Reducing the conflict between Cormorants and fisheries on a pan-European scale

REDCAFE

Final Report: Summary

Report of a Concerted Action funded by the European Union. Study contract no. Q5CA-2000-31387: Reducing the conflict between cormorants and fisheries on a pan-European scale.

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Contract number: Q5CA-2000-31387

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0 Executive summary

0.1 Background to the project

Two subspecies of Great Cormorant (hereafter 'Cormorant') occur in Europe: the 'Atlantic' subspecies *Phalacrocorax carbo carbo* and the 'Continental subspecies *P. c. sinensis*. Latest (1995) breeding estimates for *carbo* are of 40,000 pairs, mostly on the coasts of Norway, UK, Ireland and northern France. The *sinensis* population (1995) is estimated to be over 150,000 pairs throughout the region, a dramatic increase since the 1960s. It is likely that the species is now more numerous across Europe than ever before. The geographical range of these populations has also expanded with Cormorants returning to some areas after a long absence and also moving into previously unoccupied area. The reasons for such expansion are unclear but possible causal factors include a "non-limiting food supply" and protective legislation, particularly EEC Directive 79/409 on the Conservation of Wild Birds. Cormorants are generalist fish-eating predators taking a wide variety of species in shallow coastal seas, running and standing freshwaters, and both traditional/extensive and intensive aquaculture systems. In almost all countries where Cormorants occur, their increasing numbers and geographical spread has led to a growing number of conflicts with commercial fisheries and recreational angling interests.

0.2 Aims and set up of the project

Although there are several national and/or international Cormorant management plans aimed at reducing such conflicts with Cormorants, there is no co-ordinated implementation at the international level and, in practice, and certainly for many affected by the 'Cormorant problem', these plans appear ineffectual. The REDCAFE project (December 2000 – November 2001) was designed to complement and develop previous work through synthesising available information on Cormorant conflicts and aspects of Cormorant ecology leading to them, through identifying methods of reducing the current Europe-wide conflict between Cormorants and fisheries interests and collating expert evaluations of their practical use. The project also addressed a specific Cormorant-fisheries conflict case study involving recreational angling in S. E. England. REDCAFE took a novel approach to delivering solutions to these problems by, for the first time, bringing together avian, fisheries and social scientists and many other relevant 'stakeholders' to discuss and report on these issues in a rigorous, co-ordinated and equitable manner. With these aims in mind, a pan-European network of project participants was established comprising 49 people representing 43 organisations from 25 countries and including seven main stakeholder groups:

commercial fishermen, recreational fishermen, aquaculturists, avian/wetland conservationists, fisheries scientists, avian ecologists and social scientists.

0.3 Cormorant conflicts with fisheries

Various stakeholder groups often hold different values and, consequently, have different preferences for the use of limited natural resources: conflict is thus often inevitable. In addition to addressing environmental conflicts from a biological perspective, the social and cultural dimensions of human society that influence such conflicts also demand equal attention. Successful conflict management depends on conflicting parties opening communication channels and developing networks of trust for effective participation, dialogue and collaboration. Thus, wherever possible, information for the synthesis of Cormorant conflicts was provided by stakeholders affected directly by Cormorants. The provision and collation of information for the present conflict synthesis formed the basis for REDCAFE's pan-European dialogue with stakeholders. This process also highlighted the difficulties involved in creating and managing dialogue between stakeholders from many countries and diverse backgrounds and these issues are discussed.

0.4 Cases of Cormorant conflicts

REDCAFE sampled Cormorant conflicts in 24 countries and collated information on 235 conflict cases. Cormorant conflicts were reported from a wide variety of habitats and fishery types: rivers, lakes, freshwater aquaculture ponds, coasts, and coastal aquaculture sites. This demonstrated the widespread geographical distribution of conflicts. Conflicts were reported by four different stakeholder groups representing recreational, commercial and nature conservation interests and covered a wide variety of fishery types, suggesting that the nature of conflicts also differed on a geographic scale.

