required to communicate their experiences in either peer-reviewed or grey literature.

Contributions were welcomed on new literature or direct experience of recent or ongoing conflicts, conflict management measures, and any gaps in knowledge regarding the following topics:

- Conflicts related to agricultural and forestry practices (driven by policy developments)
- Conflicts linked to other sectoral activities such as water management, energy sources, housing, mining and recreational activities.
- Conflicts linked to conservation policy including the designation and management of protected areas, and the protection of particular species and habitats

The results of the e-conference were compiled and distributed to all e-conference participants and contributed to this review by gaining an overall picture of conflicts rather than those published or in the public domain.

4. Results

4.1. Pilot systematic review search statistics

The search captured a large number of articles (n=1577). After removing duplicates, and based on an assessment of the titles, the total remaining number of articles was 404. Of those, 201 were retained after reading through their abstracts. Twenty five of these articles were then randomly selected and analysed for the purposes of this review. Following an initial review of the full text of these articles, a further eight were deemed not to be relevant in terms of inclusion criteria and these were replaced by a second selection from the database.

4.2. Pilot systematic review search results

The results of the detailed analysis of selected papers are shown below. They are grouped according to a slightly amended version of the conflict management process described by Chase et al. (2000), namely starting with the knowledge base at the core of the management process, informing the decision-making-making process comprising the identification of alternatives to the current conflict situation and their consequences, and choosing a particular course of action to manage the conflict.

4.2.1. Building the knowledge base

Many of the papers selected (44%) focused on the “information base” of an existing conflict situation (Chase et al., 2000), i.e. the scientific information about conflicts. So, for example, in the case of the conflict between the conservation of birds of prey and gamebirds, the information base related to providing input in terms of what the actual impact of predator species may be on prey species (see for example Park et al., 2008). Other papers explored the impact of sea mammals on fisheries (Matthiopoulos et al., 2008), current knowledge of effects of birds on freshwater fisheries and vice versa (Wanink and Chifamba, 1999) and mapping of Special Protection Areas for birds and how these may impact on future wind farm developments (Bright et al., 2008). Building a knowledge base is an important aspect of any conflict management process to gain a greater understanding of the factual elements of a conflict on which to build any conflict management strategy. However, this brings us to an important aspect of conflicts between biodiversity conservation and other human activities, namely the issue of *perceptions* held by stakeholders, either of impacts, other stakeholders (Marshall et al., 2007), or strategies to manage the conflict. Because of these perceptions, managing a conflict will rarely be achieved by showing stakeholders the results of scientific

investigations. This is an area in which social sciences can and do make an important contribution. Indeed, of the 11 papers focussing on the knowledge base, 7 were grounded in social sciences.

In terms of understanding conflicts, the paper by White *et al.* (2009) is a good example of the contribution of social science to the knowledge base. This paper presents a conceptual framework that includes the need to consider a number of underlying issues, such as attitudinal indicators of biodiversity consisting of aggregate measures of perceived ecological, economic and social factors; and behavioural indicators of conflict and outcome-related indicators. Understanding and integrating different knowledges and values in conflict situations are often key to understanding why certain management options work or not, how stakeholders interact and how conflicts develop. For example, understanding the role and potential contributions of farmers could be key in increasing uptake of “biodiversity-friendly” agricultural schemes, which could in turn play a role in minimising the conflict between species conservation and potentially harmful agricultural practices (Riley, 2008). Better understanding of how farmers make decisions regarding whether or not to join a scheme may also be useful in terms of improving communication, identifying key individuals and promoting better schemes (Wilson, 1997). This research can also apply to the wider public in order to understand the underlying reasons influencing acceptability (or not) of management actions (Zinn *et al.*, 1998). This latter aspect is very important, as management actions can often be at the root of many conflicts. In the case of the implementation of Natura 2000, for example, conflicts, usually sparked off by designation of site relying solely on scientific information, were often the most direct driver of participation (Rauschmayer *et al.*, 2009). However, participation, if carried out in an inappropriate way, can be a source of great tension among stakeholders. Therefore, basing management actions (whether practical or political) on a solid understanding of values and different types of knowledges can help minimise potential conflicts. This is made explicit in the paper by Skutsch (2000), in which the author calls for conflicts to be acknowledged before they even manifests themselves outwardly, and for training grounded in conflict analysis and conflict resolution skills to be mandatory for any professionals working in relevant fields.

4.2.2. Exploring alternatives

In addition to the information base, a number of papers analysed (n=6, or 24%) focussed on the first phase of the decision-making process, i.e. the identification of alternatives to the current conflict situation, and their consequences. Five of the six papers analysed were written by natural scientists.

The papers focussed on many different alternatives. Zoning was a tool considered by Geneletti *et al.* (2008) in order to provide stakeholders with a visual overview of a National Park boundary, taking into account conservation and other activities in the area. Mapping and zoning approaches can be very useful communication tools in many instances and can also contribute to the knowledge base by integrating many different types of data. In terms of looking at technical solutions that could be alternatives to the current conflict situation, one alternative examined by Amar *et al.* (2004) in the case of the raptor/grouse conflict was the identification of potential “problem animals” which could be targeted by grouse managers for supplementary feeding, thereby reducing the intensity of the conflict. This, together with other technical solutions relating to this conflict such as intraguild predation, raptor “quotas” and raptor translocation, was reviewed in a paper by Thirgood *et al.* (2000). In another paper by Cope *et al.* (2003) looking at the conflict between barnacle geese and agriculture, observations of distribution and abundance of geese, in combination with multilevel modelling, identified alternatives to the current situation, including expanding the range and quality of the existing Barnacle Goose Management Scheme and/or expanding the reserve network. Another technical solution was explored by Edgar *et al.* (2005) regarding the feasibility and effectiveness of translocation in the case of great crested newts, a protected

species often threatened by new developments in the UK.

Like building an information base, exploring alternatives to the conflict situation is an essential part of conflict management and one in which scientists are often involved. Issues occurring at this stage can also relate to scale. So, while many local-scale methods have been tested in order to manage the conflict with gulls, Belant (1997) suggests an alternative that might be more effective: that of addressing and managing the conflict at the landscape-scale. The author also mentions in his paper the need for a working group to address the extent of the problem, potential solutions and the evaluation of these suggestions, an issue perhaps more related to the final phase of conflict management, namely choosing and applying management action(s).

