5 Potential Cormorant management tools

5.1 Introduction

This Work Package was an attempt to synthesise potential Cormorant management tools for resolving the conflicts synthesised in Chapter 3. Potential management tools will be assessed on two spatial/temporal scales: long-term control of European Cormorants at the population level and shorter-term site-specific control measures. At the 'population level' the synthesis involves a brief review of existing Cormorant population models for Europe and a broader discussion of the latest predictions from such work. Modelling has been used to (a) to predict the ultimate size and geographical distribution of the European Cormorant population and (b) to determine the levels of control necessary to reduce the overall population size. The ultimate aim of the modelling review will be to evaluate the possibility of Cormorant control at the pan-European population level, as proposed by, for example, EIFAC (1996).

At the 'site-specific level' the synthesis of site-specific control measures recognises that this must include the most recent (1995-2000) information (e.g. McKay *et al*. 1999) and, as far as possible, take into account the efficacy (i.e. effectiveness, practicability, acceptability, and cost of measures. The primary source of information was those REDCAFE participants involved with Cormorant population modelling and those with experience of site-specific Cormorant control. However, in addition, contributions were invited from relevant stakeholders in order that the synthesis was as complete as possible.

5.2 Methods

5.2.1 Cormorant population modelling review

Within Europe, two previous attempts have been made to model Cormorant population growth in a management context (Lebreton & Gerdeaux 1996; Bregnballe *et al*. 1997). In addition, more recent findings on Cormorant population dynamics are available (Frederiksen & Bregnballe 2000a,b; 2001). Population modelling has been used to investigate the interplay between large-scale Cormorant culling[11] and aspects of the species' population dynamics (Frederiksen *et al*. 2001). This latter study formed the basis for the REDCAFE review of Cormorant population modelling as a tool for investigating the possible effects of Cormorant control at the continental, pan-European scale.

5.2.2 Site-specific actions

Three types of information were collected for the present synthesis of site-specific actions taken against Cormorants. First, general information on those actions taken against Cormorants in each country. Second, details of national and regional Cormorant management plans and legal regulations in each country. Third, the types of Cormorant damage control activities undertaken in different Cormorant feeding habitats, including semi-quantitative information on their effectiveness (i.e how long the 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. Five types of feeding habitat were distinguished in relation to Cormorant damage control activities: (1) small rivers (width < 100m), (2) large rivers (width > 100m), (3) small still waters (< 100 ha) not used for aquaculture, (4) very large water bodies (> 100 ha, still waters and coastal waters) and (5)

[11] 'Culling' is generally considered to mean the co-ordinated killing of Cormorants with the ultimate aim of controlling (i.e. reducing) the overall population size. This definition is used here in connection with Cormorant population modeling. However, 'culling' is also commonly used to describe any killing of Cormorants, regardless of the ultimate aim and this definition is used elsewhere in this Chapter.

aquaculture sites. REDCAFE participants at the national level provided this information, although often after discussions with local stakeholders over their experiences.

Information was provided on standard spreadsheets and in order to standardise the information collection procedure as much as possible, comprehensive instructions were provided (Table 5.1)

General information on actions against Cormorants in your country		
(1) In this section we are interested in annual national and regional numbers from your country and their accuracy.		
(2) When giving regional numbers, please replace "Region 1", "Region 2", etc. by the actual name of the respective regions.		
(3) Please feel free to add all your comments and all details below the tables!		
Management plans / legal regulations		
(1) In this section we are interested in details of management plans and legal regulations from your country and its regions.		
(2) Also, we would like to know if there is any financial compensation of fish losses or financial aid for Cormorant management actions or exclosures etc.		
(3) Please fill in this table with "yes" or "no" AND give all details and additional information (like the details of management plans or the amounts of financial compensation etc.) below the tables.		
(4) When giving regional information, please replace "Region 1", "Region 2", etc. by the actual name of the respective regions.		
(5) Please feel free to add all your comments and all details below the table!		
Cormorant Damage Control Activities		
(1) For Cormorant feeding sites, there are tables for five types of water bodies: "Small Rivers", "Large Rivers", "Small Still Waters", "Very Large Water Bodies", and "Aquaculture". Please fill in all tables that are applicable to your country.		
(2) In this section we are interested in site specific control activities that are used in your country and in a number of details.		
(3) These tables are designed to make it easy and convenient for you to fill in most columns. But, in order to give us as much information as possible, we ask you to give as many details as possible in the "Remarks, Details, & Additional information" column.		
Column	**Possible Answers**	**Additional explanation**
Technique is used?	regularly / rarely / not used / unknown	Here we would like to know if a certain technique/method is commonly used and widespread in your country (or region).
Effectiveness?	days / months / years / not efficient / not known	Here we are interested in the effectiveness of techniques/methods.
Practicability?	1 - 2 - 3 - 4 - 5	Please fill in a rank from "1" to "5" with: "1" = very high practicability, "2" = high practicability, "3" = medium practicability, "4" = low practicability, "5" = no practicability. Note: If a technique is highly practicable in one situation, but not at all in another, then fill in "1 / 5".
Acceptability?	1 - 2 - 3 - 4 - 5	Here "acceptability" means acceptability to the majority of stakeholders or the general public. Please fill in a rank from "1" to "5" with: "1" = very high acceptability, "2" = high acceptability, "3" = medium acceptability, "4" = low acceptability, "5" = no acceptability. Note: If a technique is highly acceptable in one situation, but not at all in another, then fill in "1 / 5".
Costs?	1 - 2 - 3 - 4 - 5	Please fill in a rank from "1" to "5" with: "1" = very high costs, "2" = high costs, "3" = medium costs, "4" = low costs, "5" = very low costs. Note: If a technique is expensive in one situation, but of very low costs in another, then fill in "1 / 5".
Location(s) where in use	Give regions where technique is used. In special cases, give locations and co-ordinates.	Give regions where the technique is used. But, if it is meaningful or of interest (i.e. locations of study areas), please, give names of locations AND geographical co-ordinates (longitudes and latitudes).
Remarks, Details, & Additional information	Give your remarks or comments here - Give details and more extensive information on the techniques here.	**Please give us here as many additional information and details as possible. Give costs/ha or costs/year, etc.**
References	Please give full literature references (if applicable).	Please give full literature references AND make a copy available to us if possible.

Table 5.1 Instructions for the provision of information relating to site-specific actions taken against Cormorants.

5.3 Cormorant population modelling

This section is based on the most recent published study of Cormorant population modelling (Frederiksen *et al*. 2001). Previous attempts to model European Cormorant

population growth in a management context (Lebreton & Gerdeaux 1996: Bregnballe *et al*. 1997) have both been limited by data availability. Despite this, some robust conclusions were reached (see Frederiksen *et al*. 2001 for discussion). First, Cormorant population growth rate is more sensitive to changes in adult survival than in fecundity (i.e. the production of young), indicating that the shooting of adults may be the most efficient way to regulate population size. Second, if density-dependence[12] is assumed to occur naturally, hunting or culling may both reduce the level of population stabilisation and induce faster stabilisation.

Frederiksen *et al*. (2001) took advantage of recent work on Cormorant population dynamics and cull estimates from several European countries in the 1990s to achieve detailed projections of population growth and full details are given in this reference. They modelled the size of both the breeding population and the population present in autumn (i.e. before culling), because the major conflicts involving Cormorants often occur during the non-breeding season (e.g. see Table 3.8 and Figure 3.9) in areas outside the breeding range (e.g. see Table 5.2). Frederiksen *et al*. (2001) acknowledged several 'weaknesses' of their model: it was based initially on information from a single Cormorant colony (Vorsø in Denmark), knowledge about the strength of density-dependent mechanisms on the whole population scale was very limited, uncertainty over the actual numbers of birds culled. Nevertheless, they made several important findings.

Frederiksen *et al*. (2001) showed that during 1979-92, the breeding population of Cormorants in northern Europe (defined as the Netherlands, Germany, Denmark, Sweden and Poland) increased by 18% per year, in accordance with observed life-cycle parameters before the appearance of density-dependent declines. They then modelled six scenarios with varying assumptions about the strength of density-dependence in adult survival and the proportions of breeding Cormorants. A series of cull estimates were also included, based, in the first instance, on the approximate numbers of birds killed during the winter (1992-9) in France, Switzerland, Italy and Germany. Scenarios with moderate or strong levels of density-dependence provided predictions that fitted the observed numbers of breeding pairs whilst those without density-dependence in survival overestimated real (i.e. observed) population growth. It should be noted that the continued population growth after about 1999 was not predicted by the model, most likely because of the lack of geographical structure (i.e. density-dependence has not occurred at the same time in all parts of the range). The most well-supported scenarios indicated that the effects of culls at the present (1998-99) level (i.e. 17, 000 Cormorants shot) was limited. Modelling suggested that increasing the annual cull to 30, 000 birds would still have only a limited effect whereas shooting 50, 000 birds per year would lead to population extinction within 20-40 years.

Frederiksen *et al*. (2001) concluded that culls, to date, have probably had a limited effect on Cormorant populations, but if carried out in a density-dependent way (i.e. increased culling when the population was high, reduced culling when it was low) they could stablise numbers near a desired level. If culling is to be continued, Frederiksen *et al*. (2001) recommended the adoption of an adaptive and co-ordinated management strategy across Europe. They also advocated the need to account for density-dependent mechanisms in any general culling strategies.

[12] 'Density-dependence' is a biological term implying that the growth or decline of a population is regulated by mechanisms themselves controlled by the size of that population. Simply put, when population size increases, survival and/or production of young decreases, and *vice versa*.

5.4 General information on site-specific actions against Cormorants

Information was available for all 25 countries involved in the REDCAFE project (Table 5.2). This information is reviewed below, in relation to the actions taken (section 5.4), management plans and legal regulations (section 5.5) and remarks provided for individual countries (section 5.6).

NAME OF RESPONDENT AND YOUR AFFILIATION	Information given by REDCAFE participants
COUNTRY	Europe as covered by REDCAFE
REGION / PROVINCE / etc. (if applicable)	--
Period which is concerned [year(s)]	Current situation (2001/02), unless otherwise given.

General information on actions against Cormorants in each country (please give annual numbers)

	Total numbers	Country numbers																										
	European numbers	Austria (1996-2002)	Belgium	Bulgaria (1998-2002)	Czech Republic (1990-2002)	Denmark (1994-2002)	Estonia (1997-2001)	Finland	France	Germany	Greece (1996-2002)	Ireland	Israel	Italy	Latvia	Lithuania	The Netherlands	Norway (P. c. carbo)	Poland	Portugal	Romania (only Danube delta)	Slovenia (2001/2002)	Spain	Sweden (2000)	Switzerland	UK/England & Wales	UK/Scotland (1996-2002)	Remarks
Number of breeding colonies destroyed or disturbed	102	0	0	2	2	10	7	0	2	9	1	0	0	5	0	1	0	0	0	0	0	0	0	63	0	0	0	
Number of nests destroyed	<5194	0	0	91	0	3000	1600	0	0	113	0	0	0	<100	0	0	0	0	0	0	0	0	0	?	0	0	0	
Number of nestlings killed	c. 600 - 950	0	0	0	0	0	50-100	0	0	600	>50	0	0	0	0	0	0	0	0	0	0	0	0	?	0	0	0	
Number of adults killed in the non breeding season	c. 60953 - 63003	>460	0	>1000	1600-2800	2700	102	0	20000	7131	250-350	<20	200	2000-2600	>200	1000	0	10000	2100-2300	0	>200	>200	0	0	1300	200-250	300	
Is there any killing of breeding adults??? Please give numbers	<4699	0	0	yes	0	400	0	0	0	78	0	<20	0	<100	0	0	0	0	0	0	0	0	0	4000	0	0	0	
Number of night roosts destroyed or disturbed	<<249	>4	2 - 3	5	yes	1	0	0	200	yes	1	0	2	12	0	0	0	0	0	0	0	0	0	0	yes	<20	0	yes = roosts are not especially protected; shooting happens, but no data available.

Management plans / legal regulations (please give details below the table)

		Austria (1996-2002)	Belgium	Bulgaria (1998-2002)	Czech Republic (1990-2002)	Denmark (1994-2002)	Estonia (1997-2001)	Finland	France	Germany	Greece (1996-2002)	Ireland	Israel	Italy	Latvia	Lithuania	The Netherlands	Norway (P. c. carbo)	Poland	Portugal	Romania	Slovenia	Spain	Sweden (2000)	Switzerland	UK/England & Wales	UK/Scotland (1996-2002)	Remarks
Are there any management plans in effect? Please list all national or regional plans and give details		yes	no	no	no	yes	no	no	yes	yes	no	yes	yes	yes	no	no	no	yes	no	no	no	yes	no	yes	yes	no	no	
Are there any regulations in effect that allow Cormorant culling? Please list all national (or regional regulations and give details		no	no	yes	yes	yes	no	no	yes	yes	no	yes	yes	yes	no	no	no	yes	yes	no	yes	yes	no	yes	yes	no	no	
Are there any coordinated culling programmes in your country?		no	no	no	no	yes	no	--	yes	no	--	no	no	(yes)	--	no	--	no	no	no	no	no	no	no	(yes)	no	no	(yes) = in some regions yes.
Is it mandatory to obtain single permits for Cormorant killing?		yes	yes	yes	yes	yes	yes	--	yes	(no)	--	yes	yes	(no)	--	yes	--	no	(no)	--	no	no	yes	yes	(no)	yes	yes	(no) = in some regions not and/or during some parts of the year not
Has a general permit for Cormorant killing been issued?		(yes)	no	no	no	yes	no	--	yes	(yes)	--	no	(yes)	(yes)	--	no	--	yes	(yes)	no	yes	yes	no	(yes)	(yes)	no	no	(yes) = in some regions yes.
Is there any financial compensation for fish losses?		no	yes	no	yes	no	no	no	no	(yes)	no	no	no	(yes)	no	no	no	no	no	no	no	no	no	no	no	no	no	(yes) = in some regions yes.
Is there any financial aid for the construction of Cormorant exclosures or for scaring programmes, etc.?		no	(yes)	no	no	yes	no	no	(yes)	(yes)	no	no	no	no	no	yes	no	no	no	no	no	no	yes	no	no	no	no	(yes) = in some regions yes.

Table 5.2 General information on actions taken against Cormorants and relevant management plans and legal regulations for the 25 countries covered by REDCAFE.

5.4.1 Breeding colonies destroyed or disturbed

In recent years (1990-2002), 102 Cormorant breeding colonies were reported to have been destroyed or disturbed annually in countries covered by REDCAFE. Most of these colonies (62%) were in Sweden. Far fewer colonies were destroyed or disturbed in Denmark (10%), Germany (9%), Estonia (7%), Italy (5%), Bulgaria (2%), the Czech Republic (2%), France (2%), Greece (1%), and Lithuania (1%).

5.4.2 Nests destroyed

At least 5,194 Cormorant nests were reported to have been destroyed annually, including nests where eggs were oiled (i.e. Denmark). Most nests were destroyed in Denmark (58%) and Estonia (35%). In Germany and Italy about 100 nests each (2% each) were reported destroyed annually, about 81 in Bulgaria (1.6%). Although nests were known to have been destroyed in Sweden, numbers were not known.

5.4.3 Nestlings killed

About 600 – 650 Cormorant nestlings were reported to be killed in European countries covered by REDCAFE, most of them (about 80%) in north-eastern Germany. About 50 – 100 nestlings were reported killed annually in Estonia (12%) and more than 50 (about 8%) in Greece. Again, although nestlings were known to have been killed in Sweden, numbers were not known.

5.4.4 Adults killed in the non-breeding season

Between 50,953 and 53,003 adult Cormorants (including young birds in their first winter) were reported shot annually. This figure included 10,000 birds of the 'Atlantic' (*P. c. carbo*) race hunted legally in Norway. Thus, 40,953 – 43,003 adult Cormorants, mostly the 'Continental' (*P. c. sinensis*) race, were reported to be killed annually as a control measure. The highest proportion (48%) of these birds were shot in France. However, the number shot in France in 2001/02 can not be said to be an annual cull as this was the first year that so many birds had been killed. Other countries with more than 1,000 adult Cormorants reported shot annually were Germany (17%), Denmark (6%), the Czech Republic (5%), Italy (5%), Poland (5%), Switzerland (3%), Bulgaria (2%) and Lithuania (2%).

5.4.5 Breeding adults killed

More than 4,598 adult Cormorants were reported to be killed annually during the breeding season. By far the most were killed in Sweden (87%) from April to September. Far fewer breeding adults were shot in Denmark (9%), followed by Italy (2%), Germany (2%), and Ireland (0.4%). The killing of adult Cormorants during the breeding season was also reported in Bulgaria but numbers were not known. In no other countries were Cormorants reported to be killed during the breeding season.

5.4.6 Night roosts destroyed or disturbed

It was not possible to produce an overall estimate of the number of night roosts destroyed or disturbed annually in the countries covered by REDCAFE. Although Cormorants are known to be disturbed and shot at night roosts in Germany, the Czech Republic and Switzerland, no numbers were available. Of over 248 roosts reported destroyed or disturbed annually in the present study, most were from France (81%). Far fewer roosts were reported affected in the UK (England & Wales) (8%), Italy (5%), Bulgaria (2%), Austria (2%), Belgium (1%), Israel (0,6%), Denmark (0.4%), and Greece (0.4%).

5.5 Management plans/legal regulations

5.5.1 Management plans in effect

Of the 25 countries covered by REDCAFE, 11 (44%) reported that there were national or regional Cormorant management plans in effect. These countries were Austria, Denmark, France, Germany, Ireland, Israel, Italy, Norway, Slovenia, Sweden and Switzerland. Additionally, four countries (Bulgaria, the Czech Republic, Poland and Romania) reported subsequently that there was a regulation in effect allowing Cormorant culling.

5.5.2 Regulations in effect that allow Cormorant culling

In 14 of the 25 countries covered (56%), there was a regulation in effect that allowed Cormorant culling. These countries were: Bulgaria, the Czech Republic, Denmark, France, Germany, Ireland, Israel, Italy, Norway, Poland, Romania, Slovenia, Sweden, and Switzerland. In contrast, there was no legal Cormorant culling in Belgium, Estonia, Finland, Greece, Latvia, Lithuania, The Netherlands, Portugal, Spain, and the UK (both England & Wales, and Scotland). However, in Austria, Belgium, Estonia, Lithuania, Spain, and the UK (both England & Wales, and Scotland) single permits may be obtained, or at least could be obtained in future, for limited killing of Cormorants at particular sites as an aid to scaring.

5.5.3 Co-ordinated culling programmes

In most countries there were no co-ordinated culling programmes. Only Denmark, France, Italy, and Switzerland reported co-ordinated culling programmes and in Italy and Switzerland these were only at the regional or local level. In Switzerland, the culling programme was restricted to rivers with Grayling (*Thymallus thymallus*) populations and small still waters. In Denmark, culling usually involved egg oiling (see 5.6.5). In all other countries Cormorant culling was either unco-ordinated or there was no reported shooting of Cormorants.

5.5.4 'Single' permits vs. 'general' permits for Cormorant killing?

In 13 countries (52%) it was mandatory to obtain single permits for the killing of Cormorants. General permits for the killing of Cormorants were issued for the whole country, or at least parts of it, in 12 (48%) countries. In five countries (20%, i.e. Denmark, Germany, Italy, Poland, and Switzerland), single permits to kill Cormorants were only necessary in parts of the country or at some types of water body. In France, the Environment Ministry gives quota numbers for Cormorant killing to the local authorities (Departements) each year. This operates like a 'general' permit. However, some Departements are not authorised to kill Cormorants. For those where killing is allowed, the local authorities have to control the 'hunters'. Only in Norway, Romania, and Slovenia (12%) were no single permits for the killing of Cormorants necessary.