0.5 Habitat features of conflict cases

Two species of cormorant were recorded in conflicts: both races of the Great Cormorant and the Pygmy Cormorant (*P. Pygmeus*). The geographical distributions of both species, as recorded in conflicts, followed closely their known breeding and/or wintering distributions. Cormorant conflicts were reported mostly from lower altitudes (< 500m). Within river systems, Cormorant conflicts on a pan-European scale showed similar distribution patterns. They were very much restricted to the lower and middle reaches, and hence relatively wide (i.e. 10-50m) stretches, of rivers. Similar, restricted distribution patterns were clear for conflict cases on the coast which were restricted to those localities with access to shallow (< 50m deep) inshore coastal water. Overall, most conflict cases were reported on nutrient-rich (i.e. eutrophic) waters, particularly freshwater aquaculture ponds, lakes and coasts, supporting the idea that Cormorant distribution is, in part at least, determined by the nutrient status of these waters.

0.6 Conflicts in time and space

Information on the seasonality of Cormorant conflicts showed patterns that fitted closely with the known seasonal movements of birds across Europe. As a consequence, the broad pan-European picture of Cormorant conflicts has three elements. First, winter (October-March) conflicts in those countries where birds overwinter, either towards the north west or south east. Second, summer (April-September) conflicts, presumably involving breeding birds, in the Netherlands and

almost all countries bounding the Baltic. Third, conflicts throughout the year in the 'centre' of Europe (Denmark, Germany and the Czech Republic), presumably involving both breeding birds and others overwintering there from the north. Cormorant abundance increased with water surface area on a pan-European scale for stillwater lakes, freshwater aquaculture ponds and coasts and water surface area explained 56% of the variation in maximum Cormorant numbers across these habitats. There was no such relationship on rivers based on the information available for this synthesis. Such apparent differences require further investigation, particularly as information suggests that average Cormorant density on rivers is significantly higher than that in other habitats.

0.7 Conflicts: fish

Throughout Europe, there were strong associations between particular fish groups reported in conflict cases and particular habitat and fishery types. A wide variety of fish species were reported in relation to coastal conflicts. Cyprinids and salmonids were the main groups of fish recorded by stakeholders in relation to Cormorant conflicts on rivers. Similarly cyprinids, especially Carp, plus some salmonids, Perch and Pike were involved in conflicts at freshwater aquaculture ponds. Many conflicts were reported at Carp ponds throughout Europe and these sites are considered highly attractive to Cormorants in places such as the Czech Republic, Bavaria, southern Germany, and France. A small group of fishes including mullets, sea basses and sea breams were involved in conflicts at coastal, often extensive lagoon, aquaculture sites of southern Europe.

0.8 Conflicts: finance

Financial information was provided by fishery-related stakeholders for 105 conflict cases, approximately 45% of those recorded in the present synthesis. Nature conservation stakeholders did not provide any financial information in relation to any of the conflict cases they recorded. Fishery stakeholders provided information on the annual financial turnover in their fishery system and the turnover loss due to Cormorants as 'actual' figures or as 'estimates'(derived by unknown means), thus care must be taken when interpreting the financial information collected in this synthesis. Nevertheless, the 105 conflict cases gave a cumulative total for annual turnover of about 154 million euro and associated losses to Cormorants were given at about 17 million euro, an overall loss of 11%. There were significant differences in the scale of financial losses reported by the relevant stakeholders for different habitats and fishery types. All three fishery stakeholder groups independently were consistent in their views on relatively low financial losses due to Cormorants, recording average values of 9-12% of annual turnover. Around 2% of aquaculturist, 13% of commercial freshwater fishermen and 31% of commercial coastal fishermen recorded losses greater then 50% of the annual financial turnover in their fishery. In contrast, recreational anglers recorded considerably higher financial losses due to Cormorants, averaging 57% of annual turnover. Furthermore, in 43% of cases, anglers recorded financial losses greater then 50% of the annual turnover in their fishery. Although the disparity between commercial and recreational stakeholders' perceptions of financial losses due to Cormorants was clear from the information provided, the explanation for it was not and requires further investigation.