4.2.3. Choosing and applying management actions

Whereas the second phase, i.e. looking at alternatives, was dominated by the natural sciences and consisted mainly of quantitative data sources, the majority of papers in the final phase of decision-making were dominated by input from the social sciences. Of the eight papers analysed in this category, six were based on qualitative data, one was based on quantitative with the last used a mix of qualitative and quantitative data. This is unsurprising, as the second phase of the decision-making process, i.e. choosing and applying the decision, can be more or less participatory and will often be studied from a sociological perspective.

Regarding the different types of approaches to help choose and apply management actions, the most participatory is no doubt co-management whereby participants are “involved in many stages of the decision-making process, sharing responsibility for anything from identifying problems to implementing and evaluating management actions” (Chase et al., 2000). This was very much the thinking behind the development of the Moray Firth Seal Management Plan described in the paper by Butler et al. (2008). Although the management plan was developed by a key stakeholder in the conflict, a very participatory approach was adopted whereby all stakeholders were involved and could contribute either face to face, by telephone or through meetings. The end result was a common product agreed upon by all parties. Continued monitoring of the biological parameters ensures that many stakeholders are still actively involved.

Other tools described in this category were multi-stakeholder platforms (Faysse, 2006), Deliberative and Inclusionary Processes and mitigation banking (Ledoux et al., 2000) and Community Natural Resource Management (Kellert et al., 2000). In the case of highly polarised conflicts, the use of mediators or facilitators is often required, particularly in cases where some stakeholders may not feel on an equal footing with other stakeholders. The use of mediation was described in a case study of a successful conflict management process between nature conservationists and coastal protectionists in the Netherlands (Striegnitz, 2006). In addition to the involvement of a mediator, another key aspect of the process was the direct involvement of a high-level decision-maker in the process, which enabled decisions taken by the stakeholder group to be acted upon. This is a potentially very important issue, as failure to include decision-makers may result in expectations not being met and stakeholders feeling disillusioned by the entire process.

4.3. E-conference results

The e-conference had a total of 61 participants. Many participants were based in the UK (33%), although participants from 13 other European countries also took part, as well further afield, including Australia and Russia. Over the week-long e-conference, a total of 11 contributions were made by 7 contributors. The conflicts described by participants spanned across a wide variety of habitats, including marine, freshwater and agricultural landscapes. Contributors identified a total of eleven references, eight of which had not been picked up in

the pilot systematic review process. However, two of these were in a foreign language (French and Portuguese), another two were books or book chapters and three were unpublished commissioned reports. The e-conference therefore reflected the relative comprehensiveness of the pilot systematic search. In addition, the e-conference also highlighted the fact that much of the literature on biodiversity conflicts is still relatively unrepresented in ISI journals, and that a future focus of a review on conflicts might need to focus more on drawing information from grey literature and other sources.

4.3.1. Conflicts identification and building a knowledge base

Many conflicts described by participants to the e-conference related to policy developments. For example those conflicts described by Juliette Young (2009) and Dave Carss (2009) were linked to the implementation of the Birds and Habitats directives. In many ways these Directives can be seen as being successful, in terms of aiding species gain favourable status through added protection. An increase in number of these species can, however, cause a number of conflicts.

This was well illustrated in Dave Carss' contribution (2009), which focussed on the conflict between cormorant conservation and fisheries. A dramatic increase in cormorant numbers resulting from increased protection in recent years has lead many to see cormorants as an invasive or alien species. In parallel with the cormorant's increase, many fisheries have declined, but the relationship between cormorant increase and fisheries decline remains difficult to evaluate and more information is also needed on other factors that could be affecting fisheries negatively. In addition, whatever the aspects impacting on fisheries are, these are in many cases affecting livelihoods of fishermen. As such, this conflict, like many others, has important economic, social and cultural issues attached to it. For other examples, see contributions from Jan Jansen (2009a) in the context of farming practices and protected site designation, and Redpath & Thirgood (2009), in the context of conflicts between raptor conservation and gamebirds.

Davy McCracken (2009) focussed his contribution on current conflicts in agricultural areas, many of which are linked to policy and linked funding mechanisms. He started his contribution by outlining a number of problems with agri-environment schemes, namely that funds directed towards these schemes were currently limited and insufficient, and that they relied on farmers to engage voluntarily in them, resulting in potentially limited uptake, an issue which could be exacerbated with the implementation of new Rural Development Programmes. The effectiveness of agri-environment schemes was also called into question, with schemes often not taking into consideration management outside the farm and also focused on actions aimed at particular habitats or species, which could lead to conflicts where the management requirements for one species was different from those of another. An added problem with the RDP was the risk of increasing conflicts over where best to target agri-environment funding. Indeed, while agri-environment schemes were traditionally directed at farms in the wider countryside, with farmers with some form of nature conservation designation on their land able to seek separate funding, from for example, from the Scottish Natural Heritage (SNH), all funds for wider countryside and protected area management now sit within the same budget within the current Scottish RDP. Competition for these funds is likely to be high and could result in farms in the wider countryside not being able to benefit from funding within the RDP. He also identified a potentially serious conflict regarding payments for High Nature Value (HNV) farming competing with funds from Common Agricultural Policy's (CAP) Pillar 1 and Pillar 2 budget. In conclusion he called for major changes in the way that CAP support was targeted in order to prevent further farmland biodiversity decline, for example by making it a requirement for all farmers to do more in order to qualify for Pillar 1 support thereby using available limited Pillar 2 funds more effectively. Farmers would therefore need to achieve a minimum level of appropriate habitat diversity and/or management at the farm scale in order to qualify for their single farm

payment.

Jan Jansen (2009a) agreed with the view that much needed to be changed in order to preserve biodiversity-rich areas of farmland and suggested that the role of farmers' management should not only be defined in terms of narrow direct conservation payments but should be seen in a much more holistic way in terms of strengthening the synergy between nature conservation, agri-/eco-tourism, food quality production, water management, erosion control, use of renewable energy, fire and CO₂ emissions prevention, climate change management, social cohesion, cultural heritage protection and other activities. Following on from this, he emphasised that Natura 2000 would only work based on the understanding that many high-nature value farming areas have been created as a result of hundreds of years of extensive farming practices and that the success of the network hinged on an strong interplay with local people and the economy.