5.5.5 Financial compensation for fish losses

Financial compensation for fish losses attributed to Cormorant predation was rarely reported as being paid in the European countries covered by REDCAFE. Only four countries (16%) reported paying compensation or would consider doing so under their legislation. These were Belgium, the Czech Republic, one state in Germany (Saxony, see Box 6.4) and some Italian regions.

5.5.6 Financial aid for the construction of Cormorant exclosures or for scaring programmes

Only in six countries (24%), and sometimes only at the regional level, was financial aid reported to be paid for the construction of Cormorant exclosures or for scaring programmes. These countries were Denmark, Lithuania and Spain and some regions of Belgium, France and Germany.

5.6 Remarks from individual countries

5.6.1 Austria

Fishing, hunting and nature protection laws in Austria are subject of regulation by provincial governments and provincial management plans differ substantially in relation to such aspects as defined shooting-areas, time-periods, and bag limits. The general aim of all management plans is to displace Cormorants from small river systems (Grayling, Rainbow Brown Trout sections, or other sensitive fish-grounds) to alternative areas such as bigger river systems, reservoirs, and large lakes. Essentially the aim is to reduce the 'local' impact of Cormorants.

5.6.2 Belgium

There is no legal shooting of Cormorants in Belgium. However, a few birds are known to be killed illegally each year.

5.6.3 Bulgaria

Cormorants were a legal object of hunting in Bulgaria until August 2002. However, such hunting is no longer permitted under new Biodiversity legislation, which took effect at the end of 2002. Single licenses (at present) can be issued by the Minister of Environment and Waters only under special circumstances (e.g. when there is proven damage at fish-ponds or for scientific investigations).

5.6.4 Czech Republic

Under Czech legislation, the Cormorant is a specially protected species. Shooting, disturbance etc. is allowed only with exception permitted by competent authorities. The unlimited shooting of Cormorants is permitted at the breeding localities only during the non-breeding season, with the exception of specially protected areas. In other areas, only defined numbers of Cormorants may be shot. Since autumn 2001, fishery managers can ask for financial compensation for damage caused by Cormorants.

5.6.5 Denmark

Culling is not undertaken but oiling of eggs is used as method to control unwanted population growth in certain regions. The effort is concentrated on sites where Cormorants attempt to establish new colonies on the ground on small islets. However, the majority of eggs are oiled in large ground nesting colonies in western and northern Jutland in an attempt to reduce the number of Cormorants foraging in the fjords in West Jutland. A general permit is given to all owners of standing fishing gear[13] to shoot Cormorants within 1000 m of standing fishing gear when it is in use. Individual permits were given on an annual basis to hunters to shoot Cormorants in two fjords (Ringkøbing Fjord and Nissum Fjord) between 1 September and 28 February during 2002 - 2004.

5.6.6 Estonia

A national management plan is being prepared for Estonia. The Cormorant is on the list of hunted seabirds (hunting is allowed from 20 August – 31 October). The Minister of the Environment can give single permits to shoot birds outside the hunting season or for destroying nests if there is evidence of Cormorant damage. Many cases of illegal persecution

[13] 'Standing fishing gear' is a term applied to any netting structure used to catch fish that is attached permanently to the shore (often by a leader net forcing fish into on offshore net bag or trap). Some types of standing fishing gear (e.g. fly nets) are exposed, and fish may be removed, at low tide, others (e.g. bag and pound nets) remain submerged throughout the tidal cycle and fish are removed from boats.

by local fishermen (i.e. destruction of nests and eggs and sometimes killing of nestlings) are known to have taken place.

5.6.7 Finland

There is no management in Finland concerning Cormorants. As yet, there have been no real conflicts concerning fisheries and Cormorants (see Table 3.1). Nevertheless, a few cases of illegal persecution (i.e. destruction of eggs or nests) have taken place.

5.6.8 France

In France, there is a national management plan of culling wintering Cormorants, with local quotas determined by the Environment Ministry, both in fish ponds and open waters (rivers with supposed endangered "patrimonial" species, these are fishes that have both high conservation status and high value as quarry species). This culling involves both immature and adult Cormorants and about 20,000 birds were killed in 2001/02. The Environment Ministry gives quota numbers for Cormorant killing to the local authorities (Departements) each year. Some Departements are not authorised to kill Cormorants. For those where killing is allowed, the local authorities have to control the 'hunters'. Generally, these hunters are guards of the National Hunting Office (*Office National de la Chasse et de la Faune Sauvage*) or of the National Fish Council (*Conseil Supérieur de la Pêche*), and some local private individuals who are controlled by the official guards for killing operations on rivers. For fish farmers on their own fishponds, local authorities give personal (i.e named) permits. Thus, regulations ensure that 'anonymous' hunters are not allowed to kill Cormorants in France.

5.6.9 Germany

In Germany, regional management plans differ substantially. In some regions, especially in Bavaria, there is a general permit to shot Cormorants at most water bodies during the non-breeding season.

5.6.10 Greece

All sites where the 'Continental' (*sinensis*) race breeds in Greece are in protected areas (i.e. Ramsar, Special Protected Areas) and no intervention is allowed legally. No financial aid or compensation is given to fishermen (according to the Ministry of Agriculture no aid was required). Similarly, no permission was given in order to kill Cormorants (never required by fishermen).

5.6.11 Ireland

There is no national management plan for Cormorants in Ireland. Cormorants are protected in Ireland under the Wildlife Act (1976) and can only be disturbed or shot by license in exceptional circumstances under Section 42 of the Act.

5.6.12 Israel

Since 1996, there has been killing of Cormorants by a special team and fishermen everywhere in the fishpond areas of Israel, including roosting sites. Since 2002, there has been controlled shooting for frightening Cormorants at all fishponds simultaneously and the monitoring of the birds' subsequent use of alternative foraging sites.

5.6.13 Italy

The Cormorant is a fully protected species under Italian national legislation. At the regional level there are management plans that differ quite substantially and allow shooting of birds during both the wintering and the breeding seasons to reduce predation and prevent the establishment of new colonies.

5.6.14 Latvia

No official permit for the killing of Cormorants exists in Latvia. But it is estimated that some hundred birds are shot illegally every year (especially at private fishponds) although exact numbers are unknown.

5.6.15 Lithuania

The unco-ordinated shooting of Cormorants at fishponds is considered ineffective in Lithuania. Thus, it is considered necessary to start a longer-term (e.g. three-year) co-ordinated regulation of the Cormorant population on a pan-European scale and to check the subsequent effects of any such action.

5.6.16 The Netherlands

There is no overall management of Cormorants in the Netherlands. There is some habitat management in nature restoration sites in the IJsselmeer area that are being freed from Willow (*Salix* spp.) growth. However, in a recent report it was shown that Cormorant density was highest at ground breeding sites, which would go against this particular management option. Cormorants have been disturbed on several occasions, sometimes as 'experiments' by local fishermen chasing birds away with fast boats on the IJsselmeer. In all colonies (either established or new) interference is zero up to now. Illegal actions are thought to have been taken only in very few cases. Colonies are found in protected areas belonging to either State, or private organisations. Any interference thus currently meets the various standards for management directives and responsibilities in particular areas. National (Flora en Faunawet) and International Law (EC Bird Directive) are followed closely; the majority of habitat is now included under these Directives.

5.6.17 Norway

The Management Authority in Norway considers Cormorants (*P. c. carbo*) and Shags (*P. aristotelis*) as valuable game species that should be managed in such a way that sustainable populations are maintained in all parts of their distribution area.

5.6.18 Poland

There is no management of Cormorants in Poland. The Cormorant is protected and the Minister of the Environment can give single permits to disturb birds (all year except for breeding colonies) or shoot them (except for breeding season, from 15 July till birds leave colonies). According to the latest regulations, this species can be hunted or disturbed all year on the fish ponds without special permissions. Some illegal destruction of nests occurs.

5.6.19 Portugal

There is no Cormorant management in Portugal.

5.6.20 Romania

Information was only available for the Danube delta, not for all of Romania. According to Romanian hunting law, the Cormorant can be shot from 15 August – 15 March. Shooting of Cormorants occurs especially at private fishponds. The Danube delta is a Biosphere Reserve and there is no programme to reduce Cormorant numbers here. Some illegal destruction of nests and roosts occurs, i.e. in 1991 approx. 180 young chicks were illegally killed in a colony in the lagoons by fishermen.

5.6.21 Slovenia

There is a national management plan for the culling of wintering Cormorants in Slovenia, with local quotas attributed since 2000/01 by the Ministry of Agriculture, Forestry, and Food. However, there has been no success in reducing bird numbers. Shooting occurs all over the country, except on sites protected under IBA and Ramsar Conventions, because neither bureaucracy nor anglers are willing to protect most vulnerable waters with threatened fish species at 'the expense' of larger water bodies.

5.6.22 Spain

Hunting and disturbing Cormorants is illegal in Spain. In some regions, financial aid for the construction of Cormorant exclosures of up to 50% of the total costs is paid.

5.6.23 Sweden

A national Cormorant management plan has recently been produced and implemented in Sweden. This plan suggests protective hunting be allowed close to (< 300m) standing fishing gears. Alternative non-lethal methods to reduce Cormorant predation should be developed at standing fishing gears. It also suggests that disturbance at colonies is used carefully due to the risk of spreading birds to new sites where they are not wanted. The plan also suggests that Sweden should work, within the EU, for an open hunting season on Cormorants.

5.6.24 Switzerland

Cormorant management in Switzerland is primarily to protect the Grayling. There is no Cormorant shooting on water bodies of less than 50 ha but locally co-ordinated Cormorant scaring/culling is undertaken on Grayling rivers.

5.6.25 UK

In England & Wales, licences to shoot limited numbers of Cormorants at specific sites can be issued as an aid to scaring. Applicants need to be able to demonstrate that 'serious' losses are occurring and that other management options have been tried and have failed or are impractical. There is an unknown level of illegal shooting. In Scotland, a mix of about 300 adult and immature birds is shot annually under licence during the non-breeding season. Licences to shoot limited numbers of Cormorants at specific sites can be issued as an aid to scaring. Applicants need to be able to demonstrate that 'serious' losses are occurring and that other management options have been tried and have failed or are impractical. There is an unknown level of illegal shooting.

5.7 Cormorant damage control activities at feeding sites

Of the 25 countries covered by REDCAFE that reported general information on site-specific actions (see 5.4), 16 (64%) also reported on the Cormorant damage control activities undertaken at feeding sites. These countries were Austria, Belgium, Bulgaria, the Czech Republic, Denmark, Estonia, Germany, Greece, Ireland, Israel, Italy, Lithuania, Poland, Portugal, Spain and the UK (England & Wales and Scotland). Only general information on the management of Cormorants was provided for the remaining countries because there was either little management there or because it was restricted to shooting (see 5.6). Two major datasets arose from the analysis of information provided on Cormorant damage control activities at feeding sites. First, a set of tables that show which management actions were taken in each country: the complete database is given in section 5.10 and the main findings in section 5.7 below. Second, a set of tables summarising the assessments of the effectiveness, practicability, acceptability, and costs of each technique or action: the complete database is given in section 5.11 and the main findings in section 5.8.

5.7.1 Cormorant damage control methods used in Europe

An important outcome of this synthesis of information is that, in spite of the long list of techniques and actions that have been tested against Cormorants at feeding sites, only a small number of them are used regularly. Most potential methods are either rarely used, not used at all, or have only been used in trials (see 5.10).

(1) Small rivers (width < 100m)

Eleven (69%) countries reported on small river habitats. Of these, three countries (i.e. Estonia, Poland, and Portugal) reported that no actions were taken against Cormorants in this habitat. A relatively small number of techniques or actions were used regularly on small rivers, in at least one country (Table 5.3).

(1) Resource management
Habitat
- Improve habitat quality for fishes

Fish
- Altering the timing of fish stocking
- Altering the stocked fish size

(2) Bird-proof barriers
- Wire, lines or string in parallel patterns
- Submersed fish refuges

(3) Wildlife Management: non-lethal techniques
Human harassment
- Human patrol on foot or in vehicles

Audio frightening techniques
- Gas bangers / cannons (propane gas exploders)
- Pyrotechnics / Fireworks (shell crackers, screamers, whistling projectiles, exploding projectiles, bird bangers, flash/detonation cartridges)
- Live ammunition

Wildlife Management: lethal techniques
- Shooting adults and immatures to reinforce non-lethal harassment
- Shooting adults and immatures to reduce bird numbers at specific sites

Table 5.3 Techniques or actions used regularly in efforts to reduce Cormorant impacts in small river habitats.

(2) Large rivers (width > 100m)

Nine (56%) countries reported on large river habitats. Of these, four countries (i.e. Estonia, Poland, Portugal and the UK [England & Wales]) reported that no actions were taken against Cormorants in this habitat. Only a small number of techniques or actions was used regularly on large rivers, at least in one country (Table 5.4).

(1) Resource management
Habitat management
- Improve habitat quality for fishes

(3) Wildlife Management: non-lethal techniques
Audio frightening techniques
- Live ammunition

Wildlife Management: lethal techniques
- Shooting adults and immatures to reinforce non-lethal harassment
- Shooting adults and immatures to reduce bird numbers at specific sites

Table 5.4 Techniques or actions used regularly in efforts to reduce Cormorant impacts in large river habitats.

(3) Small still waters (< 100 ha) without aquaculture

Ten (62%) countries reported on the small stillwater habitats. Of these, three countries (i.e. Belgium, Estonia, and Portugal) reported that no actions were taken against Cormorants in this habitat. Only a small number of techniques or actions was used regularly on small (non-aquaculture) stillwaters, at least in one country (Table 5.5).

(1) Resource management
Habitat management
- Increase of turbidity

(3) Wildlife Management: non-lethal techniques
Human harassment
- Human patrol on foot or in vehicles

Audio frightening techniques
- Gas bangers / cannons (propane gas exploders)
- Pyrotechnics / Fireworks (shell crackers, screamers, whistling projectiles, exploding projectiles, bird bangers, flash/detonation cartridges)
- Live ammunition

Visual frightening techniques
- Simple human effigies or scarecrows
- Combination of audio and visual techniques

Wildlife Management: lethal techniques
- Shooting adults and immatures to reinforce non-lethal harassment
- Shooting adults and immatures to reduce bird numbers at specific sites

Table 5.5 Techniques or actions used regularly in efforts to reduce Cormorant impacts in small (non-aquaculture) stillwater habitats.

(4) Very large water bodies (> 100 ha; stillwaters and coastal waters)

Nine (56%) countries reported on the very large water habitats. Of these, two countries (i.e. Estonia and Portugal) reported that no actions were taken against Cormorants in this

habitat. Only a small number of techniques or actions were used regularly on large water bodies, at least in one country (Table 5.6).

(2)Bird-proof barriers

- Covering of fyke nets

3. Wildlife Management: non-lethal techniques

Human harassment

- Human patrol on foot or in vehicles or by boats

Audio frightening techniques

- Tin plates
- Gas bangers / cannons (propane gas exploders)
- Pyrotechnics / Fireworks (shell crackers, screamers, whistling projectiles, exploding projectiles, bird bangers, flash/detonation cartridges)
- Live ammunition

Wildlife Management: lethal techniques

- Shooting adults and immatures to reinforce non-lethal harassment
- Shooting adults and immatures to reduce bird numbers at specific sites
- Shooting adults and immatures to reduce regional population levels

Table 5.6 Techniques or actions used regularly in efforts to reduce Cormorant impacts on very large waterbodies (stillwaters and coasts).

(5) Aquaculture

All but one country (94%) reported on aquaculture habitats. The only country that did not was Greece. All of these countries reported that actions were taken against Cormorants in this habitat. A large number of techniques or actions were used regularly at aquaculture facilities (Table 5.7).

(1) Resource management

Fish management

- Altering the timing of fish stocking
- Altering the frequency of fish stocking
- Altering the density of fish stocked
- Altering the stocked fish size
- Locating most susceptible fish species and size close to the centre of human activity or near buildings

Facility construction

- Design / construction

(2) **Bird-proof barriers**

- Physical exclosures with narrow meshed systems (mesh sizes < 20 cm) using wire, lines or string in parallel or grid patterns
- Wire, lines or string in grid patterns (5 m mesh size)
- Wire, lines or string in grid patterns (7.5 m mesh size)
- Wire, lines or string in grid patterns (10 m mesh size)
- Wire, lines or string in grid patterns (>15 m)
- Wire, lines or string in parallel patterns (0.25 - 0.3 - (0.6) m)
- Partial exclosures (narrow meshed)
- Vertical nets in parallel patterns (set 5 - 10 m apart)
- Submersed anti-predator nets with 10 cm square mesh - submerged as curtains around floating net pens

(3) Wildlife Management: non-lethal techniques

Human harassment

- Human patrol on foot or in vehicles or by boats
- Simple human presence

Audio frightening techniques

- Sirens
- Vehicle horns
- Gas bangers / cannons (propane gas exploders)
- Pyrotechnics / Fireworks (shell crackers, screamers, whistling projectiles, exploding projectiles, bird bangers, flash/detonation cartridges)
- Live ammunition

Visual frightening techniques

- Simple human effigies or scarecrows
- Animated scarecrows (moving and/or in combination with automated sound devices)
- Mylar tape
- Combination of audio and visual techniques

Wildlife Management: lethal techniques

- Shooting adults and immatures to reinforce non-lethal harassment
- Shooting adults and immatures to reduce bird numbers at specific sites
- Shooting adults and immatures to reduce regional population levels

Table 5.7 Techniques or actions used regularly ion efforts to reduce Cormorant impacts at aquaculture facilities.

5.8 Assessments of techniques and actions used regularly

The full database for these assessments is given in section 5.11 and the main findings for each technique/action and for each of the five Cormorant feeding habitats are summarised in this section.

5.8.1 Assessments of each technique and action

1. Resource management

1.1. Habitat management

(a) Improve habitat quality for fishes

This was used only at small rivers and to some extent at larger rivers and very large water bodies. In general it was stated that the actions taken to improve habitat quality for fishes are not aimed directly at reducing Cormorant predation but are general measures to improve fish habitat and, consequently, fish populations. It was thought that, to some extent at least, more natural habitats also help fishes to avoid predation and/or to improve their reproduction. The effectiveness was given as months to years. Its practicability was mostly high, its acceptability was also mostly high. However, costs were recorded as being high to very high.

(b) Increase of turbidity

Only REDCAFE participants from the UK (England & Wales) mentioned the increase of turbidity as being regularly used at small still waters. However, this technique is not used specifically against Cormorants. Stocking of large benthic species (e.g. Carp *Cyprinus carpio*) at fisheries (now commonplace in England & Wales) is responsible for increased water turbidity. The effectiveness of the method was not known. It was considered to be of medium practicability and costs. However, acceptability seemed questionable on biodiversity/aesthetic grounds.

1.2. Fish management

(a) Altering the timing of fish stocking

Regularly used at small and large rivers and in aquaculture. Effectiveness was from days to months at small rivers and from not effective to months in aquaculture. Practicability was mostly medium to very high, acceptability ranged from low to very high and costs ranged from very low to very high. This wide variation appeared to be dependent on the individual case and group of stakeholders concerned.

(b) Altering the frequency of fish stocking

Only used regularly in aquaculture. Effectiveness was months, practicability was medium to high, acceptability also medium to high, and costs low to medium.

(c) Altering the density of fish stocked

Only used regularly in aquaculture. Effectiveness ranged from not effective to months, practicability from medium to very high, acceptability was mostly medium to high, costs low to high. This technique was used in two ways. For example, in Austria, Carp pond owners increased stocking, while Germany reported lowering fish density in Carp ponds. In general, anglers, as stated for small rivers in the UK (England & Wales), would not favour lower fish densities.

(d) Altering the stocked fish size

Used regularly on small rivers and aquaculture. Effectiveness was months at small rivers while it ranged from not effective to months in aquaculture. Practicability was medium to high, acceptability was medium to very high at small rivers, but low to high in aquaculture.