0.9 Conflict issues

Nine specific conflict issues were most commonly cited as being major ones for stakeholders. For both aquaculturists and commercial fishermen, the issue of **reduced catches** was most important whilst for both recreational anglers and nature conservationists the most important issue was **reduced fish stock through lowered production**. Recreational stakeholders also most frequently reported conflicts over reduced catches and **effects on fish population dynamics and community structure**, an issue that was also important to nature conservationists. Both aquaculturists and commercial fishermen were concerned over **loss of earnings from the fishery**, the former stakeholders cited conflicts over **loss of stocked fish** and the latter ones cited conflicts over reduced stock through lowered production. Finally, nature conservationists also frequently recorded concerns over **loss of juvenile fish and lowered recruitment**, **scaring/shooting disturbance**, **drowning of Cormorants in fishing gear** and **damage to vegetation and landscape**. Thus, although stakeholder groups frequently shared concerns over specific major conflict issues, some concerns were specific to particular groups. Most importantly, nature conservationists cited broader 'environmental' issues more frequently than did the three fishery-related stakeholder groups. The conflict synthesis showed considerable, and consistent, similarities between the opinions of both income-producing stakeholder groups involved in fisheries. Although recreational anglers shared many of the concerns of these other fishery-related stakeholder groups, they also recorded some different major conflict issues. However, the biggest differences were between fishery-related stakeholders and nature conservationists. Nature conservationists, in general, were most concerned with wider (i.e. 'environmental') conflict issues.

0.10 Information sources

Stakeholders provided over 3, 500 records of the type of information they used to inform themselves about Cormorant conflict issues. Although most records were categorised as 'popular', this category included a range of diverse sources. Overall, only 15% of information sources used by stakeholders were assigned to the scientific literature. For all stakeholder groups, scientific literature was the least frequently recorded information source. The importance of 'popular' sources of information to all four stakeholder groups contributing to this synthesis was thus clear. For several specific conflict issues, different stakeholder groups claimed to be informed by scientific literature yet considered the magnitude of such conflicts to be very different. It is clear that there is a need for better dissemination of scientific information and for better understanding of the limitations and implications of scientific research.

0.11 Cormorant ecology: factors leading to conflicts

Any successful resolution, or management, of the conflicts between Cormorants and fisheries interests on a pan-European scale must include careful consideration of the best available biological information on Cormorant populations throughout the region. REDCAFE thus synthesised aspects of Cormorant ecology that lead conflicts. Relevant factors were categorised into four main themes: (1) general ecology and habitat features, (2) migration and the annual cycle, (3) fish communities and Cormorant diet, and (4) Cormorant ecology and impact at fisheries.

0.12 Ecology synthesis in relation to Cormorants

Cormorant ecology has been well studied. With respect to numbers, distribution, migratory movements, foraging behaviour and diet it is one of the best known wild bird in Europe. It is clear that Cormorants are opportunistic generalist fish predators.

As a result of their broad ecological requirements, they do have the potential for considerable conflicts at specific fisheries. This is because, as well as flexibility in feeding site choice, generalist predators like the Cormorant could have considerable impact on their preferred prey species because their numbers are buffered to some extent against declines in these prey by their ability to switch to other types. The opportunistic nature of its foraging behaviour and its great adaptability to a variety of habitats, both freshwater and marine, makes the Cormorant an exceptionally successful species which is currently probably more abundant in western Europe than ever before and still expanding numerically in eastern Europe. This expansion in numbers and area is the result of European wide protective measures, eutrophication, the reduction of pesticides in the environment and alterations of water systems such as dams, sluices which facilitate foraging.

0.13 Ecology synthesis in relation to fish

Fish species eaten by Cormorants are, for the most part, common, widespread species. The heavy fishery pressure exerted by people in many water systems in Europe has resulted in a shift in size distribution towards the smaller classes, which enhances Cormorant foraging conditions. Fewer large predatory fish are now present in many European waters because of over-fishing. This enables populations of smaller fish species to increase, which in turn favours the Cormorant. Eutrophication of water bodies has altered fish community - (and size -) structure again increasing the possibilities for Cormorants to exploit larger densities of small prey fishes.