Vicky Ellis (2009) discussed the issue of species re-introductions in her contribution. She described the natural processes resulting from species extinctions and questioned the need, especially with habitats becoming increasingly fragmented and smaller, to reintroduce yet more competition for space and food.

In terms of understanding conflicts, Rehema White (2009a) emphasised the need for a broader framework for understanding conflicts. She advocated the need to look at conflicts through a sustainable development lens, i.e. moving away from the more traditional bi-polar view of conflicts as being between groups aiming to maximise biodiversity and those who prioritise a socio-economic goal and into a more holistic view in which environmental stewardship and social justice are seen to be complementary and co-dependent. But she followed this with potential challenges to this holistic framework approach, including greater costs, and the need to develop practical mechanisms to implement this framework.

4.3.2. Challenges

In addition to those challenges identified by Rehema White in the context of a broader framework for understanding conflicts, other challenges were highlighted by participants, including scale, communication of uncertainty and complexity and the role of different stakeholders in the process.

The issue of scale was mentioned in many contributions. Not only do many species range over large areas and often cause serious damage on the local scale, but also the environmental scale which is best suited to a particular species might not be the ideal scale at which to implement management actions. As such, it may be important, for example in order to best identify and manage conservation areas such as Special Protection Areas (SPAs) and Special Areas of Conservation (SACs), to understand the interrelations within one (smaller) region as well as the interrelations between the functionality of different smaller entities within the (global) region. This latter aspect was highlighted in Jan Jansen's (2009b) contribution, in which he called for multidisciplinary research to develop a concept capable of describing, analysing and valuing global and regional structures (ecological, social, economic, politico-administrative) in their wider geographic context.

The role of scientists in conflict management was mentioned by a number of participants. A number of difficult issues were associated with this: How can a scientist be truly "independent" in a conflict situation? Are they stakeholders – if so what is their role? How can the complexity of a conflict, uncertainty and issues of scale best be communicated to stakeholders in order to best inform their decision-making? How can scientists build trust with other stakeholders? In the case of the raptor/gamebird conflict, Steve Redpath and Simon Thirgood (2009) advocated the need for clear, rigorously collected knowledge about the conflict. They noted this was often difficult to achieve and needed to be accompanied by

managing expectations, communicating science clearly, building trust between scientists and stakeholders, and for stakeholders to be involved in the design and, to some degree, have ownership of the data. In terms of the role of scientists, they saw scientists very much as stakeholders in the process, but emphasised that scientists may need to acknowledge that their data might not be accepted in situations where political or legal issues dominated.

Another aspect, discussed by Dave Carss (2009) and other contributors, and key to conflict management situations, was the importance of developing and maintaining dialogue and trust between stakeholders throughout the conflict management process. This aspect was particularly emphasised in the contribution by Redpath & Thirgood (2009), who identified challenges in this area, including the need to determine who holds the power, who leads the discussions, who should be involved, and who should fund the meetings. They stressed the need to ensure all stakeholders recognised the need for communication and the need to find ways of managing the conflict through dialogue. In their experience, this could take a long time and could require the involvement of an independent facilitator for stakeholders to feel they were all on an equal footing. They also advocated the involvement of decision makers within the process in order to be able to make progress once ways forward are agreed upon and to involve natural and social scientists early on in order to support stakeholders and provide valuable information.

4.3.3. Conflict management strategies

Management plans as a way of managing conflicts were discussed by Juliette Young (2009) and Rehema White (2009b). Rehema highlighted the lessons that could be learned from experiences in developing countries, for example from co- management and Community Based Natural Resource Management (CBNRM), and suggested we should perhaps be using action research education for sustainability more to enhance success of participatory management plans in Europe. She also highlighted the issue of funding for management plans and the importance of costing (in terms of money, time and effort) participation effectively and using resources in the most effective way, perhaps even seeking broader investment from private-public partnerships. Returning briefly to the issue of scale, Dave Carss (2009) highlighted the need for management plans to be capable of incorporating these issues, requiring a flexible and dynamic approach to be successful.

To conclude, perhaps the main message to come out of our contributions to the e-conference was, using Steve Redpath and Simon Thirgood's words, that "*Although the process of finding solutions may sound simple in theory, in practice the steps [...] require participants to have the patience of Job, a bloody good sense of humour and a large quantity of whisky to share*".

For a complete overview of the e-conference, including all e-conference contributions, please refer to the attached e-conference report.

5. Reflection, conclusions and future research needs

A number of key issues were identified during the pilot systematic review and the e-conference, in which scientists with direct experience of working in conflict situations, some for as many as 20 years, participated. Many of the key issues identified are very practical considerations, perhaps best suited for scientists entering a conflict situation or wildlife managers needing to address a conflict situation – these are outlined in the e-conference report. However, many of these considerations and those outlined in papers selected for the pilot systematic review lead directly to research priorities.

One important aspect that emerged during the review and e-conference was the learning gained from the processes, rather than the more direct outcomes of the review and e-conference. As such, this section starts with a critical reflection on the pilot systematic review

and e-conference processes, before exploring how best to take the outcomes of these methods forward into future work.