Similarly costs were give as medium to very high at small rivers and low to medium at aquaculture, depending on the size of the fish stocked. A shift towards the stocking of larger fish would almost certainly be more expensive than the stocking of smaller individuals.

(e) Locating most susceptible fish species and size close to the centre of human activity or near buildings

Only used regularly in aquaculture. Ranged from not effective to days and even months. Thus effectiveness was strongly dependent on the local situation. For example in Italy, fishing gears and fish wintering basins are often located close to buildings and areas used by humans. However, Cormorants were not discouraged from foraging if active means were not used (e.g. blank shots, shooting, human patrolling, etc.). Practicability was mostly given as medium to high, acceptability was low to high, costs were very low to high, again highlighting considerable site-specific differences.

1.3. Facility construction

Design / construction

This referred to the fact that all aquaculture facilities (i.e. for salmonid production) in Denmark were designed in a way that allows use of wires (see below).

2. Bird-proof barriers

(a) Physical exclosures with narrow meshed systems (mesh sizes mostly < 20 cm) using wire, lines or string in grid patterns

Narrow meshed systems (spacing. 10 – 20 cm) were used widely at salmonid rearing facilities in Europe mostly using polyester string. Sometimes, these systems were also used at other types of aquaculture facility. For example, to protect wintering ponds or for partial exclosures (see below) in Carp production. In Denmark, all freshwater aquaculture facilities must be protected with these systems by law. Two important commercial producers of narrow meshed systems are the Danish companies Forelco and Gamsen, both based in Billund. Both companies sell their systems in many European countries. Sometimes these systems cause high visual impact as the strings and wires are mounted 4 – 5 m overhead on wooden poles to avoid negative impacts on the daily work operations of the fish farms protected. The effectiveness was generally given as years. The systems sometimes need maintenance after severe weather, especially ice rain and storms. Practicability was mostly medium to high, acceptability ranged from medium to very high. Costs were generally considered to be high (e.g. 15,000 – 20,000 €/ha). However when calculating over a ten year minimum life-span, the costs break down to 1,500 – 2,000 €/ha/year. In the UK (England & Wales) these systems were mainly used to reduce Grey Heron (*Ardea cinerea*) predation. Aquaculture facilities of up to 20 ha can easily be protected with narrow meshed systems.

(b) Wire, lines or string in grid patterns (5 m mesh size)

(c) Wire, lines or string in grid patterns (7.5 m mesh size)

(d) Wire, lines or string in grid patterns (10 m mesh size)

Only used at aquacultures in Germany, Italy and the UK (England & Wales). Its effectiveness was given from days to years. Practicability was given as low/medium to high, acceptability was medium to high and costs were low to high. Problems with this technique involved the potential for non-target waterbird species to crash into the wires and strings when trying to land on protected ponds, especially at night. Cormorants may learn quickly how to avoid the wires and strings. If there are large numbers of birds present, the protected ponds are densely stocked and/or there are only few alternative feeding sites, it is likely that Cormorants will learn to fish in ponds protected in such a way. In the UK (England & Wales) these systems were mainly used to reduce Grey Heron predation.

(e) Wire, lines or string in grid patterns (>15 m)

Used in Israel against Great White Pelican (*Pelecanus onoccrotalus*). However considered not effective for either Pelicans or Cormorants.

(f) Wire, lines or string in parallel patterns (0.25 - 0.3 - (0.6) m)

(i) Similar systems, use and assessments of effectiveness, practicability, acceptability and costs as described above at a) Physical exclosures with narrow meshed systems (mesh sizes < 20 cm) using wire, lines or string in grid patterns.

(ii) Parallel strings of unknown spacing are also used regularly to protect special sections of the two small Belgian rivers Amblève and Loue (both salmonid rivers) where fly fishing is traditional and during the winter months.

(g) Partial exclosures (narrow meshed)

These systems have been tested and used only in Italy and Germany. Here, large ponds were partially covered (mostly about 10% of the water surface) by a narrow meshed system as described above at a) Physical exclosures with narrow meshed systems (mesh sizes < 20 cm) using wire, lines or string in grid patterns. The protected part of the pond served as a fish refuge that the fish (Carp in Germany) enter during the day when attacked by Cormorants. The Carp are also given supplementary food in the protected part of the pond. At night, the Carp then can use the whole pond for feeding. The effectiveness is given as months to years. Its practicability ranged from low to medium to high, depending on the local situation. Acceptability was medium to high and costs were generally medium. As only about 10% of a pond can be covered, costs in general were only 10% of a regular (full) narrow-meshed system (e.g. 150 – 200 €/ha/year).

(h) Submersed fish refuges

Only regularly used at small rivers in Germany and the UK (England & Wales). As the improvement of habitat quality (see above 1.1. Habitat management; a) Improve habitat quality for fishes) this method was not directly aimed at reducing Cormorant predation but it was a general measure to improve fish habitat and, consequently, fish populations. The effectiveness was given as years. Its practicability was low to high, its acceptability mostly medium to very high, and costs were medium to high. Problems with navigation and land drainage may occur. The structures also need to be secured against flood flows.

(i) Vertical nets in parallel patterns (set 5 - 10 m apart)

Submersed fences that do not allow Cormorants to dive through; in Germany used on Carp ponds, in Italy used to discourage Cormorant access to canals connecting large growth basins and small basins used for fish wintering and stocking. Effectiveness was days to years, practicability was medium to high, acceptability was medium and costs were given as low to medium.

(j) Submerged anti-predator nets with 10 cm square mesh - submerged as curtains around floating net pens

Ireland & UK (Scotland): The nets used are generally standard predator nets at aquaculture sites and are not usually specific for Cormorants. In use were submerged anti-predator nets with 10 cm square mesh (submerged as curtains around floating net pens). Effectiveness was years, practicability and acceptability were very high, costs were high.

(k) Covering of fyke nets

In Denmark and Germany (Mecklenburg-Vorpommern) fyke nets in the Baltic Sea are regularly covered with nets. Also the roosting of Cormorants on the poles of the fykes is prevented. Unfortunately, the effectiveness was unknown, practicability and acceptability were given as high, costs as medium.

3. Wildlife Management

3.1. Non-lethal techniques

3.1.1. Human harassment

(a) Human patrol on foot or in vehicles or by boats

Human patrol was one of the most commonly used actions taken against Cormorant predation in the countries covered by REDCAFE. This technique was regularly practised at small rivers, small still waters, very large water bodies and at aquaculture facilities. In spite of its wide use, it was generally considered as being only effective in the short-term, ranging from not effective to being effective for hours or sometimes days. To keep Cormorants away for longer periods, an almost constant presence of humans was considered necessary. Consequently, costs can be high if working time has to be paid for (i.e. wages). However, if human presence involved volunteers (e.g. unpaid anglers, hunters), then the costs of this method can be quite low (e.g. fuel costs for vehicles). Practicability and acceptability ranged from low to very high and depended on the local situation and the stakeholders involved.

(b) Simple human presence

In Poland a regularly used method in aquaculture was simple human presence. But, this was considered ineffective.

3.1.2. Audio frightening techniques

(a) Sirens

Only used at aquacultures in Israel and Italy, but not effective or effective for hours at best.

(b) Vehicle horns

Only used at aquacultures in Israel and Italy, but not effective.

(c) Tin plates

A special technique of unknown effectiveness, only used regularly at Lake Kerkini in Greece.

(d) Gas bangers / cannons (mostly propane gas exploders)

One of the most widely used techniques in countries covered by REDCAFE. Regularly used at small rivers, small still waters, very large water bodies (in special situations such as fyke nets), and in aquaculture facilities. In spite of its wide use, it was generally considered as being only effective in the short-term, ranging from not effective to being effective for hours or up to days (weeks under rare conditions). Practicability was mostly high (but ranged from low to high), acceptability ranged from low to very high, depending on the local situation and the stakeholders involved. Costs were mostly given as low to medium. In Germany this techniques was often used for short, highly sensitive, periods to restrict local damage, i.e. during the draining of Carp ponds. In Italy its use was limited to small water basins. The sounds (noises) may negatively effect other non-target species as well as workers and other people. In general, it was most effective if moved regularly and used in conjunction with other visual deterrents.

(e) Pyrotechnics / Fireworks (shell crackers, screamers, whistling projectiles, exploding projectiles, bird bangers, flash/detonation cartridges)

Also a rather widely used technique. But, its use was restricted due to legal restrictions in some countries. It was used at small rivers, small still waters, very large water bodies and in aquaculture. Its effectiveness mostly ranged from not effective to days (up to weeks at small still waters and up to months in aquaculture). Practicability and acceptability ranged from low to very high, depending on the local situation and stakeholders involved. Like the gas bangers, the noises can have negative impacts on other wildlife and people. Costs were mostly given as medium to high which, at least in part, depended on whether wages were paid.

(f) Live ammunition

The use of live ammunition was one of the most widely used techniques in countries covered by REDCAFE. It was one of the few techniques reported from all five types of waterbody habitat. It was more widely distributed than the use of pyrotechnics, as live ammunition is often cheaper and more readily available. Also, there are fewer legal restrictions for its use. Again, in spite of its wide use, it was generally considered as being only effective in the short-term, ranging from not effective to being effective for hours or up to days (weeks or months under rare conditions). Its practicability and acceptability ranged from low to very high, depending on the local situations and stakeholders involved. Costs ranged from low to high which, at least in part, depended on whether wages were paid.

3.1.3. Visual frightening techniques

(a) Simple human effigies or scarecrows

Widely used in aquaculture and sometimes also regularly used at small still waters. It was more or less not effective or effective for up to days at best. Costs were mostly given as low. Practicability and acceptability ranged widely from low to very high.

(b) Animated scarecrows (moving and/or in combination with automated sound devices)

Regularly used in aquaculture facilities in Germany and the UK (England & Wales). Best when used in conjunction with other audio scarers and if moved regularly. Effective only for days, practicability was high and acceptability was medium. Costs were given as low to medium.

(c) Mylar tape

Regularly used in aquaculture facilities in Germany, Italy, and the UK (England & Wales). Effective only for days at best. Mylar is short lasting and breaks very easily in bad weather conditions. Thus, it may be a cause of both visual and water pollution. Costs were very low to low. Practicability ranged from low to high depending on local situations. Acceptability was medium.

(d) Combination of audio and visual techniques

Audio and visual techniques are mostly used in combination at aquaculture facilities but also at small rivers and in few cases at large rivers. At small still waters and in aquaculture its effectiveness was given as days to weeks, at very large water bodies only as hours to days. Practicability ranged from medium to high, acceptability was generally given as medium. Costs were given as very low to medium.

3.2. Lethal techniques

(a) Shooting adults and immatures to reinforce non-lethal harassment

Shooting of Cormorants to reinforce non-lethal harassment was reported from most of the countries included in this part of the REDCAFE synthesis. Only Estonia, Portugal and Spain reported no legal shooting at all. This technique/action was reported from all five types of water body. Its effectiveness was generally short-term, ranging from not effective to days at large rivers and very large water bodies to being effective for days to even weeks and months in aquaculture. Clearly, shooting can only be effective for weeks and months in special conditions, especially when there are stable bird populations and when there is little exchange ('turnover') of birds. The practicability ranges from low to very high, depending on the local situation and the size of the water body that is to be protected. Acceptability ranged from low to very high, depending on the stakeholders involved. Costs ranged from low to very high, depending on whether wages had to be paid or not. Similar to the audio techniques, noise from shooting may have negative impacts on other wildlife and people.

(b) Shooting adults and immatures to reduce bird numbers at specific sites

Shooting of Cormorants to reduce bird numbers at a specific site was reported in most countries. Only Estonia, Portugal and Spain reported no legal shooting at all. This technique/action was also reported from all five types of water body. Its effectiveness was also generally short-term, ranging from not effective to days at large rivers to being effective for days to even weeks and months in aquaculture. Clearly, shooting can only be effective for weeks and months in special conditions, especially when there are stable bird populations and when there is little exchange ('turnover') of birds. Some recent papers showed that shooting was not effective in reducing Cormorant numbers in France, Germany, and Austria due to the migration of birds. Shot birds were quickly replaced by new ones, especially at very attractive feeding sites (Keller & Lanz 2003; Marion 2003; Parz-Gollner 2003). The practicability ranged from low to very high, depending on the local situation and the size of the water body that was to be protected. Acceptability ranged from low to very high, depending on the stakeholders involved. Costs also ranged from low to very high, depending on whether wages had to be paid or not. Similar to the audio techniques, the noises of shooting may have a negative impact on other wildlife and people. As in some German states, the shooting of Cormorants was often only considered a means for fishermen to work off their frustration with Cormorants. Also, shooting often only appeared to change the distribution of Cormorants, rather than reducing their numbers even locally.

(c) Shooting adults and immatures to reduce regional population levels

At least officially, shooting to reduce regional population levels was only practised in a few countries covered by REDCAFE. Nevertheless, some of the shooting done in France and Germany probably comes under this category, although it is not officially stated as such. Shooting adults and immature Cormorants to reduce regional population levels was only, or has been, practised at very large water bodies in Denmark (two fjords), in Italy (Sardinia), and Sweden, and at aquacultures in the Czech Republic, Israel, and in Italy (Oristano lagoons in Sardinia). Its effectiveness ranged from unknown to days in the cases of Denmark, the Czech Republic, and Sweden, and from days or months in Israel and Italy (Sardinia). Clearly, an effectiveness of months can only be achieved when the bird populations are rather stable and shot birds are not being replaced quickly, as may be the case in mid-winter in Israel and Sardinia. Practicability was mostly given as low. Acceptability ranged from low to very high, depending on the stakeholders involved. Costs were considered to be medium to very high.

5.8.2 Assessments in relation to Cormorant feeding habitat

The following five figures (Figures 5.1 – 5.5) summarise effectiveness, practicability, acceptability and cost information for those techniques/actions used against Cormorants in five different feeding habitats.

Technique/action	Effectiveness					Practicability					Acceptability					Costs				
	yrs	mon	dys	not	?	v. high	high	med	low	not	v.high	high	med	low	not	v.high	high	med	low	v.low
Habitat management																				
improve fish habitat quality																				
increase turbidity																				
Fish management																				
alter fish stocking: timing																				
alter fish stocking: frequency																				
alter fish stocking: density																				
alter fish stocking: fish size																				
relocate susceptible species																				
(2) Bird proof barriers																				
narrow meshed systems																				
wires etc 5m mesh																				
wires etc 7.5m mesh																				
wires etc 10m mesh																				
wires > 15m																				
parallel wires																				
partial exclosures																				
submerged fish refuges																				
vertical parallel nets																				
submerged anti-predator nets																				
covering fyke nets																				
(3) Wildlife management: non-lethal																				
Human harassment																				
human patrol on foot/vehicles																				
human presence																				
Audio techniques																				
sirens																				
vehicle horns																				
tin plates																				
gas bangers/cannons																				
pyrotechnics/fireworks																				
live ammunition																				
Visual techniques																				
simple scarecrows																				
animated scarecrows																				
Mylar tape																				
audio:visual combination																				
Wildlife management: lethal																				
shooting to reinforce harassment																				
shooting to reduce numbers at sites																				
shooting to reduce regional numbers																				

Figure 5.1 Effectiveness, practicability, acceptability and cost of techniques used regularly in small rivers.

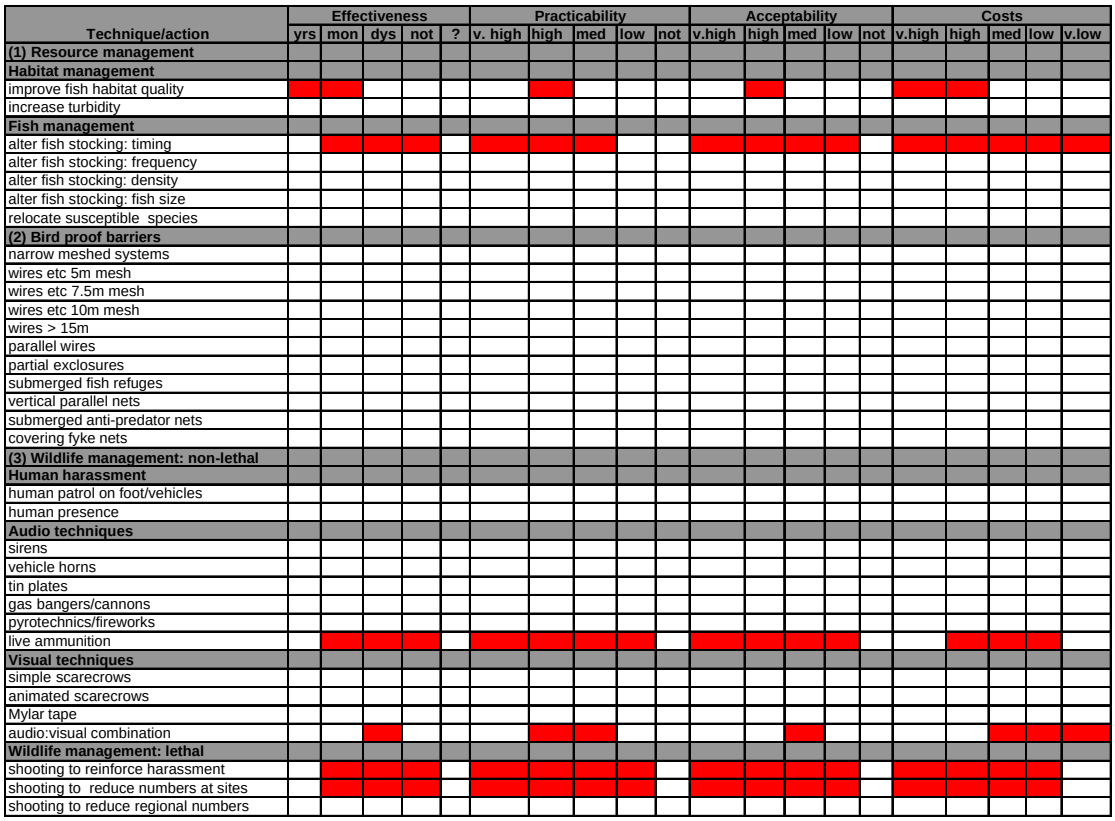

Figure 5.2 Effectiveness, practicability, acceptability and cost of techniques used regularly in large rivers.