0.14 Ecology synthesis in relation to damage at fisheries

Fish species eaten by Cormorants are, for the most part, common, widespread species. The heavy fishery pressure exerted in many water systems in Europe has resulted in a shift in size distribution towards the smaller classes, which enhances Cormorant foraging conditions. Reduction of eutrophication will decrease Cormorant numbers through reduction in the carrying capacity of fishing waters. Restoration of waterways, aiming at a greater connectivity, will favour fish populations and reduce predation risk. In fish farming areas, specific knowledge on prey detection underwater may help to reduce predation of small fish. Enlarging stocked fish above the range commonly eaten by Cormorants (i.e.>500 g) may act to reduce the damage caused by birds. Periods of large-scale Cormorant movements through Europe (e.g. March and October) require extra management attention to avoid the establishment of any tradition to visit stocked water bodies or fish farm areas. A combination of ecological, demographic, climatological and geographical data into a GIS based Decision Support System may help to predict future Cormorant ‘problems’ and reduce current ones through integrated management.

0.15 Potential Cormorant management tools

Potential Cormorant management tools were assessed on two spatial/temporal scales: long-term control of European Cormorants at the population level and shorter-term site-specific control measures. The synthesis aimed to provide a comprehensive overview of potential Cormorant management tools. It provides a review of population modelling and a synthesis of site-specific techniques and actions used against Cormorants. The synthesis also includes semi-quantitative information on the ‘usefulness’ of techniques in relation to their effectiveness (i.e. how long a technique works for), practicability (i.e how easy the technique is to use), acceptability (i.e. how the technique is viewed by both stakeholders and the general public) and costs.

REDCAFE participants provided information for this synthesis, often after discussions with local stakeholders over their experiences.

0.16 Cormorant population modelling

The most well-supported Cormorant population model scenarios using current information indicated three important things. First, that the effect of culls at the 1998-9 level (i.e. 17, 000 birds shot) was limited. Second, that increasing the annual cull to 30, 000 birds would have limited effect at the population level. Third, that shooting 50, 000 birds per year was predicted to lead to population extinction in 20-40 years. The modelling approach also demonstrated that increasing the number of culled Cormorants was risky because once the compensatory power of the population is overcome, it will inevitably decline towards extinction if the cull is unchecked. One general inference was that culls should be planned so that they become the most powerful density-dependent mechanism affecting the target population. This strategy would require a well parameterised population model and should also be accompanied by monitoring programmes. Even though Cormorant population control through culling is feasible it may not be the most efficient, economical or ethical way of limiting Cormorant damage to fisheries, and other interests, across Europe. Research suggests several limitations to culling and these are discussed.

0.17 Relatively large-scale Cormorant control

The synthesis of general information on actions against Cormorants included information from all 25 countries covered by the REDCAFE project. Some form of national or regional Cormorant management plan was in effect in 11 of these countries. A further four countries had a legal regulation in effect that allowed Cormorant culling. Overall, such a regulation was in effect in 14 counties. In a further 6 countries licences could be obtained for the limited killing of Cormorants at particular sites as a aid to scaring. In most countries (84%), there was either no killing of Cormorants or it was uncoordinated. Few countries (16%) had a co-ordinated culling programme. Few countries (or regions therein) provided either financial compensation for fish losses caused by Cormorants or financial aid for Cormorant exclosures or scaring programmes (16% and 24%, respectively). Of the 25 countries, ten recorded the destruction or disturbance of Cormorant colonies in recent (i.e. 1990-2002) years, with 102 colonies reported to be affected annually. As a result a minimum of 5,194 Cormorant nests were reported to be destroyed annually in five countries. Between 600-650 Cormorant nestlings were also reported to be killed in three countries. Numbers of both nests and nestlings destroyed were known to be under-recorded. Around 10, 000 adult Cormorants (of the ‘Atlantic’ *carbo* race) are hunted legally as game in Norway outside the breeding season. During this time of year, a further 18 countries reported killing Cormorants (mostly the ‘Continental’ *sinensis* race) as a control measure. Here, between 41-43, 000 adult birds (including young birds in their first winter) were reported to be killed annually. However, given the unprecedented number of Cormorants killed in France in 2001/02, and the fact that many of the birds killed were juveniles in their first winter, it is more appropriate to say that between 41-43, 000 fully grown birds were killed in 2001/02. A further 4,598 Cormorants were reported to be killed annually during the breeding season in six countries. However, this was known to be an underestimate. Over 248 night roosts were reported to be destroyed or damaged annually in nine countries. This figure was a considerable underestimate because roosts were also known to have been destroyed or disturbed in three other countries.