5.1. Critical reflections on the pilot systematic review and e-conference processes

- The pilot systematic review was well-balanced in terms of research on the knowledge base, possible alternatives to current conflict situation and the application of methods to manage conflicts. Although papers were well balanced in terms of input from natural and social sciences in terms of building knowledge bases, exploring alternatives was dominated by technical, natural science-based options, while applying conflict management methods was an area more grounded in social sciences.
- Based on our experience of the conflict literature, we believe the string of keywords used in the pilot review did not capture all ISI papers dealing with conflicts. In addition, the string of keywords also captured many papers describing situations which were not “conflicts” as we understood them (see definition on p.5). We explain this by the fact that many conflicts are not referred to as “conflicts” in the ISI literature, that many conflict situations are not published (see later point) and that it may be difficult, if not impossible, to capture such a complex field as biodiversity conflicts with a limited string of keywords. Equally, it is important to highlight the potential bias in the identification of strings of keywords, and that, in this case at least, the pilot review was highly dependent on an already in-depth knowledge of the conflict literature to verify the effectiveness of the search in terms of capturing all relevant papers.
- Very few papers relating to conflicts were interdisciplinary, despite the very nature of biodiversity conflicts.
- One perhaps surprising aspect of the review was the lack of papers on the evaluation or monitoring of conflict management strategies. This is an aspect of the conflict management cycle that has been highlighted in a number of papers dealing with conflicts (e.g. Niemela et al., 2005; Young et al., 2005a), but is one which seems to be lacking in literature reviewed.
- Other issues that were perhaps not covered by the review or the e-conference were the role of policy, lobbying and campaigning in conflict management. Potentially these areas could have major repercussions of how a conflict is created and/or managed and as such could also be a focus of future research.
- Scale was mentioned by many participants to the e-conference but lacking in the papers reviewed. From the contribution by participants to the e-conference, all of which were involved in conflict management, scale is a potentially key element to conflict identification and management - one which is still poorly understood.
- The e-conference was a useful triangulation exercise in terms of testing the outcome of our pilot systematic review and highlighted some important weaknesses of the pilot systematic search. The results from the e-conference demonstrated the fact that much of the literature on biodiversity conflicts is still poorly represented in ISI journals, despite its importance.
- The e-conference had a limited number of contributions despite a high number of participants and high levels of interest prior to the e-conference. In the future, we would recommend a longer e-conference with a longer preparation period in order to better publicise the e-conference and ensure more keynote contributions to stimulate debate and discussion.

5.2. Conclusions and future research areas

What is clear from the review and e-conference is the importance of biodiversity conflicts in view of their potential and real impacts on conservation efforts and human well-being. While more work needs to be done on identification of conflicts, understanding of these conflicts and management, based on the results of the systematic review and e-conference, future work

on reviewing biodiversity conflicts in the UK and ways of managing such conflicts should not focus solely on systematic, or even traditional, reviews. Indeed, experience from this exercise has shown that many conflicts either exist but are not managed, or are managed but rarely published in ISI or other peer-reviewed documents, and if published, are often not referred to as “conflicts”. In addition, many of the papers published in such journals do not always focus directly on biodiversity conflicts as understood in this review (see definition on p.5). For example, papers published on alternatives to current conflict situations do not necessarily lead to solutions that are to be communicated to other stakeholders and implemented. Many of these papers focus on scientific ideas that do not always have practical applications. In addition, and as mentioned earlier, very few papers addressing conflicts are truly interdisciplinary and therefore are not capable of addressing all aspects of a conflict – an issue highlighted repeatedly as essential in the e-conference.

In order to provide evidence-based policy in the case of biodiversity conflicts, the evidence-base should not rely strongly on published papers, but rather should tap into other sources of information. As such, any future work on reviewing biodiversity conflicts and discussing ways of managing these conflicts should aim to draw information directly from practitioners, scientists (both natural and social) and other stakeholders including land managers (including country agencies) and decision-makers. Methods to achieve this need to be interdisciplinary and could include a large focus group in the first instance to gather a representative set of interested people who could, in turn, suggest people who should be involved (in effect a snowballing exercise). This could then be followed up by a number of other focus groups and/or interviews to gain a more in-depth understanding of individual participants’ roles and views on conflicts. Each participant could also be asked, in turn, to suggest others who could add to this knowledge bank. This snowballing technique could be used until the majority of conflicts between biodiversity conservation and other human activities in the UK are identified and understood.

In terms of following up this review process with research on conflict understanding and management, the following areas were identified from papers and e-conference contributions:

- There is a need to gain solid inter-disciplinary knowledge of conflicts in order to better understand all underlying economic, social and cultural issues – this requires more and stronger interdisciplinary partnerships between scientists.
- Perceptions are often important elements of a conflict situation. As such, these need to be acknowledged, understood and managed appropriately. In addition, understanding and integrating different knowledges and values in conflict situations can inform on why certain management options work or not, how stakeholders interact and how conflicts develop.
- The issue of scale (both temporal and spatial) needs to be considered and addressed in any conflict situation – this issue was mentioned both in the pilot systematic review and the e-conference and is one which currently would seem to lack attention.
- Research on the role of scientists in conflict situations is still poorly understood, which can prove problematic for effective integration of scientific results into a conflict situation. Potential questions to be addressed are: How can complex scientific issues best be communicated? How can trust between scientists and other stakeholders be improved?
- The inclusion of decision-makers in a conflict management process can be instrumental in terms of enabling progress if and when decisions are agreed upon. More work could potentially focus on how best to include decision-makers, what their role in conflict management can be and how to manage their interaction with other stakeholders.
- Participation is often hailed as a positive way forward in conflict management, but more research needs to be done on who the ‘stakeholders’ are, how best to involve them, how to communicate effectively and how resources for public participation can be used in the most effective way.

- There is a need to develop processes that enable continued exchange of information between all stakeholders involved in conflict management. This includes methods capable of improving communication of scientific information to stakeholders and integrating different knowledges better in the process to allow two-way dialogue.

References:

- Alphandery P, Fortier A, 2001. Can a territorial policy be based on science alone? The system for creating the Natura 2000 network in France. *Sociologia Ruralis* 41:311-+.
- Amar A, Arroyo B, Redpath S, Thirgood S, 2004. Habitat predicts losses of red grouse to individual hen harriers. *Journal of Applied Ecology* 41:305-314.
- Anderson BJ, Arroyo BE, Collingham YC, Etheridge B, Fernandez-De-Simon J, Gillings S, Gregory RD, Leckie FM, Sim IMW, Thomas CD, Travis J, Redpath SM, 2009. Using distribution models to test alternative hypotheses about a species' environmental limits and recovery prospects. *Biological Conservation* 142:488-499.
- Baker PJ, Harris S, 2007. Urban mammals: what does the future hold? An analysis of the factors affecting patterns of use of residential gardens in Great Britain. *Mammal Review* 37:297-315.
- Bathe G, 2007. Political and social drivers for access to the countryside: the need for research on birds and recreational disturbance. *Ibis* 149:3-8.
- Belant JL, 1997. Gulls in urban environments: landscape-level management to reduce conflict. *Landscape and Urban Planning* 38:245-258.
- Bosetti V, Pearce D, 2003. A study of environmental conflict: the economic value of Grey Seals in southwest England. *Biodiversity and Conservation* 12:2361-2392.
- Bright J, Lanyston R, Bullman R, Evans R, Gardner S, Pearce-Higgins J, 2008. Map of bird sensitivities to wind farms in Scotland: A tool to aid planning and conservation. *Biological Conservation* 141:2342-2356.
- Butler JRA, Middlemas SJ, McKelvey SA, McMyn I, Leyshon B, Walker I, Thompson PM, Boyd IL, Duck C, Armstrong JD, Graham IM, Baxter JM, 2008. The Moray Firth Seal Management Plan: an adaptive framework for balancing the conservation of seals, salmon, fisheries and wildlife tourism in the UK. *Aquatic Conservation-Marine and Freshwater Ecosystems* 18:1025-1038.
- Carss DN, 2009. Fishing trip. In: *Managing conflicts affecting biodiversity, ecosystems and human well-being in a changing environment: Report of an e-conference* (Young J, Watt A, Carss DN, eds).
- Carss DN, Bell S, Marzano M, 2009. Competing and coexisting with cormorants: ambiguity and change in European wetlands. In: *Landscape, Process and Power: re-evaluating traditional environmental knowledge* (Heckler S, ed): Berghahn Books.
- Chaineux MCP, Charlier RH, 2003. Sustainability on the coast? By communication, not diktat. *Journal of Coastal Research* 19:947-955.
- Chase LC, Schusler TM, Decker DJ, 2000. Innovations in stakeholder involvement: What's the next step? *Wildlife Society Bulletin* 28:208-217.
- Cope DR, Pettifor RA, Griffin LR, Rowcliffe JM, 2003. Integrating farming and wildlife conservation: the Barnacle Goose Management Scheme. *Biological Conservation* 110:PII S0006-3207(0002)00182-00189.
- Davison J, Huck M, Delahay RJ, Roper TJ, 2008. Urban badger setts: characteristics, patterns of use and management implications. *Journal of Zoology* 275:190-200.
- Delahay RJ, Davison J, Poole DW, Matthews AJ, Wilson CJ, Heydon MJ, Roper TJ, 2009. Managing conflict between humans and wildlife: trends in licensed operations to resolve problems with badgers *Meles meles* in England. *Mammal Review* 39:53-66.
- Edgar PW, Griffiths RA, Foster JP, 2005. Evaluation of translocation as a tool for mitigating development threats to great crested newts (*Triturus cristatus*) in England, 1990-2001. *Biological Conservation* 122:45-52.
- Ellis V, 2009. Re-introducing lost species. In: *Managing conflicts affecting biodiversity, ecosystems and human well-being in a changing environment: Report of an e-conference* (Young J, Watt A, Carss DN, eds).
- Eppink FV, van den Bergh J, Rietveld P, 2004. Modelling biodiversity and land use: urban growth, agriculture and nature in a wetland area. *Ecological Economics* 51:201-216.
- Faysse N, 2006. Troubles on the way: An analysis of the challenges faced by multi-stakeholder platforms. *Natural Resources Forum* 30:219-229.
- Fielding AH, Whitfield DP, McLeod DRA, 2006. Spatial association as an indicator of the

- potential for future interactions between wind energy developments and golden eagles *Aquila chrysaetos* in Scotland. *Biological Conservation* 131:359-369.
- Finney SK, Pearce-Higgins JW, Yalden DW, 2005. The effect of recreational disturbance on an upland breeding bird, the golden plover *Pluvialis apricaria*. *Biological Conservation* 121:53-63.
- Geneletti D, van Duren I, 2008. Protected area zoning for conservation and use: A combination of spatial multicriteria and multiobjective evaluation. *Landscape and Urban Planning* 85:97-110.
- Gill JA, Watkinson AR, Sutherland WJ, 1996. The impact of sugar beet farming practice on wintering pink-footed goose *Anser brachyrhynchus* populations. *Biological Conservation* 76:95-100.
- Jansen J, 2009a. Potential Natura 2000 site conflicts. In: *Managing conflicts affecting biodiversity, ecosystems and human well-being in a changing environment: Report of an e-conference* (Young J, Watt A, Carss DN, eds).
- Jansen J, 2009b. RE: Management plans as a way of managing conflicts? In: *Managing conflicts affecting biodiversity, ecosystems and human well-being in a changing environment: Report of an e-conference* (Young J, Watt A, Carss DN, eds).
- Kellert SR, Mehta JN, Ebbin SA, Lichtenfeld LL, 2000. Community natural resource management: Promise, rhetoric, and reality. *Soc Nat Resour* 13:705-715.
- Krebs JR, Anderson RM, Clutton-Brock T, Donnelly CA, Frost S, Morrison WI, Woodroffe R, Young D, 1998. Policy: Biomedicine - Badgers and bovine TB: Conflicts between conservation and health. *Science* 279:817-818.
- Ledoux L, Crooks S, Jordan A, Turner RK, 2000. Implementing EU biodiversity policy: UK experiences. *Land Use Policy* 17:257-268.
- MacMillan D, Hanley N, Daw M, 2004. Costs and benefits of wild goose conservation in Scotland. *Biological Conservation* 119:475-485.
- Mahanty S, Russell D, 2002. High stakes: Lessons from stakeholder groups in the biodiversity conservation network. *Soc Nat Resour* 15:179-188.
- Mallord JW, Dolman PM, Brown AF, Sutherland WJ, 2007. Linking recreational disturbance to population size in a ground-nesting passerine. *Journal of Applied Ecology* 44:185-195.
- Marshall K, White R, Anke F, 2007. Conflicts between humans over wildlife management: on the diversity of stakeholder attitudes and implications for conflict management. *Biodiversity and Conservation* 16:3129-3146.
- Matthiopoulos J, Smout S, Winship AJ, Thompson D, Boyd IL, Harwood J, 2008. Getting beneath the surface of marine mammal - fisheries competition. *Mammal Review* 38:167-188.
- McCracken D, 2009. Addressing farmland biodiversity declines: conflicts and cures. In: *Managing conflicts affecting biodiversity, ecosystems and human well-being in a changing environment: Report of an e-conference* (Young J, Watt A, Carss DN, eds).
- Mosse D, 2001. 'People's Knowledge', Participation and Patronage: Operations and Representations in Rural Development. In: *Participation: The New Tyranny?* (Cooke B, Kothari U, eds). London: Zed Books
- Mutamba E, 2004. Community participation in natural resources: reality or rhetoric? *Environmental Monitoring and Assessment* 99.
- Niemela J, Young J, Alard D, Askasibar M, Henle K, Johnson R, Kurttila M, Larsson TB, Matouch S, Nowicki P, 2005. Identifying, managing and monitoring conflicts between forest biodiversity conservation and other human interests in. *Forest Policy and Economics* 7:877-890.
- Park KJ, Graham KE, Calladine J, Wernham CW, 2008. Impacts of birds of prey on gamebirds in the UK: a review. *Ibis* 150:9-26.
- Rauschmayer F, van den Hove S, Koetz T, 2009. Participation in EU biodiversity governance: how far beyond rhetoric? *Environment and Planning C-Government and Policy* 27:42-58.
- Redpath S, Thirgood S, 2009. Experience from the field: conflict over predator management.

