3 Cormorant conflicts with fisheries

3.1 Introduction

This Work Package was an attempt to synthesise Cormorant conflicts[2] on a pan-European scale. 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 thus often inevitable. In addition to addressing environmental conflicts from a biological perspective, the social and cultural dimensions of human society that influence conflicts with wildlife also demand equal attention.

By taking such a pluralistic approach, many people:wildlife conflicts can be understood as people:people or people: state conflicts. For example, in many societies around the world, fishing rights are controlled. Acheson (1981) believes such rights-based systems operate to reduce uncertainty: "if fishermen cannot control the fish, at least they can control who will be allowed to fish for them and how they will do so". Seen in this context, fisheries stakeholders may view Cormorants as another 'fisherman' in the system, albeit one whose access to the fishery they have little, or no, control over. Moreover, many fishermen feel that Cormorants are given unduly high conservation status or legal protection, and that current legislation works against them (see discussion in Marquiss & Carss 1997). As a consequence, they may often think that other stakeholders (e.g. nature conservationists, biologists, policy-makers) have too much control over rights of access to their fisheries and over the fisheries management decision-making process. Furthermore, a common source of Cormorant-fisheries conflict stems from feelings of exclusion among local people. For example, local experts often believe that scientists and policy makers ignore their knowledge and experiences.

Successful conflict management depends on conflicting parties opening communication channels and developing networks of trust for effective participation[3], dialogue and collaboration. The themes mentioned above are explored in more detail for a specific Cormorant-fishery conflict case study in Chapter 6 whilst this Chapter describes the broad conflict synthesis process REDCAFE used on a much broader scale. The REDCAFE pan-European synthesis was an attempt (a) to develop dialogue, both within and between the project participants and a wide network of other stakeholders and (b) to know and understand Cormorant-related conflicts at the continental level.

Wherever possible, information for the present synthesis was provided by stakeholders affected directly by Cormorant conflicts. This information is therefore

[2] Throughout this report, terms such as 'Cormorant conflicts' and 'conflicts with Cormorants' are used to mean both conflicts that cause problems for people and those that cause problems for Cormorants. Furthermore, as detailed in this Chapter, such conflicts are not restricted to fisheries issues but also include broader environmental ones.

[3] There are numerous definitions and interpretations for 'participation' (e.g. see Chambers 1998; Nelson & Wright 1995) in relation to helping local people ensure that local cultural values are respected and orientating projects towards people's felt needs. However, in the context of REDCAFE work, 'participation' means the involvement of local people as partners (rather than as passive spectators) in the process of collecting local knowledge and experiences. Future participatory work in relation to the management of Cormorant conflicts would aim for the increased involvement of local people in the decision-making process.

presented as an indication of stakeholders' perceptions of Cormorant-fishery conflicts. These perceptions are very important as they are informed by stakeholders' 'values'[4]. In the case of Cormorant-fishery conflicts, these values may, at first, appear to be related solely to environmental issues. Partially as a consequence, environmental scientists have often been asked to deliver solutions to such conflicts. These scientists have often worked in relative isolation, both between academic disciplines (e.g. avian ecology and fisheries biology) and between scientists and the wider community.

One of REDCAFE's aims was thus to break down some of the isolation associated with academic scientific research and, through dialogue with other stakeholders involved in Cormorant-fishery conflicts, better understand their values and opinions. The provision and collation of information for the present conflict synthesis formed the basis for REDCAFE's dialogue with these stakeholders. Through this process it became clear that, as with many other environmental issues, the 'environmental values' of stakeholders involved in Cormorant conflicts are a "thorny nest of intellectual and political problems. (They) delineate a complex field whose ideas and visions, rights and responsibilities encounter traditions and interests, institutions and technologies, all of which are essentially contested at the level of experience." (O'Brien & Guerrier 1995). Thus, REDCAFE's work to synthesise Cormorant conflicts on a pan-European scale was an attempt to record and understand the experience of a diverse range of stakeholders (individuals, groups and organisations) affected by these issues. Furthermore, this process highlighted the difficulties involved in creating and managing dialogue between stakeholders from many countries and diverse backgrounds.