0.18 Site-specific actions: non aquaculture habitats

A total of 33 site-specific techniques used regularly to reduce the effects of Cormorants at feeding sites were recorded for 16 countries. However, only three techniques were used regularly at all five feeding habitats (small rivers, large rivers, small stillwaters, very large waterbodies, aquaculture): the use of live ammunition to scare birds, shooting birds to reinforce other forms of scaring, and shooting birds to reduce their numbers at specific sites. Eleven techniques were recorded in regular use on small and large rivers. Only two of these appeared to be effective in the long-term (i.e. years), although both of them (improving fish habitat quality and submerged fish refuges) were primarily related to the management of fishes rather than to that of Cormorants. Several other techniques appeared to be effective on rivers for months. Eight techniques were recorded in regular use on small lakes. All appeared to be effective only for days, the exceptions being the use of two audio techniques (pyrotechnics/fireworks and live ammunition) and two lethal techniques (shooting to scare or to kill limited numbers of birds). Ten techniques were recorded in regular use on very large water bodies (lakes and coasts). Three audio techniques and three lethal Cormorant control techniques appeared effective over the time-scale of weeks to months. Other techniques appeared effective for only days.

0.19 Site-specific actions: aquaculture habitats

Twenty eight techniques were recorded in regular use at aquaculture facilities. Eight bird-proof barrier techniques appeared to be effective for up to years, although in some cases the same techniques were reported only to be effective for days. Alterations to fish stocking at aquaculture facilities appeared to be effective for up to months, as did the use of two audio techniques (pyrotechnics/fireworks and live ammunition) and three forms of lethal Cormorant control.

0.20 Cormorant management tools: conclusions

Very few techniques were, according to the experience in 16 countries covered by the synthesis, considered to be effective in the long-term (i.e. years). These long-term techniques appear to fall into two broad categories. First, those involving the alteration of fish habitat at some ‘natural’ rivers and lakes. Second, those involving the erection of various bird proof barriers (e.g. narrow mesh enclosures, wires, submerged anti-predator nets) at aquaculture facilities (both ponds and net pens/cages). Many other techniques used regularly can be effective for up to months at some sites. However, the same techniques were reported to be effective for only days, or not at all, at other sites. Overall, the practicability, acceptability and costs of all techniques used regularly were highly variable. The most likely explanation for such variation is that it is related to site-specific features. These are likely to be two-fold. First, the physical location of the site, its size, the type of fishery, the number of Cormorants involved etc. Second, the scale of the Cormorant ‘problem’ in financial terms.

0.21 Cormorant-fishery conflict resolution: a case study

REDCAFE analysed a specific Cormorant-fishery conflict case study, in the form of a three-day Workshop designed to give project participants and local stakeholders the opportunity to share their knowledge and experience. This case study also formed the basis for evaluating REDCAFE progress and the applicability of the ‘REDCAFE experience’ to the real world. Furthermore, it allowed participants to explore whether

the project's concept of equitable stakeholder involvement was a useful framework for future Cormorant-fisheries conflict resolution elsewhere in Europe. An opportunity arose to link the project to a 'live' conflict case study - that of Cormorants and recreational fisheries in the Lea Valley, Hertfordshire, south-east England. Importantly, selecting the Lea Valley Cormorant-fishery issue also allowed REDCAFE to link with Fisheries Action Plans, and the government agency-led process being developed to address and prioritise issues affecting inland fisheries at a catchment scale. The REDCAFE case study was placed in perspective through reviews and discussions of values and dialogue in conflict resolution and management, Fisheries Action Plans in the UK, and the Lea Valley case study area.