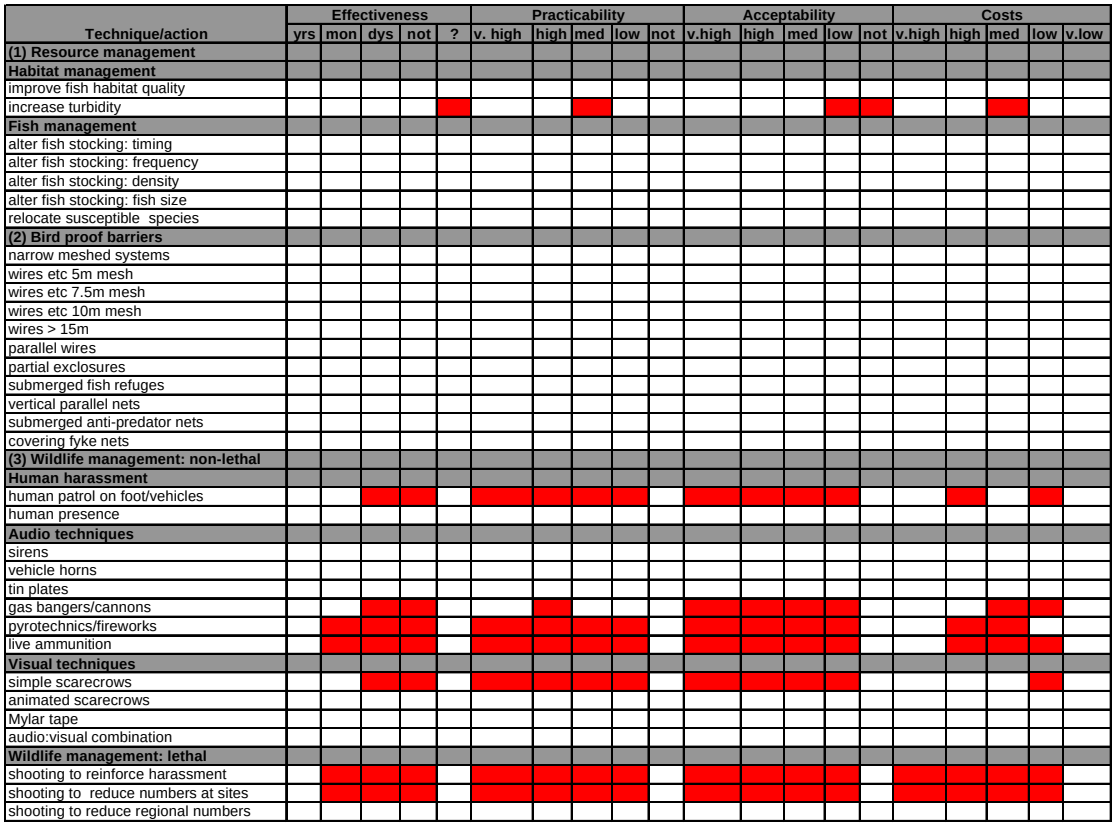

Figure 5.3 Effectiveness, practicability, acceptability and cost of techniques used regularly in small stillwaters.

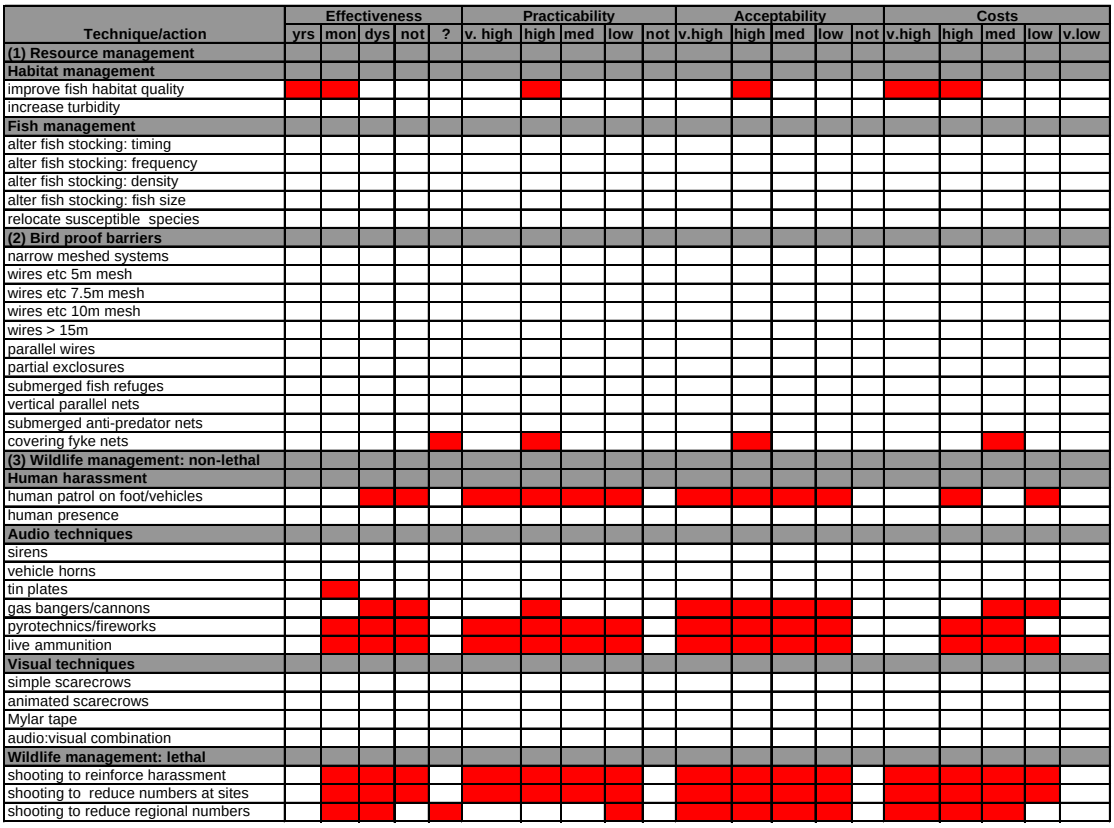

Figure 5.4 Effectiveness, practicability, acceptability and cost of techniques used regularly in very large waters: lakes and coasts.

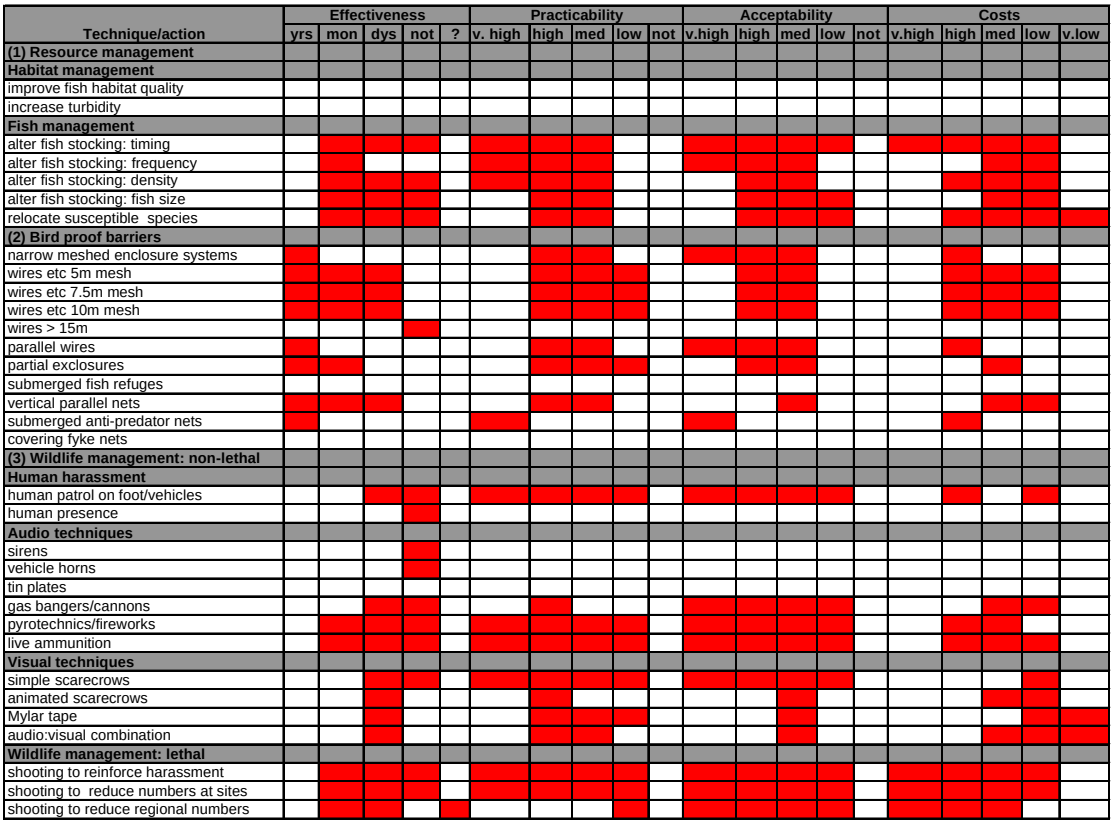

Figure 5.5 Effectiveness, practicability, acceptability and cost of techniques used regularly in aquaculture.

5.9 Discussion

Work for this synthesis aimed to provide a comprehensive overview of potential Cormorant management tools. This Chapter 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.

5.9.1 Cormorant population modelling

Current, state-of-the-art, Cormorant population modelling suffers from a number of uncertainties (see 5.3). These uncertainties arise over measurements of Cormorant population size, the strength of natural regulating mechanisms , and the extent of planned or unplanned human interventions Frederiksen *et al*. (2001). Such uncertainties are, however, a general phenomenon in the management of wildlife and natural resources, and this is one of the most compelling arguments for the use of adaptive management strategies (Walters 1986). Frederiksen *et al*. (2001) offered suggestions for the use of population modelling in planning any pan-European Cormorant cull. The most well-supported 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.

Frederiksen *et al*.'s (2001) 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.

Furthermore, Frederiksen *et al*. (2001) considered that even though Cormorant population control through culling was feasible it may not be the most efficient, economical or ethical way of limiting Cormorant damage to fisheries, and other interests, across Europe. They also cited research that suggests several limitations to culling. First, large-scale culls are inevitably expensive to carry out and they do not necessarily discourage Cormorants from continuing to use roosts and associated feeding areas (McKay *et al*. 1999). Second, subsequent to any cull, the numbers of Cormorants feeding at particular sites might decline less than the total number (or not at all) because these sites are high (optimal) quality habitats. Culls in such optimal foraging habitats may thus even reduce populations primarily in sub-optimal habitats where economic interests are less important (Bregnballe *et al*. 1997). Third, there is growing evidence that culling is inefficient in situations with large turnover of individuals (Keller & Lanz 2003). Large numbers of birds may be shot but are quickly replaced by new individuals (see also Box 6.2).

Current (2001-02 unless otherwise stated) estimates of the numbers of Cormorants killed in Europe recorded for the present synthesis (Table 5.2) have implications for the Cormorant modelling reported here and these are discussed in section 5.9.2 below.

5.9.2 Relatively large-scale Cormorant control

The current synthesis of general information on actions against Cormorants included information from all 25 countries covered by the REDCAFE project (see full list in Table 5.2, also map Figure 2.1). REDCAFE participants reported that some form of national or regional Cormorant management plan was in effect in 11 (44%) of these countries (for full lists of relevant countries see section 5.5). A further four countries (16%) had a legal regulation in effect that allowed Cormorant culling. Overall, such a regulation was in effect in 14 (56%) counties. In a further 6 (24%) 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, these operated only in Denmark and France and in parts of Italy and Switzerland. In 13 countries (52%) it was mandatory to obtain single permits for the killing of Cormorants. However, many of these countries had issues general permits for some areas or regions. Altogether, 12 countries (48%) had thus issued some kind of general permit. 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 covered by the REDCAFE project, ten (40%) 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 (20%). A total of between 600-650 Cormorant nestlings were also reported to be killed in three (12%) countries. Numbers of both nests and nestlings are known to be under-recorded because such actions have also been undertaken in Sweden although numbers are unavailable. 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 (72%) 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.

The only countries were no birds were reported to be killed legally were Belgium, Finland, the Netherlands, Portugal, Spain and Sweden (in Sweden this was only outside the breeding season). A further 4,598 Cormorants were reported to be killed annually during the breeding season in six (24%) countries. However, this was an underestimate because the numbers for Bulgaria were unknown. Over 248 night roosts were reported to be destroyed or damaged annually in nine (36%) countries. This figure was presumed to be a considerable underestimate because roosts were known to have been destroyed or disturbed in three other countries (Czech Republic, Germany and Switzerland) but the numbers involved were unknown.

Unfortunately, a proper evaluation of how these figures for killed cormorants might affect the pan-European population would require a new modelling exercise, with spatial structure. However it seems clear (Frederiksen pers. comm.) that the consequences must be smaller than originally predicted in Frederiksen *et al*.'s (2001) study, simply because the total Cormorant population is now bigger than it was expected to be.

Finally, Frederiksen *et al*. (2001) suggested that, before deciding on a pan-European culling strategy for Cormorants, management authorities should consider whether to control Cormorants, or the damage that they cause. The present synthesis of techniques currently used to reduce Cormorant damage, at the site-specific level, is discussed in the next section.

5.9.3 Site-specific actions

A total of 33 site-specific techniques used regularly to reduce the effects of Cormorants at feeding sites were recorded for 16 countries (see 5.7 for full list). 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), 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. Nevertheless, they were reported to have positive effects in relation to reducing Cormorant impacts. Several other techniques appeared to be effective on rivers for months. However, their practicability, acceptability and costs were variable, presumably reflecting, at least to some extent, site-specific circumstances at particular fisheries.

Eight techniques were recorded in regular use on small lakes. All of these techniques 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). Again as for rivers, practicability, acceptability and costs were highly variable, presumably reflecting site-specific circumstances.

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. Again as in other feeding habitats, practicability, acceptability and costs were highly variable, presumably reflecting site-specific circumstances.

By far the greatest number of techniques was used at aquaculture facilities where 28 techniques were recorded in regular use. 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. However, as for all other Cormorant feeding habitats, there was considerable variation in practicability, acceptability and costs, presumably reflecting site-specific circumstances. This synthesis also highlighted two other techniques for aquaculture facilities that appeared to warrant further research. The first involved the production of large one-year old (> 100 g) and two-year old Carp (> 700 g) through supplementary feeding, a technique tested successfully in Saxony (eastern Germany). The main principle is to let the Carp quickly grow too big for Cormorants in their 2nd summer of life (in Saxony this is the most problematic time as the Carp are normally of optimal size for Cormorants at this age under ‘normal’ growth conditions). The second involved the use of high-pressure water jet systems, also tested successfully on Carp ponds in Germany. A very positive side effect of this technique is that the ponds also get aerated, this is especially important during summer when oxygen levels in Carp ponds can fall to very low levels. These

two techniques, or variants of them, may be applicable to other regions in Germany and elsewhere in Europe where fish are grown in large ponds.

5.9.4 Concluding remarks

It was clear that very few techniques were, according to the experience in 16 countries covered by this part of 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. These techniques are primarily employed as a fishery management tool, as opposed to a Cormorant management one. 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.

Stakeholders thus 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. Therefore it seems likely that adopting 'new' techniques to reduce Cormorant impacts at feeding sites, in whatever habitat, is likely to be a case of trial-and-error in the majority of cases. There are also numerous possibilities for using various techniques in combination, or for changing techniques used in time and/or space as a reaction to changing site-specific conditions. Clearly, considerably more work is required to trial the use of techniques to reduce Cormorant impact at feeding sites. There is also an urgent need for detailed information on the site-specific effectiveness, practicability, acceptability and costs of specific techniques to be disseminated as widely as possible to relevant stakeholders. Thus the formation of an information exchange network would be a very useful tool to facilitate the rapid transfer of ideas, experiences, 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.

6 Cormorant-fishery conflict resolution: a case study

6.1 Introduction

This Chapter reviews the REDCAFE analysis of a specific Cormorant-fishery conflict case study. This work Package was designed to give REDCAFE 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. The case study was discussed and analysed during a three-day Workshop attended by REDCAFE participants, local stakeholders and other experts.

This Workshop was perhaps the most important single event of the REDCAFE project and so considerable thought was given to both the case study itself and to the most appropriate and effective mechanism for discussing it. Three issues relating to the choice of case study were important. First, given that the working language of the REDCAFE project was English, choosing a case study from a country where English was a second language might mean that local stakeholders and others were unable or unwilling to discuss matters as fully as they would if speaking in their native tongue. Second, it would be beneficial if there were some historical information available on the case study, particularly in relation to conflict management. Third, it would be unwise to choose a case study where REDCAFE involvement might inflame a conflict.

REDCAFE originally proposed to develop and run a Multiple Criteria Decision Model for the specific case study. However, 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. This conflict has received considerable attention in the UK at the national level,, e.g. see Moran Committee 2001, 2002 and elsewhere, see footnote #3). 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 (see 6.3). Adopting the Lea Valley case study thus presented REDCAFE with an opportunity to explore strategies that could link policy and practice, through conflict analysis and management processes that have been successfully tested in other natural resources contexts (see 6.5.1).

6.2 Values and dialogue in conflict resolution and management

Before briefly describing Fisheries Action Plans and their development, background to the Lea Valley and reporting on the Workshop, it is perhaps useful to discuss some important aspects of environmental conflicts and their management.

All individual and collective action is informed by *values.* These may be the personal values that each person holds and which are the motives, reasons, and justification for their actions. Conversely, these values may be those embedded in a social context (e.g. family, community, work or recreation) which influence

individual actions whether or not they accord with personal values (O'Brien & Guerrier 1995). Furthermore, the effects of values (or 'preferences') on human experience only become apparent when one 'action framework[14]' encounters another and a choice has to be made. Thus environmental issues often involve value/preference conflicts and these may occur within individuals, between individuals, between individuals and groups and between different groups of people (Chase & Panagopoulos 1995).

Given that various stakeholder groups often hold different values, and consequently have different preferences for the use of limited natural resources, conflict in natural resource management is inevitable. The successful management of such conflicts is often complicated by the fact that they occur at a variety of scales: local, regional, national and global (Buckles & Rusnak, 1999). Such 'people-wildlife conflicts' typically involve antagonism because different individuals or groups are competing for the same resources. Conflict is also prevalent generally in fishery systems where people and institutions interact in a variety of ways (Charles, 2001). Cormorant-fisheries conflicts provide many examples in Europe (van Eerden *et al*. 1995, also Chapter 3) and elsewhere (e.g. Nettleship & Duffy 1995).

Considerable scientific effort has resulted in a much improved understanding of the ecology of both birds and fish, their interactions and potential conflicts. However, in addition to addressing environmental problems from a biological perspective, the social and cultural dimensions of human society that influence conflicts with wildlife usually demand as much attention (Knight, 2000). Indeed by taking such a pluralistic approach to conflict analysis, many people-wildlife conflicts can be understood as people-people or people-state conflicts (Knight, 2000).

REDCAFE participants responded to the specific biological, cultural and socio-economic issues that Cormorant-fisheries conflicts raised among a variety of stakeholders, including local individuals and groups, government and non-government agencies and scientists. They also began to develop responses to conflicts where scientific input is necessary, but where individuals and groups often have difficulty linking science to the local context in helpful ways. Building trust between REDCAFE scientists, community members and other stakeholders was actually achieved quite quickly once the need to do this was recognised by all. Maintaining that, and building on the communication and information needs of all stakeholders, continues to be an important element of REDCAFE participants' work.

In fact, a common source of Cormorant-fisheries conflict stems from feelings of exclusion among local people, to which poor communications and simplistic understandings of information transfer needs have contributed. For example, in England and Wales, four years of government–funded research was undertaken into the impact of fish-eating birds on inland fisheries (1994-1998) at a cost of about 1.5 million euro. The work resulted in the publication of six major scientific reports[15], containing 1447 pages of text, tables and figures. But, to many key stakeholders, it was '*a waste of time and money*' because it didn't appear to address their specific

[14] An 'action framework' is defined by O'Brien & Guerrier (1995) as one way of acting in and on the world. Conflicts arise when more than one action framework is possible and a choice must be made.
[15] Russell *et al*. 1996a, 1996b; McKay *et al*. 1999; Hughes *et al.* 1999; Feltham *et al*. 1999; Wernham *et al.* 1999.

concerns nor offer a practical solution to their problems. Similarly, in many environmental conflicts elsewhere, local experts often believe that scientists and policy makers ignore their knowledge and experiences (Charles, 2001). However, taking a broader, holistic approach highlights multiple stakeholder perspectives (Buckles & Rusnak 1999) and facilitates a greater understanding of the inter-relationships among stakeholders (Ramirez 1999). Above all, successful conflict management depends on conflicting parties opening communication channels and developing networks of trust for effective collaboration and dialogue (Warner & Jones, 1998).

The Lea Valley case study emerged as an important example of good practice in conflict management because participants considered the needs, fears and concerns of the various stakeholders involved and sought ways of integrating relevant biological information into the dialogue that was required for successful conflict management there. If trust and confidence were two critical aspects of this dialogue, having a process such as that of a Fisheries Action Plan to link with was equally important. In this way, the Lea Valley dialogue was not merely biological insights and mutual understanding but linked a meaningful debate to a concrete planning process.