- In: Managing conflicts affecting biodiversity, ecosystems and human well-being in a changing environment: Report of an e-conference (Young J, Watt A, Carss DN, eds).
- Redpath SM, Thirgood SJ, Leckie FM, 2001. Does supplementary feeding reduce predation of red grouse by hen harriers? *Journal of Applied Ecology* 38:1157-1168.
- Richards C, Sherlock K, Carter C, 2004. Practical Approaches to Participation. SERP Policy Brief No.1. Aberdeen: Macaulay Institute.
- Riley M, 2008. Experts in their fields: farmer-expert knowledges and environmentally friendly farming practices. *Environment and Planning A* 40:1277-1293.
- Roe M, Benson JF, 2001. Planning for conflict resolution: Jet-ski use on the Northumberland coast. *Coastal Management* 29:19-39.
- Stokes KE, O'Neill KP, Montgomery WI, Dick JTA, Maggs CA, McDonald RA, 2006. The importance of stakeholder engagement in invasive species management: A cross-jurisdictional perspective in Ireland. *Biodiversity and Conservation* 15:2829-2852.
- Striegnitz M, 2006. Conflicts over coastal protection in a National Park: Mediation and negotiated law making. *Land Use Policy* 23:26-33.
- Thirgood S, Redpath S, Newton I, Hudson P, 2000. Raptors and Red Grouse: Conservation conflicts and management solutions. *Conservation Biology* 14:95-104.
- Wanink JH, Chifamba PC, 1999. Interactions between freshwater fisheries and birds. *Perspectives in Ecology*:219-225.
- Warren C, 2002. Of superquarries and mountain railways: Recurring themes in Scottish environmental conflict. *Scottish Geographical Journal* 118:101-127.
- Watson M, Thirgood S, 2001. Could translocation aid hen harrier conservation in the UK? *Animal Conservation* 4:37-43.
- White R, 2009a. Broader frameworks for biodiversity conflicts. In: Managing conflicts affecting biodiversity, ecosystems and human well-being in a changing environment: Report of an e-conference (Young J, Watt A, Carss DN, eds).
- White R, 2009b. RE: Management plans as a way of managing conflicts? In: Managing conflicts affecting biodiversity, ecosystems and human well-being in a changing environment: Report of an e-conference (Young J, Watt A, Carrs D, eds).
- White RM, Fischer A, Marshall K, Travis MJJ, Webb TJ, di Falco S, Redpath SM, van der Wal R, 2009. Developing an integrated conceptual framework to understand biodiversity conflicts. *Land Use Policy* 26:242-253.
- Wilson CJ, 2004. Could we live with reintroduced large carnivores in the UK? *Mammal Review* 34:211-232.
- Wilson GA, 1997. Factors influencing farmer participation in the environmentally sensitive areas scheme. *Journal of Environmental Management* 50:67-93.
- Young J, 2009. Management plans as a way of managing conflicts? In: Managing conflicts affecting biodiversity, ecosystems and human well-being in a changing environment: Report of an e-conference (Young J, Watt A, Carrs D, eds).
- Young J, Nowicki P, Alard D, Henle K, Johnson R, Matouch S, Niemela J, Watt A, 2003. Conflicts between human activities and the conservation of biodiversity in agricultural landscapes, grasslands, forests, wetlands and uplands in Europe. A report of the BIOFORUM project.
- Young J, Watt A, Nowicki P, Alard D, Clitherow J, Henle K, Johnson R, Laczko E, McCracken D, Matouch S, Niemela J, Richards C, 2005a. Towards sustainable land use: identifying and managing the conflicts between human activities and biodiversity conservation in Europe. *Biodiversity and Conservation* 14:1641-1661.
- Young J, Watt A, Nowicki P, Alard D, Clitherow J, Henle K, Johnson R, Laczko E, McCracken D, Matouch S, Niemela J, Richards C, 2005b. Towards sustainable land use: identifying and managing the conflicts between human activities and biodiversity conservation in Europe. *Biodivers Conserv* 14:1641-1661.
- Zinn HC, Manfredo MJ, Vaske JJ, Wittmann K, 1998. Using normative beliefs to determine the acceptability of wildlife management actions. *Society & Natural Resources* 11:649-662.