0.22 Lea Valley Workshop

Workshop delegates comprised 36 REDCAFE participants, representing 20 countries, and 16 stakeholders, representing 11 institutions or organisations. Successful conflict management depends on conflicting parties opening communication channels and developing networks of trust for effective collaboration and dialogue. REDCAFE thus worked closely during the Workshop with a facilitator skilled in environmental conflict management. The Workshop began the process of approaching the numerous environmental conflicts apparently affecting the Lea Valley. Although time was short, many important issues were addressed and developed, including conflict management experiences from both continental Europe and the Lea Valley itself. Several key issues arose from discussions with local stakeholders. First, many believe that the main problem facing the Lea Valley is an economic one. Economic measures of angling 'effort' (i.e. day and season ticket sales and angling club membership) have all fallen considerably in the last decade. This has had a knock-on effect on the local economy. Second, several lines of evidence suggest that many fish stocks and/or catches there have declined dramatically. The perception is that most small fish – both small individuals and small species - have declined, whilst there are still some fisheries containing large individuals (i.e. 'specimen' fish). There is also some evidence that the distribution of fish has changed within the Lea Valley. Third, the lack of fish, and the related economic decline, has local conservation implications, social implications, and planning and policy implications. These are all discussed.

0.23 Workshop progress

Key local issues were summarised in an initial 'problem statement' for the Lea Valley. Substantial progress was made in identifying critical scientific and social issues in cormorant/fisheries conflicts. Cormorant-fishery conflicts play a part in the mix of issues facing the Lea Valley but one important outcome of the Workshop was to situate these conflicts in a broader social, economic and ecological context. Local stakeholders made considerable progress where escalating conflicts had become significant obstacles in the Lea Valley. REDCAFE participants had the opportunity to explore part of a conflict management process that related directly to many Cormorant-fishery conflicts across Europe. The Workshop process enabled significant progress to be made in several areas: (a) linking scientific processes and data to real-world social issues, (b) agreeing initial problem statements, stakeholders and needs, (c) identifying relevant agencies, people and pathways for action planning, and (d) identifying research priorities and dissemination actions that link the need for strong, evidence-based scientific knowledge with social and strategic planning needs.

0.*24 Workshop evaluations*

A specific element of the REDCAFE project was to evaluate the conflict resolution Workshop in terms of determining whether the project's concept of equitable stakeholder involvement was a useful framework for future Cormorant-fisheries conflict resolution elsewhere in Europe. To this end, the Facilitator organised an anonymous questionnaire survey of delegates immediately after the Workshop. Twenty-six responses (50% of Workshop delegates) were received and almost all agreed that the case study was useful and enjoyable and that REDCAFE had helped them relate conflict management methods to Cormorant-fisheries conflicts elsewhere. A series of questions were also asked of delegates and those responding to the questionnaire provided over 200 responses which are synthesised in the report.

0.25 The REDCAFE process: main strengths

The most commonly cited strength of the case study Workshop, and of the REDCAFE process in general, was the development of trust between project participants and other stakeholders, and effective dialogue between scientists and others. Next followed the pan-European involvement and collaboration produced by the project and the opportunity it has provided to bring international perspectives to bear on local case studies. Another important strength identified was the project's attempts to reach consensus on Cormorant-fisheries conflicts through collaboration with social scientists.

0.26 The REDCAFE process: main weaknesses

In relation to the case study Workshop, the commonest weaknesses identified were lack of time and the involvement of too few local stakeholders. It was recognised that these constraints probably limited, to some degree, discussions on potential site-specific management tools. More generally, policy makers should have been included as REDCAFE participants and the continued need for effective dialogue between all interested parties was highlighted.

0.27 The REDCAFE process: main lessons learned

Several lessons for the REDCAFE project were recorded. The most frequent involved the vital importance of participation and dialogue. Almost all stakeholders stated that conflicts can only be resolved through relationships and trust: people must work together, ideally in face-to-face discussions, to develop solutions. All those involved in dialogue must consider the language they use and be aware that different participants (individuals or groups) will have different levels of confidence and enthusiasm. Respondents also noted that it takes time to understand conflict and decide how best to manage it. There may be no ultimate solutions but effective dialogue will invariably help to resolve conflicts. Another important lesson was that large-scale culling of Cormorants will almost certainly be ineffective. Cormorants are now an established element of many aquatic ecosystems and people need to learn to live with them. Scientific information is necessary to inform debate and potential mitigation policies, and REDCAFE has demonstrated that clear communication of scientific information can influence other stakeholders' perceptions and understanding and *vice versa*. Other important REDCAFE lessons were cited and these are discussed in detail in the report.