6.3 Fisheries Action Plans

The UK Environment Agency (**http://www.environment-agency.gov.uk**) is a non-departmental public body operating in England and Wales, sponsored partly by government. The Environment Agency (EA) provides environmental protection and improvement and has numerous responsibilities and duties, including the maintenance of air, land and water quality, regulation of water abstraction and waste management, and conservation and recreation. The Agency is also involved with fisheries management issues affecting commercial and recreational fisheries in England and Wales and is responsible for issuing rod licences to all recreational anglers here. The Agency has pioneered the development of Fisheries Action Plans (FAPs), partnership schemes involving the EA, recreational anglers, conservationists and other interest groups. As well as providing greater local stakeholder involvement in the management and development of local fisheries, FAPs also ensure EA accountability in delivering its fisheries duties at the local level.

Although Fisheries Action Plans are based on river catchments, they cover canal and stillwater fisheries as well as those on rivers. They may deal with a wide range of issues from fish habitat to angling promotion and land management. Each FAP is different and reflects the concerns and priorities of local angling and fisheries interests. A FAP Group, comprising 12-15 members representing relevant stakeholders, develops a specific FAP through a formal process. The FAP Group compiles a list of key issues reflecting the concerns of local angling and fisheries stakeholders. Targets to resolve each of these issues are then agreed by the Group who set out the actions required to achieve each target. Responsibility for delivering each of the actions is ascribed to the EA or other stakeholders as appropriate. Funding for actions may be provided by the EA but Groups are also expected to seek funds from a wide range of sources. As many actions are spread over a number of years, the Group is expected to review progress at least annually. Thus FAPs provide a clear route for local angling and fisheries interests to influence the way that their local fisheries are managed and developed.

Five pilot FAPs were launched by the EA in England & Wales in 2001 and, following the success of these schemes and discussion with the Moran Committee[16], the agency agreed to help create four further FAPs, including one to cover the Lea Valley catchment in Hertfordshire, south-east England. Cormorants were cited as one of the 'problems' facing the Lea Valley (but see also 6.4), specifically in relation to conflicts with recreational angling, and would certainly require consideration in the development of a local FAP. Moreover, the 'Cormorant problem' here is believed to be typical of that faced by 80-90% of catchments in England and Wales (Adrian Taylor, Environment Agency, pers. comm.).

As discussed above, FAPs provide a mechanism for managing local fisheries in a holistic way through participation (see footnote #3) and dialogue between all interested stakeholders. Indeed, high levels of participation and dialogue are regarded as necessary prerequisites of successful conflict management through the FAP process. Thus REDCAFE chose the Lea Valley as a conflict resolution case study, not only because of the wider relevance of its 'Cormorant issues', to England and Wales at least, but because, through the FAP process, the social, economic and cultural dimensions of these issues could also be explored. It also gave local stakeholders the opportunity to participate in an externally facilitated conflict management process that would help them move forward with the Lea Valley FAP in specific and measurable ways.

6.4 The Lea Valley

The River Lea (sometimes spelled 'Lee') runs some 90 km, roughly north to south, from rural Bedfordshire to the River Thames in east London at the East India Dock Basin (Figure 6.1). Although much of the upper river is natural or semi-natural, the lower catchment is a mosaic of countryside areas, urban green spaces and completely urban areas. The river itself has been extensively managed for much of its length, particularly in the lower catchment where much has been canalised. Most of the lower river flows through the Lea Valley Country Park (**http://www.leavalleypark.com**) and here there is also a variety of stillwaters ranging from small natural lakes and wetlands to large artificial reservoirs. As some 3 million people live within 30 minutes drive of the Lea Valley, it is a much-valued resource used by walkers, runners, cyclists, water sports enthusiasts, birdwatchers and recreational anglers.

There are a variety of recreational fisheries on the River Lea, particularly in the lower reaches. These comprise trout fisheries and two main types of 'coarse' angling. Trout fisheries are restricted to a small number of stillwaters and are 'put-and-take' fisheries, where trout (both Brown and Rainbow Trout see Table 3.5 for scientific names) grown in hatcheries on site or elsewhere are released into the water for subsequent capture by anglers.

[16] The Moran Committee was set up in 1997 to provide a co-ordinated platform of organisations to address angling and fisheries interests in England and Wales. It represents 13 of the major fisheries organisations here and, through its Joint Bird Group, has recently forged links with other nature conservation groups to ensure that 'a reasonable balance is struck between the need to conserve both fish and birds'.

Coarse fisheries tend to vary considerably in the target species. For example some fish such as Barbel, Chub, and Dace (see Table 3.5 for scientific names) predominantly occur in riverine fisheries, whereas other species such as Roach, Pike and Perch are much more widespread. A range of other species are also fished for including Bream and Tench. Fishing for carp has become increasingly popular over recent years, largely in view of the large size of this species, Carp fishing tends to occur at specialist 'specimen' fisheries.

Figure 6.1 The location of the River Lea, south-east England.

As well as requiring a national rod licence (see 6.3), local fishing is regulated by a 'permit' system, anglers can purchase either season tickets or day tickets, some fisheries also allow angling at night. Season tickets cost up to 270 euro, day tickets around 4 euro. Some fish stocks are enhanced through stocking hatchery reared fish: predominantly trout but also some coarse fish species.

The fisheries in the Lea Valley face a number of serious problems that suggest significant disturbance or change in ecological, economic and social systems. The sustainability of many standing and running water systems in the valley is in considerable doubt. Various explanations exist for this situation, some are agreed by nearly all stakeholders and some are the subject of debate. Cormorant-fishery conflicts contribute to this mix of issues and explanations. These conflicts are a strong focus for discussions among different local groups. Over recent years, conflicts have escalated as evidence and opinion indicate reduced numbers of anglers and supporting businesses, and a rapid decline in fish stocks, especially small fish and certain (mainly small) species such as Dace and Roach. Many fishing clubs have existed in the area for over a hundred years, however young people are not now joining them in significant numbers. As a result, the total number of anglers and clubs is falling. This represents a loss of social capital[17] and of key institutions that could assist community organisation and development in the Lea Valley.

One of the core members of the Lea Valley FAP group, representing the Lee Anglers' Consortium, which provides angling on 35 km of a canalised section called the Lea Navigation, explains:

> *"After the river recovered from heavy pollution it became an important fishery for Londoners and residents of the northern Home Counties. The fishing peaked around 1994 when good bags of Roach, Dace, Perch, Chub and Bream could be caught from the whole of its length… Many club and open matches were held on the river and there were several summer and autumn match series attracting 50 plus competitors… However, more important was its attraction to the pleasure angler and in particularly the senior citizens and juniors who cannot travel far from home for their fishing."*
>
> Dennis Meadhurst

Most clubs along the Lea now face economic difficulties as membership has dwindled alongside fish catches. For example, in 1992/93 (over a period of nine months) over 23,000 anglers purchased a day ticket. Additionally, 600 season tickets were sold and club membership numbered around 6,500. In contrast the forecast for the 12 months to December 2002 expects to see season and club membership dropping by approximately 54% with day membership decreasing by over 70%. Fishing tackle shops across north-east London have also suffered a significant downturn in trade and many have had to close. Many anglers claim that they have stopped fishing the Lea because of low catch rates and the associated increase in Cormorant numbers there.

[17] The term 'social capital' captures the idea of social bonds and social norms, incorporating relations of trust; reciprocity and exchanges; common rules, norms and sanctions and connectedness, networks and groups. (Petty & Ward (2001).

However, as the REDCAFE Workshop highlighted (see 6.5), Cormorant predation is only one of a number of issues thought to have contributed to declining fish numbers. Water quality and levels, pressure on particular waterbodies by other water users, poaching, safety issues, loss of key angling sites (as a result of the siting of overhead electricity pylons, barriers, moorings and residential development) and competition from commercial fisheries, are all areas of concern. Through greater collaboration, the Lea Valley FAP group hope to achieve better understanding of the major biological and social problems affecting the catchment and develop effective solutions.

6.5 Lea Valley Workshop

6.5.1 Introduction

Workshop delegates comprised 36 REDCAFE participants, representing 20 countries, and 16 stakeholders, representing 11 institutions or organisations (Table 6.1). Successful conflict management depends on conflicting parties opening communication channels and developing networks of trust for effective collaboration and dialogue (see 6.2). REDCAFE thus worked closely during the Workshop with a facilitator skilled in environmental conflict management. In this way, delegates – both REDCAFE participants and local stakeholders – could be guided effectively in their deliberations and maximise the opportunities afforded by the Workshop.

The three-day 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 during the Workshop during six working sessions (Table 6.2).

Stakeholder institution/organisation	**Type**	**Main area of interest**
Lea Valley Regional Park Authority	Local	Environmental management, recreation
Lea Anglers' Consortium	Local	Recreational angling
Lea Valley Consultative Association	Local	Recreational angling
RMC Angling	Local	Recreational angling
Hertfordshire Bird Club	Local	Birdwatching, ornithological studies
Moran Committee	National	Angling/fisheries
National Federation of Anglers	National	Recreational angling
Thames Water Utilities	Regional/local	Water Company – supply and conservation
British Waterway	National/local	Management of inland waterway network
Environment Agency	National/local	Environmental protection, water management
English Nature	National/local	Environment/biodiversity conservation

Table 6.1 Stakeholder institutions or organisations attending Lea Valley case study Workshop.

Day	Session	Issues	Format	Leader
One	One	Relating key REDCAFE experience to the Lea Valley Case Study	Plenary	
		1. Introduction to the REDCAFE project and concept		REDCAFE
		2. Learning from the REDCAFE experience: pan-European examples		
		3. General discussion/summary of key points		
	Two	The Lea Valley Case Study	Plenary	
		1. Introduction to the Lea Valley: geography, history and present day circumstances		Stakeholders
		2. Site visits: Walthamstow Reservoirs and Lea Valley Park		
Two	Three	Conflict Management Sessions	Plenary	
		1. Introduction to the Environment Agency's work		Facilitator
		2. Overview of Fisheries Action Plans and the planning process		Environment Agency
		3. Summary of issues facing the Lea Valley		
		4. Introduction to 'Stakeholder Analysis' and 'Conflict Management' techniques		Facilitator
	Four	Lea Valley Issues	Groups	
		1. Group discussions		
		(i) Lea Valley: problems		
		(ii) Lea Valley: stakeholder analysis		
		(iii) Lea Valley: Cormorant issues		
		(iv) General: approaches to building stakeholder dialogue		
		(v) General: economic issues relating to Cormorant-fishery conflicts		
		2. Summary presentations of Group discussions	Plenary	
Three	Five	Consensus Building		
		1. Relating the Lea Valley experience to the REDCAFE project and *vice versa*		
		2. Progress and plans		
	Six	Action		
		1. Establishing a route map for Lea Valley FAP progress		

Table 6.2 Timetable and issues covered at REDCAFE's Lea Valley case study Workshop.

Each of the six Workshop sessions and their outputs, where applicable, are described below. Where necessary, further information is provided to give context to, or interpretation of, the Workshop activities. The aim of the remainder of this section is to give the reader as clear a picture as possible of the dynamic Workshop processes and their outcomes.

Many of the most important points discussed in Sessions One and Two are described elsewhere in this report (Chapters 2, 3 and sections 6.3, 6.4 above, respectively). A field trip gave Workshop delegates the opportunity to relate conflict management and ecological issues in two contrasting areas of the Lea Valley: Walthamstow Reservoirs and an area of the Lea Valley Park. The reservoir complex comprises eleven concrete lakes (ca. 245 ha) that are fed from both the River Lea and with water pumped from the R. Thames. The reservoirs are situated in the south of the catchment in a mainly urban area. Three are stocked with Brown and Rainbow Trout and the remainder contain coarse fish species and all are used by day ticket anglers. In contrast, the Lea Valley Park site to the north is a semi-natural wetland complex comprising a stretch of the River Lea and several naturalised gravel pits all containing populations of coarse fish species.

6.5.2 *Conflict management experiences from continental Europe*

Four presentations were given by REDCAFE participants on issues pertinent to the Lea Valley: they described a range of learning from REDCAFE experience and were chosen to be relevant to the case study.

To many, including some anglers in the UK, the only solution to the 'Cormorant problem' is to kill birds. Such large-scale population culls have also been considered by biologists, both theoretically and in practice. Morten Frederiksen and Thomas Bregnballe discussed the theory of large-scale population control as a tool in Cormorant management (Box 6.1). Thomas Keller discussed relatively large-scale Cormorant culling in practice, based on experiences in Bavaria, southern Germany (Box 6.2). Could lessons be learned from the experience there of seven years of intensive Cormorant shooting? In terms of reducing Cormorant numbers, uncoordinated shooting in Bavaria had failed. However, Tamir Strod and Jonathan Harari described a successful Cormorant management programme in the Hula Valley, Israel where, about 8,000 Cormorants winter and the birds cause major conflicts at fishponds (Box 6.3). Cormorants also pose problems to fishpond aquaculture in Saxony, Germany. Kareen Seiche described an alternative approach to the mitigation of Cormorant damage to fish stocks there (Box 6.4).

Based on an analysis and synthesis of Cormorant ringing studies in Denmark, it is clear that many aspects of Cormorant 'performance' (e.g. production of young, survival of adults) is limited throughout the year by density dependence[18]. Thus, Cormorant populations are at present regulated naturally within relatively narrow bounds, and if population size is reduced artificially, remaining birds compensate through increased reproductive success, survival or immigration from other areas. In theory, Cormorant populations could be controlled at a large (pan-European) scale by preventing the foundation of new colonies, reducing the production of young, or by culling fully-grown birds (immatures and adults). Reducing the number of young produced is expensive and has only a small effect on population size. Culling would therefore be more effective. However, because of density dependence, large numbers of Cormorants would have to be killed every year to reduce the population size substantially: there would also be practical (and perhaps ethical) problems. Furthermore, population regulation may not reduce the most pressing conflicts because Cormorants are attracted to the most profitable ('optimal', see also 5.9.1) food sources – often where they are most likely to come into conflict with human interests. A more effective approach might be to take advantage of density dependence by making the environment less attractive to Cormorants and thus decreasing the carrying capacity[19]: this would often be consistent with limiting the damage rather than the 'pest'.

Box 6.1 Danish case study: Cormorant population control in theory.

Cormorant culling in Bavaria (mostly during the winter migration: August – March) began in 1995 and developed subsequently through various State regulations and legislation from the Bavarian State Government. Although 2,547 – 6,258 Cormorants have been shot each winter - sometimes in greater numbers than the average number counted during regular surveys – the number of birds wintering in Bavaria has remained remarkably stable. Moreover, since shooting began, the number of night roosts in Bavaria has increased. It was concluded that uncoordinated shooting of Cormorants over seven winters had not reduced the overall, nor the local, numbers of birds wintering throughout Bavaria. Thus, there must be a high turnover of migratory birds through Bavaria, even in midwinter. As Cormorant numbers had not been reduced, there was no reason to believe that there had been a reduction in the amount of fish consumed by them. However, the number of Cormorant night roosts in Bavaria increased during the years of shooting, suggesting that birds may now be more evenly distributed in the region than before.

Box 6.2 Bavarian case study: Cormorant population control in practice.

[18] 'Density dependence' is a biological term implying that the growth or decline of a population is regulated by mechanisms themselves controlled by the size of that population. Simply put, when population size increases, survival and/or production of young decreases, and *vice versa*.

[19] 'Carrying capacity' indicates the level at which the population is regulated by density-dependent processes in a given environment.

In the Hula Valley, Israel, about 8,000 Cormorants winter and the birds cause major conflicts at fishponds Hundreds of Cormorants have been shot every winter over the past ten years but the problem remains at the same level; shooting is costly and ineffective, it also pollutes the environment (bird carcasses and lead shot). In a collaborative partnership, biologists, fish farmers and NGOs developed a co-operative management scheme for the Hula Valley. On arrival, Cormorants are scared from fishponds, particularly those holding preferred prey *Tilapia* spp., in a co-ordinated manner. Cormorant numbers decline very quickly at fishponds and the programme is effective throughout the winter. As a result of this large-scale, co-ordinated disturbance (with minimum killing), Cormorants are now feeding at less sensitive, alternative foraging sites. As this control programme has developed, operating costs (e.g. staff time, ammunition), numbers of dead Cormorants, and estimated fish losses have all declined. Coupled with the availability of alternative foraging sites for Cormorants, the key to the success of the Hula Valley scheme has been due to:

- Organisation (e.g. interest/expert groups, manpower, resources)
- Information (e.g. Cormorant physiology and ecology, fish stock assessments)
- Timing (e.g. bird migration, co-ordinated scaring)

Box 6.3 Israeli case study: successful Cormorant management.

The most commonly cultivated fish in Saxony is Carp (see Table 3.5 for scientific name) which are farmed in a three-year cycle, the production of one- and two-year old fish being most important. Between May and November about 90% of the Cormorants in the region are roosting close to fishponds, numbers can reach around 3, 000 birds and Carp is their staple food. Cormorant damage at Carp ponds is assessed, for each year-class of fish, from (a) numbers of Cormorants visiting ponds daily, (b) an estimated daily food intake of 500g per bird, and (c) estimates of 'normal' stock losses in ponds (i.e. excluding Cormorant predation). In addition to fish consumed, an additional, arbitrary, 10% is added to account for 'stressed and injured' fish. Since 1996 fish farmers have been paid compensation for fish looses to Cormorants if this is seen as threatening to their livelihood. Up to 80% of the estimated damage is compensated on condition that reliable evidence of heavy Cormorant damage is available and that losses amount to at least 1, 000 euro per year.

Financial help is also available to those farmers who farm their fish in an environmentally friendly way (e.g. according to nature protection regulations, low stocking levels, no supplementary feeding, and long-term rotation of ponds). The interactions between Cormorants and fish appear to be very complex and, as a result, are not fully understood. Nevertheless, many feel that there is enough information available upon which to base a financial compensation scheme. Although sound information is needed about Cormorant-fish interactions at ponds, the conflict cannot be solved solely at a scientific level. Thus a forum has been developed whereby biologists, fish farmers and regional politicians can discuss these matters and work together to find a satisfactory solution. Although the compensation scheme is acknowledged to be subjective, all feel that it is based on current best estimates of the situation – and it has gone some way to mitigate local concerns about fish losses to Cormorants.

Box 6.4 Saxony case study: financial compensation scheme.

6.5.3 Lea Valley conflict management

Five key issues arose from discussions with Lea valley stakeholders and these are described in turn. First, many believe that the main problem facing the Lea Valley is an economic one (see also 6.4). 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. The Lea Valley case thus raises a number of important social issues in relation to young people, and community livelihoods and traditions. The problem is complex, urgent and related both to institutions and their survival.

Second. these economic problems are the result of too few anglers catching too few fish in the Lea Valley. 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 may still be fisheries containing large individuals (i.e. 'specimen' fish) of some species such as Barbel and Carp. However, even for these latter species, the concern is that once these larger individuals die, the capacity for the species to breed successfully and sustain viable populations will be greatly reduced. In some cases, such perceptions have been confirmed by fish surveys. There is also some evidence that the distribution of fish has changed within the Lea Valley. Anglers often choose to fish adjacent to bridges in the belief that these structures are now the only places were fish aggregate in any numbers.

Third, the lack of fish, and the related economic decline, has local conservation implications. There are concerns at the species and genetic levels in relation to the stocking of non-indigenous fish. There are also concerns that other fish-eating birds will suffer as a result of the lack of small fish or due to the 'aggression' of Cormorants. As the fishery declines, it becomes uneconomical to pay bailiffs to maintain river banks, with resulting declines in littoral growth and associated fauna and increases in litter and pollution events.