Annex 1: Analysis of selected papers

Paper	Conflict	Methods	Data	Description
Information base White et al. 2009. Developing an integrated conceptual framework to understand biodiversity conflicts. Land Use Policy 26: 242-253.	Hen harrier and red grouse conflict	Conceptual basis to develop approaches to model conflict dynamics	Mixed	Useful in terms of having a framework to understand all aspects of a conflict and to serve as basis for modelling approaches. Does not explicitly include institutional factors.
Matthiopoulos et al. 2008. Getting beneath the surface of marine mammal-fisheries competition. Mammal Review 38(2&3): 167-188.	Sea mammals and fisheries	Model for sea lions with linkages between adult sea lion abundance, energetic state, energetic state of their pups, density of their prey, spatial distribution of prey	Quantitative	May help policy-makers in terms of better understanding the intricacies of the system and the actual impacts of marine mammals on fisheries. Could also be key in building on knowledge base, i.e. dispelling anecdotal evidence and misperceptions. Caveats associated with the use of models.
Park et al. 2008. Impacts of birds of prey on gamebirds in the UK: a review. Ibis 150(1): 9-26.	Birds of prey and gamebirds	Literature review complemented by a few consultations and workshops	Quantitative	Could help in terms of providing scientific reviewed information and the message is that losses of gamebirds to raptors are low, BUT acknowledges that conflict is unlikely to be resolved by more data on scale of predation. Also suggests future work needed in the area, e.g. potential densities of raptors if allowed to breed freely, responses of predators to varying prey densities and interdisciplinary work on economic impacts of gamebird losses.
Riley, M. 2008. Experts in their fields: farmer-expert knowledges and environmentally friendly farming practices. Environment and Planning A 40: 1277-1293.	Farming practices and conservation	Interviews (with farmers in and out of AESs) and participant observation	Qualitative	Emphasises that scientific knowledge is not sufficient in the development of AESs and the need to better understand farmers' knowledges to promote acceptance of schemes and develop better schemes. Practicalities of incorporating such knowledges into policy are not specified.
Wilson, G. 1997. Factors influencing farmer participation in the Environmentally Sensitive Areas Scheme. Journal of Environmental Management 50: 67-93.	Farming practices and conservation	Questionnaires to farmers followed by interviews	Mixed	Good starting point to better understand role of farmers in conservation. In terms of reducing conflicts linked with agricultural practices, results could help improve scheme so that smaller farms take it up thereby reducing threats to those habitats and reduce tensions between participants and non-participants. In addition, it helped identify those farmers (usually better educated, younger and longer residency) who are willing to do more, often for less payment.
Bright et al. 2008. Map of bird sensitivities to wind farms in Scotland: a tool to aid planning and conservation. Biological Conservation 141: 2342-2356.	Expansion of wind farms and conflict with birds	Mapping based on various sources (e.g. national surveys)	Quantitative	Could help in the planning process for wind farms in Scotland, in addition to the requirement for most wind farm developments to have an individual EIA. Constraints also in terms of data availability, using SPAs as a surrogate for bird sensitivity and socio-economic aspects pertaining to the siting of wind farms.

Paper	Conflict	Methods	Data	Description
Wanink, J.H. & Chifamba, P.C. 1999. Interactions between freshwater fisheries and birds. In: Perspectives in Ecology (A. Farina, Ed.), pp 219-225. Blackhuys Publishers, Leiden.	Fishermen and nature conservationists	Review	Quantitative	Article sums up the results of a symposium which reviewed current knowledge of negative and positive effects of birds on freshwater fisheries and vice versa. Participants agreed on the need for a holistic approach in aquatic ecosystem research, a greater emphasis on empirical studies and conflict resolution between harvesters and conservationists. Most of these recommendations would serve to improve the knowledge base on which to build conflict management strategies.
Zinn, H.C. et al. 1998. Using normative beliefs to determine the acceptability of wildlife management actions. Society and Natural Resources 11: 649-662.	Conflicts between humans and mammals (coyotes, beavers, mountain lions)	Two surveys: acceptability of management actions against mountain lions, acceptability of destroying beavers and coyotes.	Quantitative	Stresses the importance of understanding normative beliefs and links with value orientations in order to inform decision-makers of acceptability or not of management actions, thereby avoiding conflicts. Acknowledges that more research on situational specifics and human values needs to be carried out to better understand and predict public responses to management options.
Marshall, K. et al. 2007. Conflicts between humans over wildlife management: on the diversity of stakeholder attitudes and implications for conflict management. Biodiversity and Conservation 16: 3111-3128.	Raptor-grouse conflict	Interviews with members of two predefined groups: raptor conservationists and those with grouse management/shooting interests. PCA.	Mixed	Advocates that understanding actors' values and perceptions of each other and issues related to the conflict could help understanding between actors and move towards development of potential solutions. Also emphasises the added value of social science in understanding and managing conflict situations.
Rauschmayer et al. 2009. Participation in EU biodiversity governance: how far beyond rhetoric? Environment and Planning C: Government and Policy 27: 42-58.	Designation of Natura 2000 sites	Review	Qualitative	Stresses the gap between rhetoric and reality of participation. Conflict appears to be the most direct driver of more participation (e.g. France).
Skutsch, M.M. 2000. Conflict management and participation in community forestry. Agroforestry Systems 48: 189-206.	Conflicts linked to the implementation of community forestry programmes	Review	Qualitative	Suggests that uptake of community forestry programme would be higher if community forest workers acknowledged conflict in any local community situation, and acted appropriately, i.e. anticipate and recognise conflict, and address it. In practical terms, the author suggests introducing a socio-critical element to forestry training, including grounding in conflict analysis and conflict resolution skills. Useful in terms of highlighting the impact of "silent", underlying social conflicts.
Decision-making: Identification of alternatives				
Geneletti, D. & van Duren, I. 2008. Protected area zoning for conservation and use: A combination of spatial multicriteria and multiobjective	Zoning of a National Park in Italy	Subdivision of the park into sub-units, three multicriteria evaluations, assignation of each unit	Quantitative	Good in terms of providing land managers and other stakeholders with a better visual overview of the area (e.g. results highlighted that current zoning did not encompass some areas that were important for conservation). Needs to be complemented however with stakeholder consultations on park boundaries in