The following sections discuss the general synthesis of Cormorant conflicts as follows. First, the methods used are described (section 3.2) and then the findings of the information collection and collation exercise are presented (section 3.3). methodological difficulties and limitations are discussed (section 3.4) before a general synthesis and discussion of the information presented (in 3.3) is presented (section 3.5). Finally, Cormorant –fisheries conflicts in a wider context (section 3.6) and ways to take work forward (section 3.7) are discussed.

3.2 Methods

Given time and logistical constraints and the need for a relatively high level of standardisation in data collection, a spreadsheet was devised to incorporate all the information thought relevant to Cormorant conflicts (Figure 3.1). This spreadsheet was designed so that, through a collaborative process involving REDCAFE participants working in partnership with other stakeholders, information could be recorded separately for each of four stakeholder groups: recreational fishermen ('anglers'), commercial fishermen, aquaculturists and nature conservationists.

Six categories of information were provided by stakeholders. First a basic **site description** covering geographical location, type of and characteristics of the waterbody. Second, information on **fish and birds**, including the species of cormorant involved in the conflict (or, in the case of Great Cormorants, the race), the numbers of birds and species of fish involved, and the months over which conflicts occurred. Third, **financial information**, either 'actual' or estimated', on both the annual

[4] For further discussion on 'values' and resulting actions, see section 6.2

turnover in the system and the turnover loss due to cormorants. Fourth, specific details of **conflict issues** arising at the site. These were placed in three categories relating to Fisheries, Fish Stocks and Other issues on the spreadsheet (see Figure 3.1). However, given the nature of the seven issues in this latter category, they are better termed 'Environmental' issues and this term is therefore used throughout the rest of this Chapter. Stakeholders recorded (see Figure 3.1) the magnitude of each relevant conflict issue (a score of 0-3), any references to literature used to inform themselves about the conflict, and the status of these references (coded *p*, *g*, or *s*, see Figure 3.1 for explanation). This allowed a semi-quantitative analysis of both the scale of perceived conflicts but also the type of information used by various stakeholders in relation to particular conflict issues. Finally, space was provided for stakeholders to give additional comments and also further details of the literature references cited. These literature references are provided in a bibliography in Volume 2 of this report.

In the first instance, the information described above was requested on specific conflict cases. Secondary to this, case study information was also collated under generic headings relating to rivers, stillwaters and coasts, and these were further collated to provide a national profile for each country. This information was later incorporated into some aspects of the pan-European analysis (see 3.3.2) but the bulk of this Chapter deals with the specific case study information.

Again, given time constraints, REDCAFE participants from each country completed spreadsheets initially for as many case studies as they could. These were then passed to relevant stakeholders, identified by REDCAFE participants after regional or national consultation, who both refined the information for these cases and also provided further information for other cases (full lists of the stakeholders involved are given in Volume 2 of this report). Although every effort was made to ensure that the information included in this synthesis was derived from the stakeholders themselves, in a few cases the only information available was that provided by REDCAFE participants (see 3.3.1).

After completion, spreadsheets were returned to REDCAFE participants and then collated on a national basis. Resulting data was analysed in two ways. First a pan-European overview was generated through a redundancy analysis (ter Braak & Šmilauer, 1998; Jongman *et al*., 1995; Šidák, 1967). Essentially, this analysis distils all the information into simple interpretative diagrams that show the strongest relationships between factors recorded on the original spreadsheets. In these diagrams, each arrow points in the direction of steepest increase of values for the corresponding factor. Arrows thus show the relative importance of this factor: the longer the arrow, the more important its corresponding factor in explaining variation within the overall dataset. The angles between arrows can be used to indicate correlations (or covariance) that is, the 'degree of relatedness' between factors. In the second analysis, specific factors relating to each of the pieces of information provided in case study spreadsheets were analysed separately using appropriate statistical tests. It was therefore possible to investigate relationships between factors at a more fine-scale level than was possible in the 'global' redundancy analysis described above.