Fourth, the lack of fish, and the related economic decline, has local social implications. Local angling clubs are considered critical social partners with the National Federation of Anglers (NFA), the Environment Agency (EA) and central government. The NFA operates a coaching scheme that teaches coaches to train young people in all aspects of angling and environmental issues, whilst the EA and central government operate an Angling Participation Scheme. This scheme aims to re-establish derelict urban fisheries and develop properly trained, motivated young people (active, outdoors, occupied, learning, contributing). Such 'stewardship' schemes, and the recreational opportunities associated with them (as well as things like local employment and transport demand) all decline as the number of local angling clubs, and anglers, declines.

Fifth, the lack of fish, and the related economic decline, has local planning and policy implications. With the decline of angling clubs, organised citizens groups loose a key player with its associated conservation and financial benefits. Moreover, falling motivation levels as a result of declining angling clubs mean that other Government initiatives suffer (e.g. angling/environmental awareness schemes) and other community links may be lost.

Many of the concerns described above can be addressed through the Fisheries Action Plan process – a policy instrument for the waters and wider environment of the Lea Valley. At this stage it is possible to summarise many of the issues facing fisheries in the Lea Valley as an initial 'problem statement' (Figure 6.2).

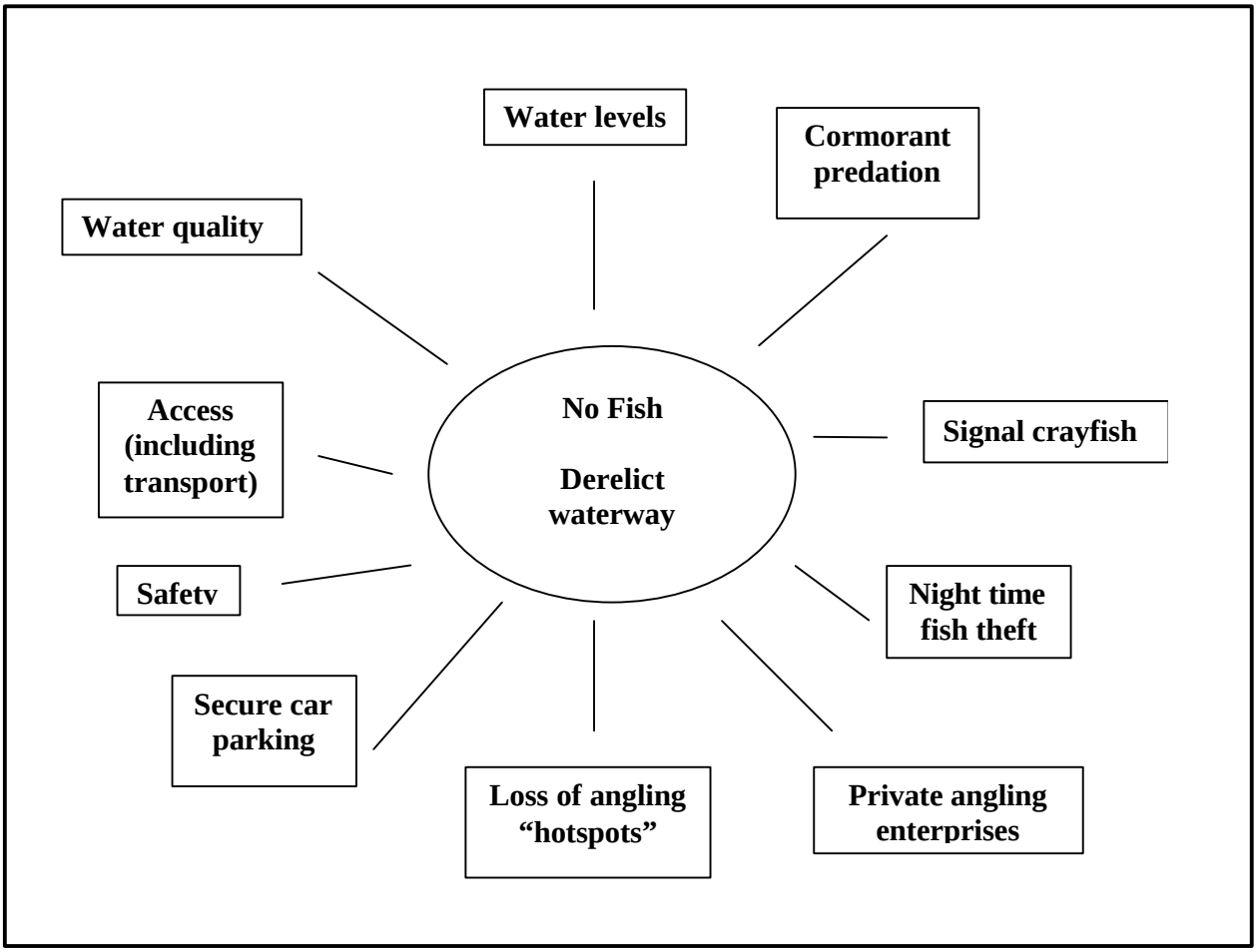

Figure 6.2 An initial 'problem statement' for fisheries issues in the Lea Valley.

Cormorant predation is only one of several problems facing the Lea Valley, though it is often the most conspicuous. There are some other biological issues involved including changes in both water quality and levels and the threat of the invasive Signal Crayfish (*Pacifastacus leniusculus*). However, many problems stem from social issues including poaching of Carp for the table, the influence of private angling enterprises, the loss of angling 'hotspots' as a result of poor planning, and several access and safety issues. This complex, and sometimes conflicting, social and biological situation will require time and effort to develop effective, sustainable processes for fishery management. The initial stages of this process are to determine who the relevant Lea Valley stakeholders are and to consider their needs and concerns (see Tables 6.3, 6.4). Consideration should be given to economic, social, technical, environmental and institutional issues. Once problems have been identified, solutions can be suggested and actions planned. Such a process will feed directly into the Fisheries Action Plan.

However, this process will only be effective if there is active participation and dialogue between all stakeholders and common ownership both of the dialogue process and the subsequent outcomes. As a first step towards opening dialogue among stakeholders, Workshop delegates considered a variety of conflict management styles (Warner 2000) that related the relative importance of 'goals' and 'relationships'. In the Lea Valley case, the importance of stakeholders' relationships was considered to be high, as was the importance of the goal of an effective and shared Fisheries Action Plan. Although 'compromise' is often cited as the best means to resolve conflicts, this requires all sides to make concessions with the result that none may be happy with the outcome. It was thus clear that the best, perhaps only, way forward in relation to conflict management in the Lea Valley context was through partnership and a negotiated consensus and through stakeholders developing mutual understanding of the problems facing fisheries in the area.

6.5.4 Lea Valley issues

Workshop delegates split into four groups (of 10-12 people) in order to examine three key issues of relevance not only to the specific Lea Valley case study but to other Cormorant-fisheries conflicts across Europe.

1. The problems, needs and concerns facing stakeholders in the Lea Valley.

As discussed earlier (6.5.3), this is the first stage in the conflict management process, and so discussions were restricted to the Lea Valley context.

2. Approaches to building stakeholder dialogue.

As discussed earlier (6.2, but see also 3.7), effective dialogue is a prerequisite for successful conflict management within the Lea Valley and elsewhere. Discussions were thus wide-ranging and reflected pan-European experiences.

3. Economic issues and reasons for non-disclosure of relevant financial information in relation to Cormorant-fisheries conflicts.

Economic issues are often at the heart of cormorant-fisheries conflicts. However, earlier REDCAFE experience in synthesising these conflicts (see Chapter 3)

highlighted the fact that relevant financial information was often difficult to obtain from stakeholders (see 3.4, 3.5.5). Discussions were thus wide-ranging and reflected pan-European experiences on why this should be so.

The number of local stakeholders at the Workshop was relatively small, so it was decided to have two groups with both Lea Valley stakeholders and REDCAFE participants, and two other groups solely of REDCAFE participants. The former two groups would address specific Lea Valley issues whilst the latter two would address significant issues that could be helpful for the Lea Valley case and more generally to cormorant/fisheries conflicts. The tasks and deliberations of these four groups are summarised below.

The problems, needs and concerns facing stakeholders in the Lea Valley

The specific tasks for the first two groups were to focus on the Lea Valley and (a) agree the 'problems' facing stakeholders in the Lea Valley, (b) develop a preliminary list of stakeholders and analyse their needs and fears/concerns with respect to these problems, and (c) consider the specific 'Cormorant-fishery' issue there. Numerous Lea Valley problems were reported (Figure 6.3). These covered both individuals and institutions or organisations and affected both people and resources. Two lists of Lea Valley stakeholders were produced. One for the whole catchment (Table 6.3) and one for the Lower River Lea, excluding adjacent stillwaters (Table 6.4). In both cases, large numbers of stakeholders were identified and their general needs, fears and concerns detailed. Considering the specific Cormorant-fishery issue in the Lea Valley, 11 points were highlighted (Table 6.5). Although the impact of Cormorants was unquantified, there was a major concern over the effects of predation within the catchment. The need to collate available information and local knowledge was identified, as was the desire for no further research to be undertaken. Several potential management tools were highlighted but their effectiveness was questioned.

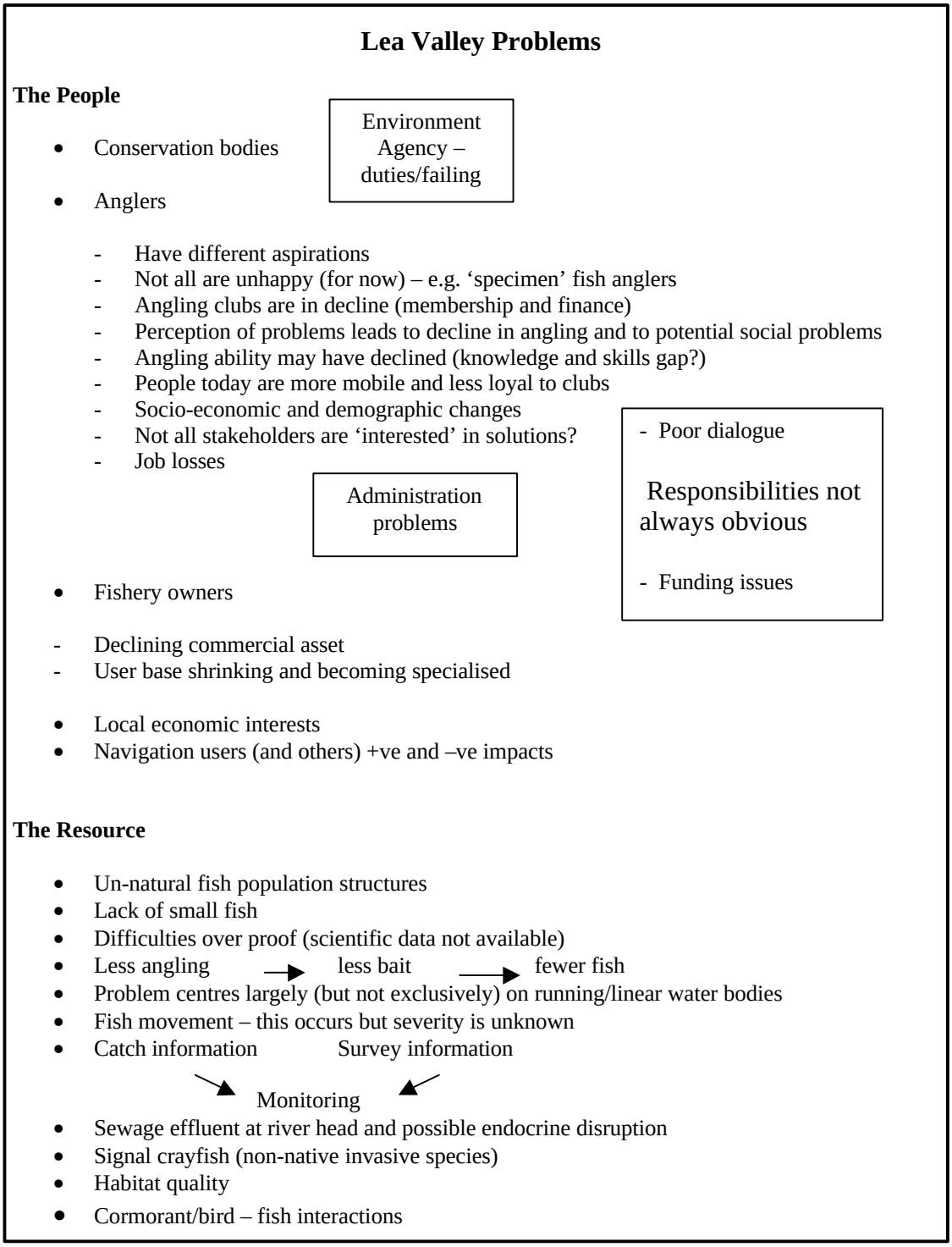

Figure 6.3 Lea Valley problems identified in Workshop discussion.

Stakeholder group	Needs	Fears / Concerns
1. Anglers - general - big fish - trout	• Healthy, abundant fish stocks • (good quantity/quality fish to catch) • Enjoyable recreational experience	• Loss of preferred fishing area • Costs of alternative fishing • Loss of enjoyment
2. Angling clubs	• More members • More income • Preserve social traditions	• Disbandment of club (due to loss of members + income)
3. Fishery Owners and tenants	• Sustainable income • Secure perspective • Integrated management • Good public relations about Lea Valley / angling • Accessibility • Secondary activities	• Loss of core business • Loss of income
4. Commercial outlets (related to angling)	• Customers (bait, tackle, food, etc.) • Reasonable profit	• Financial instability due to loss of customer base • Closure of business – need to relocate, find alternative income
5. Water suppliers	• Sufficient water of suitable quality • Place to discharge effluent	• Lack of water, or low quality = failure to meet legal requirements
6. Environment Agency	• Sustainable fisheries • Customer satisfaction • Meet legal requirements • Appropriate resources	• Cannot meet operational and legal requirements • Insufficient resources
7. Conservation groups	• Healthy, sustainable ecosystems • Species survival and health • Recognition and status as a stakeholder • Protection of special sites and species	• Loss of biodiversity • Negative impacts of non-native species • Habitat degradation and fragmentation
8. Other recreation users	• Good access • Appropriate facilities • Quality recreational experience	• Conflict with other users • Loss of access
9. Local community	• Attractive local environment • As (8) above, especially access	• Over development • Dereliction

Table 6.3 Stakeholder groups, their needs, fears and concerns identified in the context of the Lea valley catchment.

Stakeholder Group	Needs	Fears/Concerns
1.Anglers and Fishery organisations	• Sustainable fishery • Better public image • Good access • Affordability • Recruitment of anglers	• Decline in fishery • Decline in infrastructure • Perceived cormorant impact
2. Tackle trade/local commerce	• Local anglers	• Loss of income
3. Riparian owners	• Sustainable fishery • Anglers	• Loss of income
4. Navigators	• Sufficient water • Infrastructure (moorings, access)	• Low water flows
5. Water companies	• Water (clean) • Profit for shareholders	• Pollution • Low water flows • Legislation and extra cost
6. Other recreational interests	• Access • Infrastructure • Pleasant environment	• Restrictions on access • Environmental degradation
7. Environment Agency	• Meet statutory responsibilities (fisheries, flood defence, water quality and resources etc.)	• Failure to meet requirements • Loss of public support (funding)
8. Lea Valley Park	• Meet statutory responsibilities (conservation and recreation)	• Failure to meet requirements • Loss of public support (funding)
9. English Nature	• Enhancing biodiversity • Sustainable habitats	• Impacts on adjacent statutory sites • Habitat degradation • Loss of public support (funding)
10. Local Authorities	• Local economic development • Meet statutory responsibilities (recreation, infrastructure, ‘quality of life,’ providing best value) • Public support • Social inclusion	• Legislation • Failure to meet obligations • Loss of public support • Urban decay, dereliction

Table 6.4 Stakeholder groups, their needs, fears and concerns identified in the context of the lower River Lea, excluding adjacent stillwaters.

What do we do about cormorants in the Lea Valley?

- Cormorant roost established late 1980's
- Perceived impact of birds on fish is unquantified - major concern is absence of 'medium sized' fish
- Need to identify what information is available (i.e. collect & collate information - bird counts, fishery data, 'anecdotal' information)
- No more R&D – instead a 'reasonable interpretation of available information'
- Awareness of other constraining factors - try to put cormorant problem in context
- Cormorant colony on Site of Special Scientific Interest site in urbanised area - can't shoot birds there
- Prevent new colonies forming - avoid situation getting worse
- Creation of 'honey pots' (but does problem get worse?)
- Promoting good habitat management, explore opportunities for providing artificial refuges for fish
- Conditioned Taste Aversion ?
- Providing dead fish as an alternative food source ?

Table 6.5 The specific Cormorant-fishery issue in the Lea Valley.

Approaches to building stakeholder dialogue

Group Three consisted of REDCAFE participants and its task was to examine approaches to building stakeholder dialogue in general and, specifically, to reach agreement on key principles that should be employed in developing dialogue amongst a variety of stakeholders each with different needs and goals.

Dialogue was identified as critically important if stakeholders are to work together towards common ownership of issues, ideas and solutions. The general approach to building dialogue identified (Box 6.5) involved the acceptance of initial mistrust and suspicion and the importance of the subsequent development of trust between stakeholders. Clarity was also highlighted, in relation to identifying issues, stakeholders, and their needs. Patience was also considered important, in terms of working at a pace that suits everyone. They key principle when considering dialogue amongst a variety of stakeholders with different needs was identified as being able to see issues from all points of view (Box 6.6), or at least respecting the differing views of others. In addition, dialogue could be helped if the 'group' involved do something together fairly early in the process.

Three other comments on building dialogue were recorded. First, all those involved in the dialogue process need to recognise, and take account of, different motivation levels amongst stakeholders. Second, all should be aware of a possible bias in the principle of dialogue: it will exclude groups who are not organised or who cannot organise themselves. Finally, dissemination issues are important both in terms of advertising meetings and of informing stakeholders (both individuals and institutions) about results and activities.

Building Stakeholder Dialogue

Dialogue takes time, but is critically important. WHY?

- Information exchange – people will not work together if they don't have information.
- Helps to involve everybody (if they want to be involved!) – creates ownership of the issue. Be open and welcoming to newcomers!
- Dialogue builds participation and participation is important for sustainability.

Process principles

- Accept that there will be mistrust and suspicion at the beginning. These are normal issues at the beginning a dialogue-building process. An example was given from Sweden where five meetings had taken place before a key NGO became involved but it was five years before a key business company did so. All this time, all stakeholders were sent periodic newsletters and updates on activities -- because their needs were known and because their eventual participation was important to the process.