Paper	Conflict	Methods	Data	Description
evaluation. Landscape and Urban Planning 85: 97-110.		to a protection unit through a multi-objective land allocation procedure, sensitivity analyses.		order to avoid conflicts.
Cope et al. 2003. Integrating farming and wildlife conservation: the Barnacle Goose management scheme. Biological Conservation 110: 113-122.	Conflict between farming and goose conservation	Observations of distribution and abundance of geese and multilevel modelling	Quantitative	Description of a successful project integrating goose management and agriculture. Authors recommend an advanced planning approach to avoid any future conflicts in the area by either expanding the range and quality of the BGMS or by expanding the reserve network.
Amar et al. 2004. Habitat predicts losses of red grouse to individual hen harriers. Journal of Applied Ecology 41: 305-314	Raptor conservation and red grouse management	Harrier monitoring, grouse abundance counts, grouse predation rates, habitat data, stats	Quantitative	Could lead to the identification of "problem animals" which could then be targeted by grouse managers for diversionary feeding. This approach can also potentially be used for other species and other conflicts.
Thirgood et al. 2000. Raptors and red grouse: Conservation conflicts and management solutions. Conservation Biology 14(1): 95-104.	Raptor conservation and red grouse management	Review of current state of research in the raptor-grouse situation	Qualitative	Potential solutions suggested for the raptor-grouse conflict are: habitat management, diversionary feeding, intraguild predation, raptor "quotas", and raptor translocation. Questions the acceptability of managing raptors as a renewable resource. In terms of conflict management his paper suggests a number of solutions, including the feasibility of these solutions and effectiveness.
Edgar et al. 2005. Evaluation of translocation as a tool for mitigating development threats to great crested newts in England, 1990-2001. Biological Conservation 122: 45-52.	Development and conservation of newts	Analysis of licence database and questionnaire analysis	Quantitative	Article provides a useful information base in terms of translocation as a conflict management option.
Belant, J.L. 1997. Gulls in urban environments: landscape level management to reduce conflict. Landscape and urban planning 38: 245-258	Gulls and human infrastructure and health	Review	Quantitative	Addresses the threats posed by gulls to human health and safety, property damage and reduced aesthetics and reviews local-scale methods to alleviate the conflict. Advocates a landscape-scale approach to the conflict with the implementation of a working group to assess extent of problem, potential solutions and evaluation of these strategies.
Decision-making: Choosing and applying decisions				
Chase et al. 2000. Innovations in stakeholder involvement: what's the next step? Wildlife Society Bulletin 28(1): 208-217.	Deer and goose management in the US	Review of two case studies - no details of methods given	Qualitative	Highlights co-management as most effective conflict management strategy providing increased ownership for stakeholders, sharing of responsibilities (useful for wildlife managers), and an opportunity for communities to have a stronger voice.

Paper	Conflict	Methods	Data	Description
Ledoux et al. 2000. Implementing EU biodiversity policy: UK experiences. Land Use Policy 17: 257-268.	Implementation of Natura 2000	Case studies (Cley and Hickling)	Qualitative	Shows through the use of two UK case studies that implementation of Natura 2000 sites can lead to conflicts. Also includes a review of deliberative and participatory methods that can help in the implementation of Natura 2000: DIPs and mitigation banking. Suggests that conflicts in this field can only be reduced by a flexible national interpretation of the Habitats Directive.
Faysse, N. 2006. Troubles on the way: An analysis of the challenges faced by multi-stakeholder platforms. Natural Resources Forum 30: 219-229	Case studies: MSPs in South Africa and Bolivia as well as experiences of other documented MSPs	Not specified in this paper. See Faysse (2004); Faysse & Gumbo (2004) Faysse et al (in press) & Seshoka et al. (2004)	Qualitative	Evaluates two MSPs in potential unfavourable situations, with regards to: power relations, platform composition, stakeholder representation and impact, decision-making power and mechanisms, and costs of MSP. Ends with a set of important steps for future investigations. Very useful in terms of identifying pitfalls of MSP and providing ideas for future research, however, this needs to be communicated to practitioners and pursued as MPSs develop
Striegnitz, M. 2006. Conflicts over coastal protection in a National Park: Mediation and negotiated law making. Land Use Policy 23: 26-33	Nature conservationists and coastal protectionists ("dyke associations")	Case study observation	Qualitative	Explores the use of multicriteria evaluation techniques and mediation in a polarised conflict. MCA useful in this context to identify options and evaluate them jointly, maintain transparency of the process and make all participant values explicit. One key aspect to the success of this arrangement was the use of a mediator (which could be too costly for many conflict situations) and direct access from the group to the State Secretary and Minister.
Butler, J.R.A. et al. 2008. The Moray Firth Management Plan: an adaptive framework for balancing the conservation of seals, salmon, fisheries and wildlife tourism in the UK. Aquatic Conservation: Marine and freshwater ecosystems 18: 1025-1038.	Salmon fisheries and seal conservation	Case study	Quantitative	Describes an innovative management plan to manage a conflict between fisheries and seal conservation, which focussed on Potential Biological Removal of harbour seals, training for marksmen, the designation of management areas to target "problem" animals and further research and monitoring. Could be adapted to other conflicts of this kind. Success heavily hinges on who leads this process (needs trust of fishermen and conservationists) and trust between all stakeholders.
Decker, D. & Chase, L. 1997. Human dimensions of living with wildlife - a management challenge for the 21st century. Wildlife Society Bulletin 25(4): 788-795.	Farming and the conservation and hunting of deer and elk	Review of deer and elk case studies in North America	Qualitative	Highlights the need to balance stakeholder input with scientific information. Outlines the role of wildlife managers, especially in conflict situations. Very practical paper aimed at wildlife managers, which, although not preaching one sure-fire solution, emphasises the importance of stakeholder involvement.

Paper	Conflict	Methods	Data	Description
Kellert et al. 2000. Community natural resource management: Promise, rhetoric and reality. <i>Society and natural resources</i> 13: 705-715	Conflicts around conservation areas (Nepal), wildlife sanctuary (Kenya) and cooperative management of salmon (US)	Not specified in paper but included structured, semi- and open-ended interviews. In the US case study, methods also included participant observation and a review.	Mixed	Conflict resolution is one of the variables evaluated in CNRM in three counties (Nepal, Kenya and the US). In terms of conflicts, these were rarely resolved by CNRM, and on the contrary were sometimes exacerbated due to expectations being raised. Success of CNRM would appear to be very contextual.
Hughes, P. 2001. Animals, values and tourism - structural shifts in UK dolphin tourism provision. <i>Tourism management</i> 22: 321-329	Dolphin conservation and increasing tourism	Review of captive and non-captive dolphin industries and their impacts on wildlife	Qualitative	The most relevant case study is that of dolphins in the Moray Firth where boat operators are required to follow a code of practice. However that code of practice is associated with SNH, which, in turn is viewed as pro-conservation by boat operators. In terms of conflict management the main message seems to be that tour operators need to be on their guard in terms of what they do considering the capacity of animal welfare and animal right lobbies. More of a threat than a deliberative conflict management option, but one that seems to work in this context!