NAME OF RESPONDENT AND YOUR AFFILIATION: ____________________

(1) SITE DESCRIPTION

CASE STUDY SITE — Name: ______ — Geographical coordinates: Long ______ Lat ______

COUNTRY ______ — Region/province/etc. ______

river location — upper — middle — lower

river width — <10 m ______ — 10-50 m ______ — 50-100 m ______ — 100+m ______

altitude — < 100 m ______ — 100 - 500 m ______ — 500 + m ______

Water body type and size — Running waters ______ ha drainage — Still waters ______ ha surface — Coastal waters ______ ha surface

trophic status — oligotrophic ______ — mesotrophic ______ — eutrophic ______

Anthropogenic influences — natural ______ — semi-natural ______ — artificial ______

(2) FISH AND BIRDS

CORMORANT species/sub sp — Ph.c.c. ______ — Ph.c.s. ______ — Ph.pygmeus ______

No. CORMORANTS involved — Birds: min= ______ max= ______ (Min and max over the year)

Breeding pairs ______

FISH SPECIES (in conflict) ______

Months of conflicts (Jan=1) — first: ______ last: ______

(3) FINANCE

(a) Annual turnover in the system ______ euro — actual/estimate ______ — Source of information ______

(b) Turnover loss due to cormorants ______ euro — actual/estimate ______ — Source of information ______

Notes: (a) this figure is the revenue of fisheries/aquaculture or value to local economy of recreational fisheries
(a) and (b) please provide actual values and source of information if available, if unavailable please give best estimate

(4) CONFLICT ISSUES

		STAKEHOLDERS											
		Commercial fisheries			Recreational fisheries			Aquaculture			Nature conservation		
	organisation:												
	respondent name:												
		magnit	reference	status	magnit	reference	status	magnit	reference	status	magnit	reference	status
FISHERIES	reduced catch												
	loss of stocked fish												
	reduced value of catch (damage)												
	removal of fish from nets												
	damage to fishing gear												
	reduced catchability (stress/behav)												
	loss of earnings from the fishery												
	reduced capital values of fisheries												
	reduced fishing tackle sales												
	*increased recurrent costs												
	loss of employment												
STOCKS	reduced stock - lowered production												
	effects on popn dynamics/comm structure												
	threats to endangered fishes												
	vectors of diseases/parasites												
	loss of juvenile fish - lowered recruitment												
	loss of spawners												
	loss of aquaculture stock												
OTHERS	eutrophication												
	interactions with other birds												
	scaring/shooting disturbance												
	lead comtamination (birds,environment)												
	landscape alteration												
	drowning in fishing gear												
	damage to vegetation / landscape												

*NB "increased recurrent costs" include things like increased workload and provision of anti-predator measures

Magnitude coding
- **0** not claimed / not applicable
- **1** no impact
- **2** minor effect (~ 10 %)
- **3** major effect (~ 50 %)

Status coding
- **p** Popular literature, magazines, oral communication
- **g** Gray literature, official reports, etc
- **s** Scientific publication, refereed journal

(5) ADDITIONAL COMMENTS

(6) LITERATURE REFERENCES

code author, year, title, source, any other useful information
1
2
3
etc

Figure 3.1 Spreadsheet template completed by stakeholders to provide information for REDCAFE pan-European Cormorant conflict synthesis.

3.3 Cormorant conflicts at the pan-European scale

3.3.1 Coverage

Work Package I sampled Cormorant conflicts in 24 countries, all those detailed in Figure 2.1 with the exception of Switzerland. Overall REDCAFE collated information on 235 conflict cases (Table 3.1)[5]. The majority of information provided (79% of countries and 91% of cases) was based on some degree of stakeholder input (see 3.2). Only for Belgium, Finland, Israel and Romania was information provided solely by REDCAFE participants.