- Be sure to communicate the positive aspects of dialogue

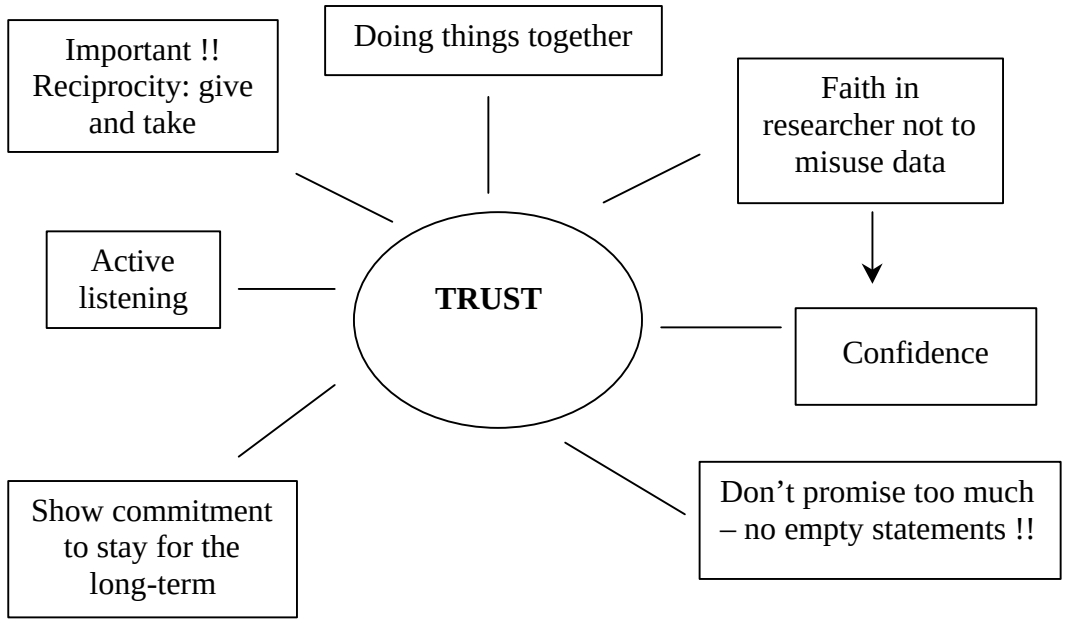

Diagram 1 – Some issues relating to Trust

- Identify the issue – for example, what do stakeholders want from the process.

- Identify stakeholders – remember that stakeholder groups are not homogeneous.

- Patience is important: set and maintain a pace with which everyone is comfortable, including when building and agreeing the consensus that may come later.

Box 6.5 General approach to building dialogue as identified by Workshop delegates.

Action Research

- It is very important for 'the group' to do something together fairly early in the process, to evaluate this (learning together from our mistakes and successes) and then to move forward. One possible route is outlined below.

1. Local meetings (advertised) and open meetings as groups develop consensus around issues (remember that there are conflicts within groups as well as among them). Then consider 'triangle of concern' for building dialogue (Diagram 2).

2. Identify representatives and form a group of representatives (Diagram 2)

- Remember to see issues from all points of view – find the fit between your self-interest and perceptions, and those of others.

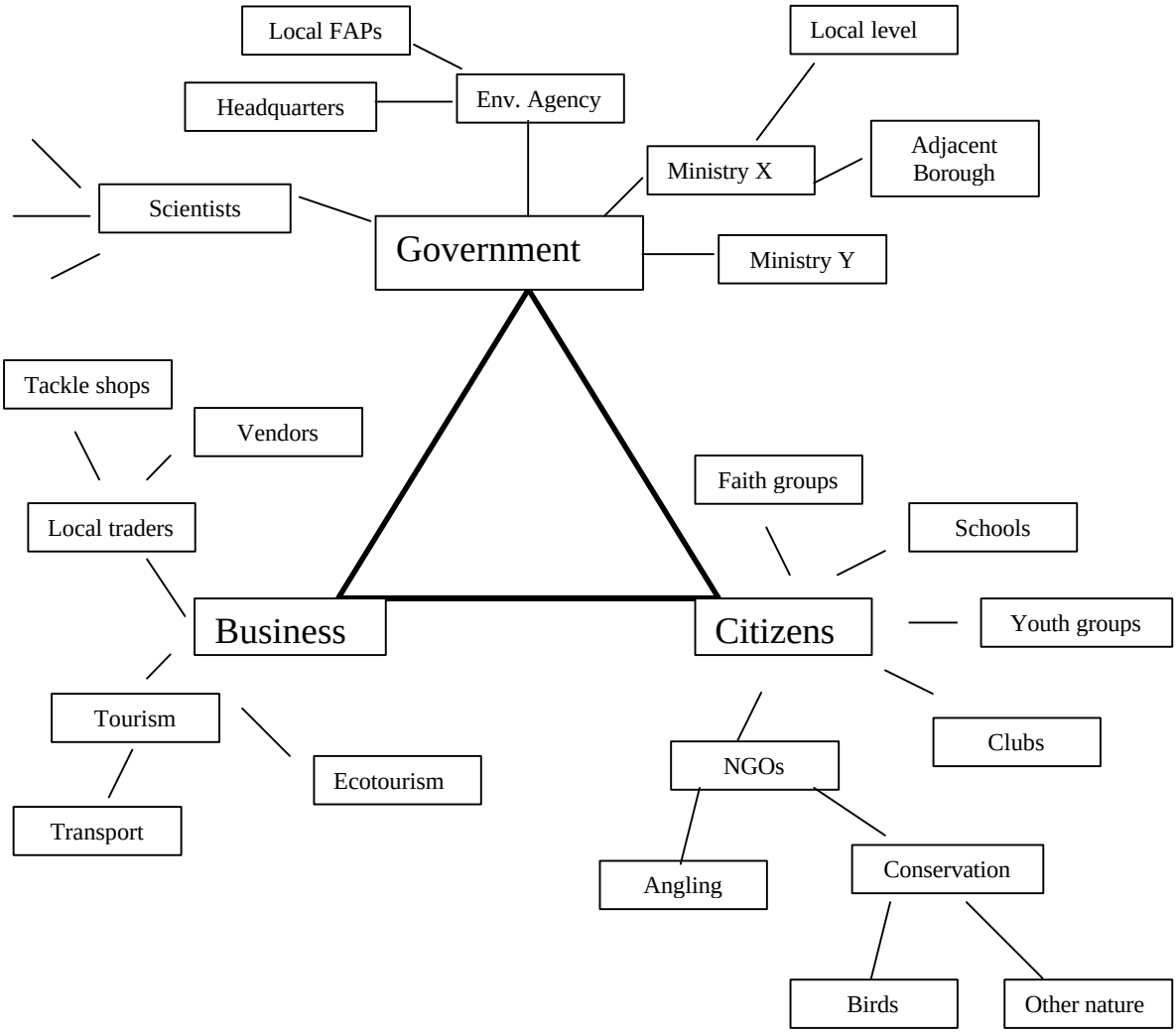

Diagram 2 - 'Triangle of concern' for building dialogue: although based on the Lea Valley case study, many elements will be common to situations elsewhere.

Box 6.6 Key principles when considering dialogue amongst a variety of stakeholders with different needs as identified by Workshop delegates.

Economic issues and reasons for non-disclosure of relevant financial information in relation to Cormorant-fisheries conflicts

Group Four consisted of REDCAFE participants and its task was to consider economic issues that relate to cormorant/fisheries conflicts in general, in the light of REDCAFE experience. It had been a concern of a number of REDCAFE participants that economic issues were among the most problematic to analyse, due partly to the lack of relevant financial data. Among the issues for discussion were the possible reasons for non-disclosure of relevant financial data.

The first point identified was that not all Cormorant-related conflicts are about money (Box 6.7). Indeed the synthesis of Cormorant conflicts (Chapter 3) highlighted that nature conservation stakeholders did not provide any financial information in relation to the conflict issues of concern to them (see 3.5.5). In general however, commercial fisheries stakeholder may not disclose financial information for business reasons whilst recreational angling stakeholders may be unable to put a monetary value on their quarry. Several possible reasons for the non-disclosure of financial information were reported (Box 6.7) highlighting some of the real difficulties in obtaining such information. These provide insight into why so little financial information was made available during the Lea Valley Workshop and why it was provided for relatively few (45%, see 3.3.5) of the case studies included in the pan-European conflict synthesis (Chapter 3).

Two other points were raised in relation to the disclosure of financial information. First, over much of eastern Europe there has been switch from State to private ownership (see also 3.6, Box 3.2). When fisheries were State owned, financial compensation was paid for any losses. However since the privatisation of many fisheries, compensation is no longer paid and fisheries have become increasingly competitive and secretive, presumably leading to a reluctance to disclose financial information. Second, not all stakeholders are concerned with losses of fish to Cormorants and some may offer financial information freely. For example, in Poland some Cormorant problems are related to forestry damage – bird guano damages and kills trees leaving them susceptible to insect pests. In such circumstances, forestry stakeholders are very open about the financial losses suffered to their industry and the information is in the public domain.

Finally, can any lessons be learned from financial incentives to kill Cormorants ? The Fishermens' Organisation in the Czech Republic introduced a bounty scheme whereby fishermen were paid a bounty of 10 euro or were given a Carp for every cormorant shot. As the fishermen's daily income was around 16 euro, this was a very big incentive to shoot birds. However, despite around 1,000 birds being shot each year there has been no reduction in the Cormorant population. Moreover, as a response to shooting, Cormorants began roosting on bigger islands where they are more difficult to shoot, and so fewer are shot regardless of effort. Although altering roosting distribution, shooting has not affected Cormorant distribution on foraging sites and so they are still considered a problem.

1. For some stakeholders, disclosure of financial information was not a problem, why should it be so for others ?

2. Some schemes provide extra financial support for ‘green’ aquaculture (e.g. see Saxony example in 6.5.2) – some stakeholders may be unwilling to divulge financial information in case they are caught cheating the system.

3. More generally: people don’t want anyone else to re-calculate their figures (e.g. for costs of fish, financial outlays, compensation, cost of damage etc.).

4. If the State is paying for fish, individual fishers do not worry about economic losses.

5. People are unwilling to divulge financial information for reasons such as tax, insurance, and subsidies.

6. There is competition between fishery owners – so they do not wish to give financial information.

7. Some stakeholders actually have no financial information (e.g. they are non-profit groups).

8. Fish cannot be seen most of the time without very special and expensive effort. Thus for most systems (perhaps with the exception of intensive aquaculture) information on fish communities and stocks is lacking. Thus placing financial values on such resources, or the losses to factors such as Cormorant predation, is very difficult.

Box 6.7 Possible reasons for non-disclosure of financial information as identified by Workshop delegates.

6.6 Lea Valley case study: summary of progress

The REDCAFE project has made substantial progress in identifying critical scientific and social issues in cormorant/fisheries conflicts. These cover a range of fisheries and habitat types where ecological and social processes vary across different spatial and time scales. REDCAFE participants' extensive knowledge was usefully brought to bear in the Lea valley case study, where a large range of stakeholders face complex issues relating to fishery, and institutional, sustainability. 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. 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 five areas, these are summarised below.

6.6.1 De-escalating conflict among key local stakeholders

With the disturbance or change in ecological, economic and social systems in the Lea Valley (see 6.4) in mind, many stakeholders were not optimistic in coming to the Workshop. Several groups had strong opinions about certain issues. The Workshop evaluations (see 6.7) confirmed informal conversations that many people felt able to move forward in a less discordant environment after the Workshop. There are several possible explanations for this, perhaps the most important of which are:

1. People felt listened to: REDCAFE participants and other stakeholders listened attentively, respectfully and with interest to the concerns and fears of local people and learned from their experiences. Delegates had the opportunity to understand the Lea Valley context in four ways; through presentations, by means of handouts supplied by local people, through informal meetings and during a field visit to two sites in the Lea Valley. An important aspect of the Workshop was that many delegates were experts in their field who were trying to come to grips with a British situation, explained in English. The significant efforts made to do this were very much appreciated by local stakeholders.

2. REDCAFE presentations about the science and learning from various research activities were well organised and clearly presented, in ways that local people found accessible, interesting and relevant. A number of local people commented on this and found themselves thinking through the practical implications of the science in new and challenging ways. These presentations had a clear impact on helping people approach scientific data in an objective way. Local people felt, some for the first time, that science was not just 'a waste of time and money' but could add value to discussions and possible solutions (see 6.2).

3. The tone of the Workshop was exploratory and collegial, setting a style for discussions that was enabling and supportive as people tried to get across their points of view. Local stakeholders worked hard to try to understand what science and REDCAFE experience had to offer, and everyone treated each other as equals and with mutual respect.

4. It was very helpful having a process with which to engage. The Fisheries Action Plan process offered a way forward, establishing a possible pathway for next steps. It was clear that the Workshop was not just a 'talking shop', but presented an opportunity to link policy with practice, through a planning strategy that had some evidence of success elsewhere. The Fisheries Action Plan also had legitimacy from the perspective of all the groups involved: government, community, NGOs and business stakeholders.

5. For the Lea Valley, the Workshop began the practical business of formalising stakeholder groups, their needs and concerns and the way that different groups might view 'the problem'. It also enabled people to see that it was possible to reach consensus fairly quickly on the key issue – sustainability (see footnote #7). In fact, the process itself started to build early consensus on the economic, social and ecological realities of the situation. People also started to acknowledge how the issues informed others' points of view, and to establish respect for the perceptions and views of others in a non-confrontational way.

6.6.2 Linking scientific processes and data to real-world social issues

There remained small differences of opinion among delegates about the nature of science and how science may be situated in a social and political context. Like it or not, the scientific aspects of the conflicts with which REDCAFE has been working have strong social and political travelling companions. Just as REDCAFE has been successful in enabling scientists to understand and work with multiple scientific views within the group, so at this Workshop, REDCAFE participants demonstrated empathy with the arguments about the social and economic context within which science must operate in the Lea Valley.

The Lea Valley stakeholders, likewise, appreciated the opportunity to hear from scientists directly and gained appreciation for what science has to offer. This was a particularly important outcome for REDCAFE since previous scientific reports on UK Cormorant-fishery conflicts (see 6.2) had been considered by some to be remote, jargon-ridden and largely irrelevant to their needs. In sum, considerable bridge building between local people, the scientific community and policy makers was achieved. This was helpful in reducing conflict and establishing a positive role for science in facilitating the development of the forthcoming local Fisheries Action Plan.

6.6.3 Agreeing initial problem statements, stakeholders and needs

The Fisheries Action Plan process will take forward the issues explored at this Workshop. The Workshop itself could not hope to achieve what is a fairly lengthy process of exploring stakeholder perceptions and needs, identifying and agreeing on problems, maintaining effective dialogue and actually building a plan with agreed implementation, monitoring and evaluation actions. This is a multi-stakeholder process that will take some time. However, the Workshop was successful in establishing the early part of a route map toward that process, as the outputs from the small groups (see 6.5.4) show.

6.6.4 Identifying relevant agencies, people and pathways for action planning

The introduction to the Fisheries Action Plan process and the associated resources (web and hard copy) indicated the range of stakeholders that have been involved in the pilot FAPs. At the Workshop, the small group activities (see 6.5.4), field trip and personal interactions allowed this introduction to be taken forward so that stakeholder identification, needs and concerns could be linked with a concrete process for next steps. In sum, the Workshop process identified ways of fitting stakeholder needs, problem identification and planning processes, and produced outputs that can be taken forward for verification with a wider group of stakeholders (i.e. those unable to attend the Workshop) under Environment Agency leadership.

6.6.5 Identifying research priorities and dissemination actions that link the need for strong, evidence-based scientific knowledge with social and strategic planning needs

Of particular significance in the Lea Valley case study Workshop were the parallel issues explored in other REDCAFE Work Packages in respect of the social and cultural impacts of fisheries decline (see 3.6 for discussion). In the Lea valley, long-standing family traditions, institutions and social capital were eroded as fisheries became unsustainable.

What was particularly useful about this Workshop was that local stakeholders and scientists were brought face-to-face to discuss these issues. Local people were not simply asked to read a scientific report. Scientists were not asked to 'imagine' the local context. In this Workshop it was possible to improve understanding (and motivation) through establishing good rapport and an effective Workshop process. Field trips and social evenings provided good opportunities for informal interaction while the formal sessions themselves enabled facilitated question and answer sessions. In these ways, both parties gained clarity on what the issues of importance were (e.g. more studies on fish population dynamics, community structure and spatial distribution and on Cormorant scaring techniques) and what processes were necessary for effective information dissemination.

6.7 Workshop evaluations

6.7.1 Overview

A specific element of this part 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. This section provides an overview of questionnaire returns.

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 (Table 6.6).

	Strongly agree	Agree	Disagree	Strongly disagree
REDCAFE has helped me relate conflict management methods to Cormorant-fish conflicts	23%	73%	4%	0
The case study was useful	35%	61%	4%	0
The case study was enjoyable	40%	51%	9%	0

Table 6.6 Summary of responses (n = 26) to anonymous REDCAFE evaluation.

A series of questions were also asked of delegates and those responding to the questionnaire provided over 200 responses. It is not possible to reproduce all of these within the present report. Nevertheless, responses are summarised below in three sections: the REDCAFE process of addressing Cormorant-fisheries conflicts, the main lessons learned, and looking forward. Further insights from the evaluation process are discussed in sections 7.1 and 7.2.

6.7.2 The REDCAFE process of addressing Cormorant-fisheries conflicts

The Main Strengths

By far 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. This was often achieved through clear (but not oversimplified) presentations of issues across Europe. Another important strength identified was the enthusiasm, open-mindedness and friendliness of project participants and, through collaboration with social scientists, the project's attempts to reach consensus on Cormorant-fisheries conflicts. REDCAFE offered the first opportunity to apply recognised conflict management techniques to Cormorant-fisheries interactions at the pan-European level.

The Main Weaknesses

A number of weaknesses were identified. In relation to the case study Workshop, the commonest 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. Clearly, such participation is important because of the complexity of many of the central problems and issues to be addressed. 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 (see 6.2), professionals in other disciplines should be increasingly involved in these conflict management issues.

6.7.3 The main lessons learned

Five lessons for the REDCAFE project were cited most frequently. By far 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. It is clear that a neutral, comfortable and relaxed atmosphere is the best forum for such discussions and that reaching consensus (e.g. Warner 2000) is probably the best goal.

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. It is also important to realise that, in complex or wide-ranging conflicts, scientists are stakeholders too.

Following this, respondents 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*.

It seems clear that there can be no single solution to the pan-European Cormorant-fisheries conflict. Most, if not all, situations are a complex mixture of biological, social and economic issues and each will be slightly different. Nevertheless, a number of potential mitigation measures are available (see Chapter 5) and successful Cormorant management is possible (see 6.5.2).

Other REDCAFE lessons cited include the realisation that a conflict situation exists (sometimes regardless of scientific evidence to the contrary) if a particular stakeholder group perceives it to be so. Furthermore, it is clear that Cormorants are not always the main problem affecting fisheries: other issues may, ultimately, be more important. In some cases, Cormorant 'problems' are merely a symptom of a damaged aquatic system. Solutions may be very hard to devise if systems are artificial, for example some reservoirs and aquaculture facilities or fisheries enhanced through intensive fish stocking. Most, if not all, Cormorant-fisheries conflicts have an economic or financial element but financial information is rarely in the public domain (see 6.5.4). However, provision of such financial information will be crucial when assessing the cost-effectiveness of potential mitigation measures.

7 Concluding remarks: reiteration and looking forward

7.1 Overview; reiteration

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 have been 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.

The Workshop 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. Many people currently working in Cormorant-fisheries conflicts acknowledge that further conflict management training is essential if they are to maximise the effectiveness of their work. There is acknowledgement that the process of conflict management will take time and require appropriate resources, including funds. Interestingly, several Workshop delegates noted that the costs of funding these initiatives are likely to be far lower than they would be if conflicts were left unmanaged.

7.2 Looking forward: next steps

The important next steps for managing Cormorant-fisheries conflicts in Europe, as determined from the REDCAFE evaluation process (see also 6.7), can be described in two ways: in relation to (a) specific case studies, individuals, or groups of local stakeholders, and (b) to the scientific community in general.

7.2.1 *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 (Chapter 5). 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 (see footnote #3).

Linked to this is a recognition of 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. There is a need for long-term studies to quantify the effectiveness of various measures to mitigate against Cormorant problems at fisheries. Similarly, 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.

7.2.2 The scientific community

While social issues now feature strongly in the mind of natural scientists after the REDCAFE project, many in that community expressed clear needs to improve understanding of ecological issues. These include Cormorant physiology, biology and daily food intake, fish population dynamics and community structure, and Cormorant impacts on fish populations and catches in various aquatic habitats. There is also a need to explore means of reducing the carrying capacity of these habitats for Cormorants (see 6.5.2).