0.28 Looking forward: overview

REDCAFE has attempted to synthesise, for the first time, key stakeholder groups' views and perceptions on Cormorant conflicts with fisheries (and, to a lesser extent, with the wider environment) in a standardised way across Europe. Despite methodological limitations, many clear pictures emerged and these are discussed. Just as importantly, collecting and collating information for this synthesis has allowed REDCAFE participants (primarily natural scientists or those working closely with them) to forge links with local stakeholders experiencing conflict issues at first hand. REDCAFE offered the first opportunity to apply recognised conflict management techniques to Cormorant-fisheries interactions at the pan-European level. Through discussions with stakeholders it was clear that conflicts with Cormorants are not the only ones facing many fisheries and environmental stakeholders. To better understand the nature of Cormorant-fishery conflicts it is useful to consider other internal and external issues leading to conflicts over fisheries resources. These issues, both environmental and social, are often complex and closely linked. Environmental conflicts over resources, including those involving fisheries, usually involve numerous issues. This appeared true across Europe: many of the stakeholders who provided specific information on Cormorant conflict issues for the present synthesis also described other issues, fears and concerns affecting their businesses or recreation. Many stakeholders also recorded concerns over the creation of sustainable fisheries and the development and implementation of effective, 'holistic' fisheries management programmes. Some of the other wider concerns affecting fishermen contributing to the present synthesis related to ownership and property rights and to changes in market economies. These issues are discussed in the report. The evaluation process confirmed that the REDCAFE philosophy of developing interdisciplinary links within and between the fields of natural and social science was very useful. Moreover, the project clearly demonstrates the necessity, and value, of dialogue and participation between all stakeholders (or their legitimate representatives) involved in Cormorant-fishery conflicts. Evaluations also showed that REDCAFE's approach to a specific Cormorant-fishery conflict case study provides a useful framework for similar activities elsewhere. There is acknowledgement that the process of conflict management will take time and require appropriate resources, including funds.

0.29 Looking forward: case studies, individuals and stakeholder groups

At the local level, by far the most commonly anticipated next step was to consider potential site-specific management techniques based on lessons learned from the REDCAFE synthesis. There is a strong desire to put theories into practice and to try mitigation measures that have been shown to work elsewhere. For many, next steps should include exploring the possibilities of developing and implementing local fishery management, or action, plans for specific case studies and/or the building of partnerships at the national level between fishery and conservation organisations such as the Moran Committee in the UK. REDCAFE emphasised the importance of making concerted efforts to create participation, dialogue and consensus building between local stakeholders involved in Cormorant-fisheries conflicts across Europe. This will require effective dissemination of relevant information at local, regional, national and international levels. Politicians and policy makers should also be included in such dissemination activities.

0.30 Looking forward: the scientific community

While social issues now feature strongly in the minds of the natural scientists involved in the REDCAFE project, many in that community expressed clear needs to

further improve understanding of ecological issues. Scientists also realise the need to forge better links with others. Although scientific independence and rigour remain crucial, there is a need for scientists to apply their research results to real life cases. Scientists also need to collaborate with other stakeholders and local people, for example in the development of local management plans. Such collaboration will require scientists to communicate practical information to others in a clear manner and to maintain dialogue with all interested parties. Natural and social scientists also need to forge closer links because Cormorant-fisheries conflicts are situated in social and political contexts.

0.31 Looking forward: Fisheries co-management

While REDCAFE focused on Cormorant-fishery conflicts, other tensions were recognised by the project as influencing them. Addressing such broad fisheries conflict issues is not trivial and will take time and require trust between stakeholders. Furthermore, in order to avoid inadequate fisheries policies and management systems, that tend to treat the symptoms rather than address underlying problems, broader environmental and institutional factors should be taken into account and fundamental socio-cultural conditions must also be given high consideration. Participatory co-management in fisheries, where managers and local fishermen co-operate in drafting policy, may facilitate successful management while also offering the possibility of reducing public costs. If natural resource management is to be sustainable in the long term, an understanding of human behaviour is vital and this multidisciplinary approach was recognised by REDCAFE. The fundamental challenge for fisheries management in this context is to find ways of expanding technical expertise whilst increasing collaboration in decision-making processes. In the past there has been much co-operation between fishermen and scientists at the individual level but a more organised management structure is required to bring these, and other, groups together. REDCAFE's work established an area of co-operation between natural scientists, local environmental stakeholders (fishermen and conservationists) and policy makers which should form the basis of future dialogue and collaboration.