Five distinct habitats were identified in relation to Cormorant conflicts. The highest proportion of conflicts detailed was on rivers, followed by lakes, freshwater aquaculture ponds and coasts, with fewest at coastal aquaculture sites (Table 3.1)

COUNTRY	**RIVERS**	**LAKES**	**AQUA-CULTURE PONDS**	**COASTS**	**COASTAL AQUA-CULTURE**	**TOTAL NO.**
Austria	30	1	-	-	-	31
Belgium	2	1	1	-	-	4
Bulgaria	-	1	-	-	-	1
Cz. Republic	2	-	3	-	-	5
Denmark	-	-	-	5	-	5
Estonia	-	-	-	3	-	3
Finland	-	-	-	9	-	9
France	-	5	-	1	-	6
Germany	7	9	4	-	-	20
Greece	-	2	-	2	-	4
Ireland	No specific cases cited					
Israel	-	-	1	-	-	1
Italy	3	2	1	4	8	18
Latvia	-	1	1	-	-	2
Lithuania	-	-	15	-	-	15
Netherlands	-	3	-	-	-	3
Norway	-	-	-	1	-	1
Poland	-	14	22	2	-	38
Portugal	-	-	-	-	12	12
Romania	Danube Delta case cited – both lake and coastal					
Slovenia	19	2	1	-	-	22
Spain	5	2	-	8	2	17
Sweden	-	2	-	7	-	9
UK *	2	7	-	-	-	9
Total no.	**70**	**52**	**49**	**42**	**22**	**235**
% of total	**29.8**	**22.1**	**20.8**	**17.9**	**9.4**	**(=100%)**

Table 3.1 Distribution of Cormorant conflict case studies collated by REDCAFE in relation to country and the 5 main habitat types identified.
Here, UK refers to England & Wales and Scotland. The number of cases was not distributed evenly amongst habitat types (X^2_4 = 14.154, P = 0.007).

[5] For France, at least, it was clear that the case studies reported were not representative of the full national picture. This point is discussed further in section 3.4.

3.3.2 Pan-European overview

Stakeholders, habitats, conflict issues, and sources of information

Redundancy analysis, based on 23 countries (Ireland was excluded due to the fact that no specific cases were cited), was based on a descriptive dataset containing 24 factors and a response dataset containing 28 factors (Figure 3.2).