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 (see 3.7.3 for discussion). Part of this process will involve wide dissemination of REDCAFE material but 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, as discussed elsewhere (see 6.2), Cormorant-fisheries conflicts are situated in social and political contexts.

Scientists are aware that co-management (see 3.7.2.for discussion) should be more participatory rather than ‘top down’: they do not wish to tell people what to do. However, they must be involved in the management process: providing a better understanding of Cormorant-fisheries interactions and increasing their ability to predict the likely outcomes of particular management and mitigation scenarios. Related to this is the need for the scientific community to become more integrated into the decision-making process at regional, national and international levels.

7.2.3 *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. It has been suggested that 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 the need for collaborative links between natural and social scientists was recognised by REDCAFE. The fundamental challenge for fisheries management in this context is to find ways of expanding technical expertise whilst increasing collaboration amongst all stakeholders 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 for further dialogue and collaboration in the future.

7.2.4 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 from dialogue with other stakeholders that they also 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. Therefore it seems likely that adopting 'new' techniques to reduce Cormorant impacts at feeding sites, in whatever habitat, is most likely to be a case of trial-and-error. 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 (see 3.7.3). 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.

7.3 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. There is also an urgent need for detailed information on the site-specific effectiveness, practicability, acceptability and costs of specific techniques to be disseminated as widely as possible to relevant stakeholders. Thus the formation of an information exchange network would be a very useful tool to facilitate the rapid transfer of ideas, experiences, 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. 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 REDCAFE project is the most comprehensive attempt to address Cormorant-fishery conflicts at the pan-European scale, covering 25 countries. However, it is clear that the project is merely the first step of this process. 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-fisheries 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 now 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.

8 Literature references

Acheson, J.M. (1981) Anthropology of Fishing. *Annual Review of Anthropology* 10: 275-316.

Adamek, Z., Klinger, H. & Staub, E. (1997) Cormorants in Europe – the evaluation of EIFAC/FAO questionnaire campaign. *Ricerche di Biologia della Selvaggina* XXVI: 347-353.

Bell, S., Nichersu, I., Ionescu, L. & Iacovici, E. (2001) Conservation versus livelihood in the Danube Delta. *Anthropology of Eastern Europe Review* 19: 11-15.

Bezzel, E. (1997) Schlagzeilen: "Schwarze peste und killer kommen über uns" *Der Falke* 44: 268-270.

Bildsøe, M., Jensen, I.B. & Vestergaard, K.S. (1998) Foraging behaviour of cormorants *Phalacrocorax carbo* in pound nets in Denmark: the use of barrel nets to reduce predation. *Wildlife Biology* 4: 129-136.

Bregnballe, T. & Gregersen, J. (1997) Changes in growth of the breeding populations of cormorants *Phalacrocorax carbo sinensis* in Denmark. *Supplemento alle Ricerche di Biologia della Selvaggina* XXVI: 31-46.

Bregnballe, T., Goss-Custard, J.D. & Durell, S.E.A. le V. dit (1997) Management of cormorant numbers in Europe: a second step towards a European conservation and management plan. In: (van Dam, C. & Asbirk, S. eds) *Cormorants and Human Interests.* IKC natuur beheer, Wageningen: 62-122.

Buckles, D. & Rusnak, G. (1999) Conflict and collaboration in natural resource management. In: (Buckles, D. ed) *Cultivating Peace*. International Development Research Centre, World Bank Inst., Washington, USA.

Carss, D.N., Bevan, R.M., Bonetti, A., Cherubini, G., Davies, J., Doherty, D., El Hili, A., Feltham, M.J., Grade, N., Grandeiro, J.P., Grémillet, D., Gromadzka, J., Harari, Y.N.R.A., Holden, T., Keller, T., Lariccia, G., Mantovani, R., McCarthy, T.K., Mellin, M., Menke, T., Mirowska-Ibron, I., Muller, W., Musil, P., Nazirides, T., Suter, W., Trauttmansdorff, J.F.G., Volponi, S. & Wilson, B. (1997) Techniques for assessing Cormorant diet and food intake: towards a consensus view. *Supplemento alle Ricerche di Biologia della Selvaggina* XXVI: 197-230.

Chambers, R. (1998) Beyond 'Whose Reality Counts ?' new methods we now need. In (Fals, O. ed) *Peoples Participation – Challenges Ahead*. New York Intermediate Technology Publications: 105-130.

Charles, A.T. (2001) *Sustainable Fisheries Systems: an Interdisciplinary Approach to Fisheries Analysis*. Fishing News Books.

Chase, J. & Panagopoulos, I. (1995) European values and social psychology: a European common market or commons dilemma ? In: (Guerrier, Y., Alexander, N., Chase, J. & O'Brien, M. eds) *Values and the Environment*. Wiley.

Conover, M. (2002) *Resolving Human-Wildlife Conflicts: the Science of Wildlife Damage Management.* Lewis Publishers, Washington, D.C.

Couper, A.D. & Smith, H.D. (1997) The development of fishermen-based policies. *Marine Policy* 21: 111-119.

Cramp, S. & Simmons, K.E.L. (eds) (1977) The Birds of the Western Paleartcic. Vol. 1. Oxford University Press, Oxford.

Daniels, S.E. & Walker, G.B. (2001) *Working Through Environmental Conflict: the Collaborative Learning Approach.* Praeger, Connecticut.

Davies, J.M. & Feltham, M.J. (1997) Investigation into the impacts of cormorants *Phalacrocorax carbo carbo* on angling catches on a river system. *Ekologia Polska* 45: 273-278.

Debout, G., Røv, V. & Sellers, R.M. (1995) Status and population development of cormorants *Phalacrocorax carbo carbo* breeding on the Atlantic coast of Europe. *Ardea* 83: 47-59.

de Nie, H. (1995) Changes in inland fish populations in Europe in relation to the increase of the Cormorant *Phalacrocorax carbo sinensis*. *Ardea* 83: 115-122.

EAA (1998) *Situation of the Cormorant in Europe*. European Alliance of Anglers, Amersfoort, the Netherlands.

EIFAC (1996) Summary report of the *ad hoc* working party on prevention and control of bird predation: effects of cormorant predation on fish populations. *European Inland Fisheries Advisory Commission* report, EIFAC/XIX/96/Inf.11.

Engström, H. (2001) *Effects of Great Cormorant Predation on Fish Populations and Fishery*. PhD Thesis, University of Uppsala.

Eschbaum, R., Veber, T., Vetemaa, M. & Saat, T. (2003) Do cormorants and fishermen compete for fish resources in the Väinameri (easten Baltic) area ? In: (Cowx, I.G. ed) *Interactions Between Fish and Birds: Implications for Management.* Fishing News Books.

Feltham, M.J., Davies, J.M., Wilson, B.R., Holden, T., Cowx, I.G., Harvey, J.P. & Briton, J.R. (1999) Case studies of the impact of fish-eating birds on inland fisheries in England and Wales. Report to Ministry of Agriculture, Fisheries and Food, London.

Frederiksen, M. & Bregnballe, T (2000a) Evidence for density-dependent survival of adult cormorants from a combined analysis of recoveries and resightings. *Journal of Animal Ecology* 69: 737-752.

Frederiksen, M. & Bregnballe, T (2000b) Diagnosing a decline in return rate of 1-year-old cormorants: mortality, emigration or delayed return ? *Journal of Animal Ecology* 69: 753-761.

Frederiksen, M. & Bregnballe, T (2001) Conspecific reproductive success affects age of recruitment in a great cormorant *Phalacrocorax carbo sinensis* colony. *Proceedings of the Royal Society of London*, series B, 268: 1519-1526.

Frederiksen, M., Lebreton, J. –D. & Bregnballe, T (2001) The interplay between culling and density-dependence in the great cormorant: a modelling approach. *Journal of Applied Ecology* 38: 617-627.

Funtowicz, S.O. & Ravetz, J.R. (1991) A new scientific methodology for global environmental issues. In: (Costanza, R. ed) *Ecological Economics: the Science and Management of Sustainability*. Columbia University Press, New York: 137-152.

Goodwin, P. (1998) Challenging the stories about conservation: understanding local participation in conservation. *Ecos* 19:12-19.

Goostrey, A. Carss, D.N., Noble, L.R. & Piertney, S.B. (1998) Population introgression and differentiation in the great cormorant *Phalacrocorax carbo* in Europe. *Molecular Ecology* 7: 329-338.

Hagemeijer, W.J.M. & Blair, M.J. (1997a) *The EBCC Atlas of European Breeding Birds: Their Distribution and Abundance*, T. & A. D. Poyser, London: pp34-35.

Hagemeijer, W.J.M. & Blair, M.J. (1997b) *The EBCC Atlas of European Breeding Birds: Their Distribution and Abundance*, T. & A. D. Poyser, London: p38.

Hampshire, K., Bell, S., Stepukonis, F. & Wallace, G. (in review) 'Real' poachers and predators: shades of meaning in local understandings of threats to fisheries. *Society and Natural Resources*.

Hughes, B., Bevan, R.M., Bowler, J.M., Still, L., Carss, D.N., Marquiss, M., Hearn, R.D. & Bruce, J.H. (1999) Feeding behaviour of fish-eating birds in Great Britain. Report to Department of the Environment, Transport and the Regions, London.

Jongman, R.H.G., ter Braak, C.J.F. & van Tongeren, O.F.R. (1995*) Data Analysis in Community and Landscape Ecology*. Cambridge University Press.

Keller, T. & Lanz (2003) Great Cormorant *Phalacrocorax carbo sinensis* management in Bavaria, southern Germany - What can we learn from seven winters with intensive shooting? *Vogelwelt* 124, Suppl.: 339 - 348.

Keller, T., Vordermeier, von Lukowicz, M. & Klein, M. (1997) The impacts of Cormorants on fish stocks of several Bavarian water bodies with special emphasis on the ecological and economical aspects. *Supplemento alle Ricerche di Biologia della Selvaggina* XXVI: 295-311

Knight, J. (ed) (2000) *Natural Enemies: People-Wildlife Conflicts an Anthropological Perspective*. Routledge, London and New York.

Lebreton, J. –D., & Gerdeaux, D. (1996) Gestion des populations de Grand Cormoran (*Phalacrocorax carbo*) sejournant en France. Unpublished report. CEFE/CNRS, Montpellier, France.

Marion, L. (1994) Evolution numérique et préférences écologiques des Grands Cormorans hivernant en France. *Alauda* 62: 13-26.

Marion, L. (1995) Where two subspecies meet: origin, habitat choice and niche segregation of Cormorants *Phalacrocorax carbo carbo* and *P. c. sinensis* in the common wintering area (France) in relation to breeding isolation in Europe. *Ardea* 83: 103-14.

Marion, L. (1997) Le Grand Cormoran en Europe: dynamique des populations et impacts. In: (Clergeau, Ph. Ed) Oiseaux à Risques. *INRA*: 133-178.

Marion, L. (2003) Recent development of the breeding and wintering population of Great Cormorants (*Phalacrocorax carbo*) in France - Preliminary results of the effects of a management plan of the species. *Vogelwelt* 124, Suppl.: 35 - 40.

Marquiss, M. & Carss, D.N. (1997) Fish-eating birds and fisheries. *BTO News* May-June/July-August 1997: 201-211.

Marquiss, M., Carss, D.N., Armstrong, J.D. & Gardiner, R. (1997) *Fish-eating Birds and Salmonids in Scotland.* The Scottish Office Agriculture and Fisheries Department, Edinburgh.

McKay, H., Furness, R., Russell, I., Parrott, D., Rehfisch, M., Watola, G., Packer, J., Armitage, M., Gill, E. & Robertson, P. (1999) The assessment of the effectiveness of management measures to control damage by fish-eating birds to inland fisheries in England and Wales. Report to Ministry of Agriculture, Fisheries and Food, London.

Moran Committee (2001) *Cormorants: the facts*. Moran Committee, London.

Moran Committee (2002) *Protecting your fishery from Cormorants.* Moran Committee, London.

Musil, P. & Janda, J. (1997) Habitat selection by the cormorant *Phalacrocorax carbo* on South Bohemian fishponds. *Ekologia Polska* 45: 173-180.

Musil, P., Janda, J. & de Nie, H. (1995) Changes in abundance and selection of foraging habitat in Cormorants *Phalacrocorax carbo* in the Southern Bohemia (Czech Republic). *Ardea* 83: 247-254.

Nelson, N. & Wright, S. (eds) *Power and Participatory Development: Theory and Practice*. London: Intermediate Technology Publications.

Nettleship, D.N. & Duffy, D.C. (eds) (1995) The double-crested cormorant: biology, conservation and management. *Colonial Waterbirds, Special Publication 1*, Vol (18).

Noakes, D.J., Fang, L., Hipel, K.W. & Kilgour, D.M. (2003) An examination of the salmon aquaculture conflict in British Columbia using the graph method for conflict resolution. *Fisheries Management* 10: 123-137.

O'Brien, M. & & Guerrier, Y. (1995) Values and the environment. In: (Guerrier, Y., Alexander, N., Chase, J. & O'Brien, M. eds) *Values and the Environment*. Wiley: xiii-xvii.

Pálsson, G. (1995) Learning by fishing: practical science and scientific practice. In: (Hanna, S. & Munasinghe, M. eds) *Property Rights in a Social and Ecological Context: Case Studies and Design Applications*. The Beijer Institute, Stockholm.

Pálsson, G. (2000) Finding one's sea legs. In: (Neis, B. & Felt, L. eds) *Finding Our Sea Legs: Linking Fishery People and Their Knowledge with Science and Management*. ISER Books, St John's, Newfoundland.

Parz-Gollner, (2003) Monitoring of the Great Cormorant *Phalacrocorax carbo sinensis* in Lower Austria (1996/97 - 1999/00): phenology, regional distribution and control actions. *Vogelwelt* 124, Suppl.: 61 - 70.

Petty, J. & Ward, H. (2001) Social capital and development. *World Development* 29(2): 209-227.

Pinkerton, E. (1989) Attaining better fisheries management through co-management – prospects, problems and propositions. In: (Pinkerton, E. ed) *Co-operative Management of Local Fisheries: New Directions for Improved Management and Community Development.* University of British Columbia Press, Vancouver: 7-33.

Ramirez, R. (1999) Stakeholder analysis and conflict management. In: (Buckles, D. ed) *Cultivating Peace*. International Development Research Centre, World Bank Inst., Washington, USA.

Rettig, R.B., Berkes, F. *et al.* (1989) The future of fisheries co-management: a multi-disciplinary assessment. In: (Pinkerton, E. ed) *Co-operative Management of Local Fisheries: New Directions for Improved Management and Community Development.* University of British Columbia Press, Vancouver: 273-289.

Reymond, A. & Zuchuart, O. (1995) Perch fidelity in Cormorants *Phalacrocorax carbo* outside the breeding season. *Ardea* 83: 281-284.

Richner, H. (1995) Wintering Cormorants *Phalacrocorax carbo carbo* in the Ythan estuary, Scotland: numerical and behavioural responses to fluctuating prey availability. *Ardea* 83: 193-198.

Rusanen, P., Mikkola-Roos, M. & Asanti, T. (2003) Current research and trends of Finland's Great Cormorant *Phalacrocorax carbo sinensis* population. *Vogelwelt* 124 Suppl.: 79-82

Russell, I.C., Dare, P.J., Eaton, D.R. & Armstrong, J.D. (1996a) Assessment of the problem of fish-eating birds in inland fisheries in England and Wales. Report to Ministry of Agriculture, Fisheries and Food, London.

Russell, I.C., Dare, P.J., Eaton, D.R. & Armstrong, J.D. (1996b) Assessment of the problem of fish-eating birds in inland fisheries in England and Wales – summary report. Report to Ministry of Agriculture, Fisheries and Food, London.

Salmi, P. & Muje, K. (2001) Local owner-based management of Finnish lake fisheries: social dimensions and power relations. *Fisheries Management and Ecology* 8: 435-442.

Salmi, P., Auvinen, H., Sipponen, M. & Jurvelius, J. (2000) Finnish lake fisheries and conservation of biodiversity: co-existence or conflict ? *Fisheries Management and Ecology* 7: 127-138.

Samusenko, I. & Kozulin, A. (1997) Population dynamics of cormorants and key-factors determining expansion in Belarus. *Supplemento alle Ricerche di Biologia della Selvaggina* XXVI: 73-79.

Šidák, Z. (1967) Rectangular confidence regions for the means of multivariate normal distributions. *Journal of the American Statistical Association*, 62: 626-633.

Suter, W. (1995) The effect of predation by wintering cormorants *Phalacrocorax carbo* on grayling *Thymallus thymallus* and trout (*Salmonidae*) populations: two case studies from Swiss rivers. *Journal of applied Ecology* 32: 29-46.

Suter, W. (1997) Roach rules: shoaling fish are a constant factor in the diet of Cormorants *Phalacrocorax carbo* in Switzerland. *Ardea* 85: 9-27.

Symes, D. (1996) Fishing in troubled waters. In: (Crean, K. & Symes, D. eds) *Fisheries Management in Crisis*. Fishing News Books: 3-16.

Symes, D. (2001) The future of Europe's fisheries: towards a 2020 vision. *Geography* 86: 318-328.

Tacconi, L. *Biodiversity and Ecological Economics: Participation, Values and Resource Management*. Earthscan, London.

ter Braak, C.J.F. & Šmilauer, P. (1998) *CANOCO Reference Manual and User's Guide to Canoco for Windows: Software for Canonical Community Ordination (version 4).* Microcomputer Power, Ithaca, New York.

Tucker, G.M. & Heath, M.F. (1994) *Birds in Europe: Their Conservation Status.* BirdLife International (BirdLife Conservation Series no. 3), Cambridge, UK.

Wilson, D.C. (2000) *Social Literature Review for the Knowledge in Fisheries Management Project*, Institute for Fisheries Management: 1-50.

van Dam, C. & Asbirk, S. (eds) (1997) *Cormorants and Human Interests*. IKC natuur beheer, Wageningen.

van Eerden, M.R. & Gregersen, J. (1995) Long-term changes in the northwest European population of cormorants *Phalacrocorax carbo sinensis. Ardea* 83: 61-79.

van Eerden, M.R. & Munstermann, M.J. (1995) Sex and age dependent distribution in wintering Cormorants *Phalacrocorax carbo sinensis* in western Europe. *Ardea* 83: 285-298.

van Eerden, M.R., Koffijberg, K. & Platteeuw, M. (1995) Riding the crest of the wave: possibilities and limitations for a thriving population of migratory cormorants *Phalacrocorax carbo* in man-dominated wetlands. *Ardea* 83: 1-9.

Vetemaa, M., Eschbaum, R., Aps, R. & Saat, T. (2000) Collapse of political and economical system as a cause for instability in fisheries sector: an Estonian case. Proceedings of the IIFET 2000 International Conference. Microbehaviour and Macroresults. Oregon State University, Corvall, USA. Available at: http://www.orst.edu/Dept/IIFET/2000/papers/vetemaa.pdf.

Vihervuori, P. (1992) *Environmental Law – Finland*. Deventer: Kluer Law and Taxation Publishers.

Warner, M. (2000) Conflict management in community-based natural resource projects: experiences from the Lakeamu Basin Integrated Conservation and Development Project, Papua New Guinea. In: (Tacconi, L. ed) *Biodiversity and Ecological Economics: Participation, Values and Resource Management*. Earthscan, London: 196-219

Warner, M. & Jones, P.S. (1998) Assessing the need to manage conflict in community-based natural resource projects. *ODI: Natural Resource Perspectives* 35: 1-6.

Wernham, C.V., Armitage, M., Holloway, S.J., Hughes, B., Hughes, R., Kershaw, M., Madden, J.R., Marchant, J.H., Peach, W. & Rehfisch, M.M. (1999) Population, distribution, movements and survival of fish-eating birds in Great Britain. Report to Department of the Environment, Transport and the Regions, London.