0.32 Looking forward: future research

A major challenge for natural scientists will be to make their work more relevant and useful to stakeholders. It is clear that different stakeholders involved in Cormorant-fisheries conflicts have different values and perceptions over these issues. It is also clear that other stakeholders view scientists as having different values and perceptions. Thus, scientists should be considered as another stakeholder group involved in the issue of Cormorants and fisheries. Given the recognition that there is no single value or perception (i.e. 'reality') for all the different stakeholders groups within this conflict, it is unrealistic to expect a single method of collecting, analysing and interpreting useful scientific information. The development of a rigorous scientific research programme to address Cormorant conflict issues will have to maintain high scientific standards but will also have to be both relevant to and influential in the decision-making process. There is a need for a practical pan-European Cormorant-fishery research programme that includes ecological study, collaboration between natural and social scientists and a strong conflict management element. Similarly, there is a need for long-term studies to quantify the effectiveness of various measures to mitigate against Cormorant problems at fisheries. Stakeholders have a long list of possible management actions against Cormorants but relatively little guidance on their likely effectiveness, practicability, acceptability or costs at a

specific site. Clearly, considerably more work is required to trial the use of techniques to reduce Cormorant impact at feeding sites. Whatever framework future scientific research into Cormorant conflicts takes, it is clear that all stakeholders are concerned over the common issues of quality, health and status of biological resources in wetland systems. Dialogue with stakeholders highlighted several areas where major conflicts were currently poorly served by scientific literature and these are discussed. However, it must be stressed that such research should be undertaken with participation from stakeholders at all stages where possible. Ultimately, this should increase the useful knowledge of both scientists and other stakeholder groups whilst also increasing collaboration between all parties, but particularly local people, in the decision-making process with regard to Cormorant conflict issues across Europe.

0.33 Looking forward: concluding remarks

Full information from REDCAFE should be disseminated as widely as possible so that the lessons learned from the project can be applied elsewhere. The establishment of a pan-European information exchange network would greatly facilitate the conflict resolution process and allow stakeholders to view their own particular situations in the broader continental context. Information must be exchanged at several levels: within and between disciplines of natural and social science, between scientists and other stakeholders, and between all interested parties and politicians, policy makers and the general public. The most important next step after dissemination is to build on the findings of REDCAFE so that local stakeholders can begin to develop effective site-specific strategies for resolving local conflicts. The formation of an information exchange network would be a very useful tool to facilitate the rapid transfer of ideas, experiences, management techniques, their implementation and subsequent outcomes. It could also offer stakeholders opportunities for discussion and could provide them with clear information on the actual costs (both invested and saved) of specific techniques. Although the REDCAFE project is the most comprehensive attempt to address Cormorant-fishery conflicts at the pan-European scale, it is clear that the project is merely the first step. Opportunities must now be explored to further develop the foundation framework that REDCAFE has developed in linking science with society and advancing processes of conflict management across a range of European contexts.

The REDCAFE Cormorant-conflict synthesis demonstrated clearly that such conflicts are complex, in terms of both biology and equally important social and economic issues. This synthesis is an important first stage towards developing trust and collaborations between all those affected by Cormorant conflicts. These issues are as much a matter of human interests as they are of biology. It is hoped that this element of REDCAFE's work will indeed be the start of a management process for Cormorant-fisheries conflict issues and, by implication, for wider environmental issues affecting fisheries and aquatic conservation across Europe. A formal approach to applying REDCAFE philosophy to the thousands of other case studies across Europe is needed. Moreover, the onus is currently on biologists to solve what are essentially people-people conflicts, professionals in other disciplines should be increasingly involved in these conflict management issues.