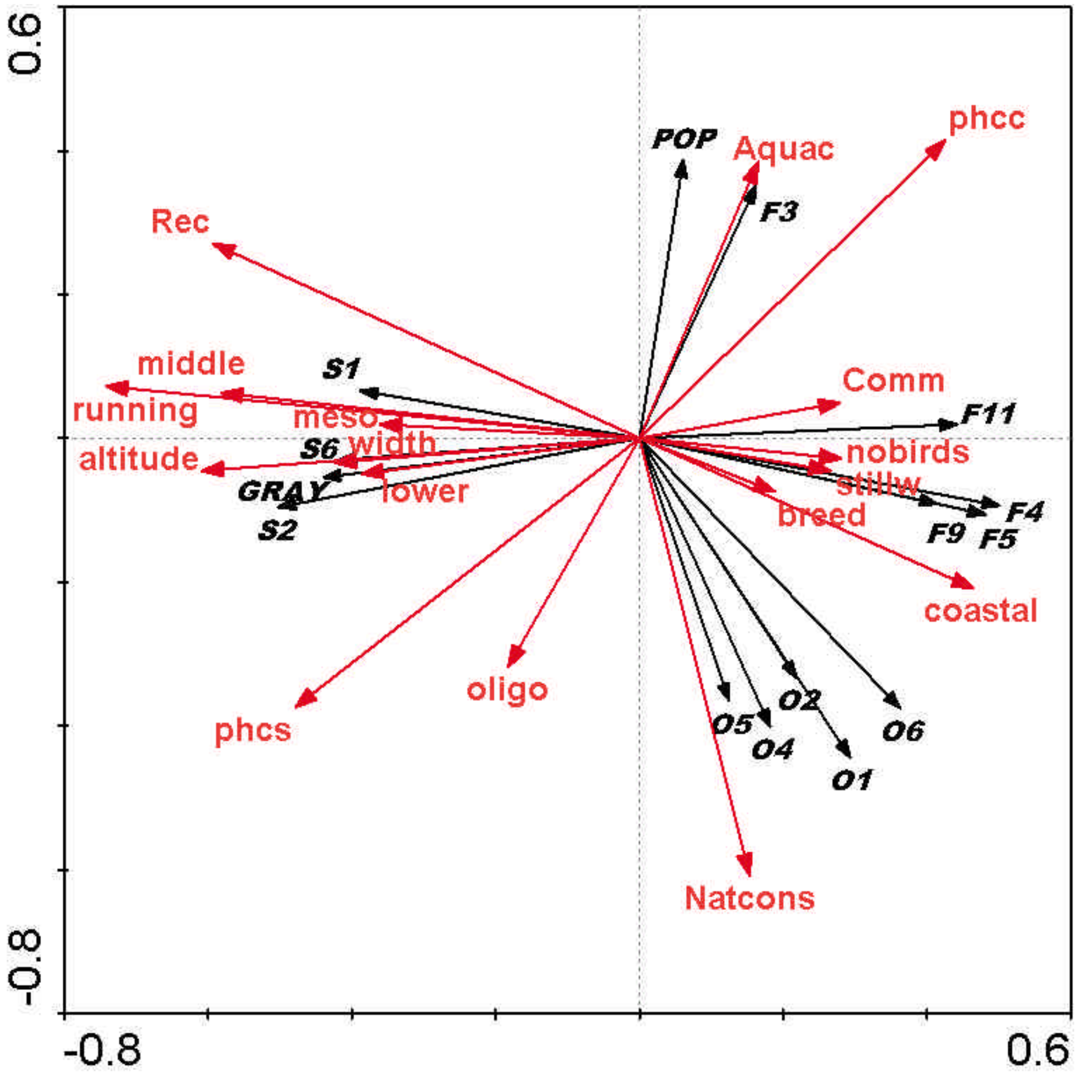

Figure 3.2 Pan-European overview of Cormorant conflicts: stakeholders, habitats, conflict issues, and sources of information. Red arrows indicate descriptive factors, black arrows indicate response factors. For interpretation, see text. In this figure descriptive variables having a t-value below 3.7 have been excluded, which means that 15 variables remain. Response variables having a fit range lower than 14% have been excluded, which resulted in 15 remaining variables. Test for first canonical axis: F=18.29, p<0.01, test for significance of all canonical axis: F=3.24, p<0.01 (Sidak correction performed).

The following points emerge from this analysis.

1. Of the four stakeholder groups, aquaculturists (Aqua) and commercial fishermen (Comm) were most similar with their arrows in the top right. The arrow representing Recreational fishermen (Rec) was also towards the top of the figure but points to the left. This was in sharp contrast to the arrow representing nature conservationists (Natcons) which points to the bottom right.

2. Several factors were associated with recreational stakeholders. These related clearly to river habitats: running waters, middle and lower reaches of rivers, river width, mesotrophic status, and altitude.

3. Several factors were associated with commercial fisheries. These related to two habitat types, stillwaters and coasts, and to both Cormorant numbers in general and to numbers of breeding birds.

4. There were significant differences between the two races of Cormorant, Atlantic birds (phcc) and Continental ones (phcs) as their associated arrows point in almost opposite directions.

5. One ‘Fisheries’ conflict issue in particular (F3: reduced value of catch [damage]) was closely associated with aquaculture.

6. Four ‘Fisheries’ conflict issues (F4, 5, 9, 11) were closely related to commercial fishing: removal of fish from nets, damage to fishing gear, reduced fishing tackle sales and loss of employment.

7. Three fish ‘Stock’ conflict issues (S1, 2, 6) were closely related to recreational fishing: reduced stock through lowered production, effects on population dynamics and community structure, and loss of spawners.

8. Five ‘Environmental’ conflict issues (O1, 2, 4, 5, 6) were closely related to nature conservation: eutrophication, interactions with other birds, lead contamination (birds, environment), landscape alteration, and drowning in fishing gear.

9. Two sources of information appeared important to stakeholders: popular literature, discussions (Pop) and grey literature, official reports etc. (Gray).

Fish species and conflict issues

Redundancy analysis, based on 23 countries (Ireland was again excluded due to the fact that no specific cases were cited), was based on a descriptive dataset containing 68 factors (i.e. fish species) and a response dataset containing 25 conflict issues (Figure 3.3).

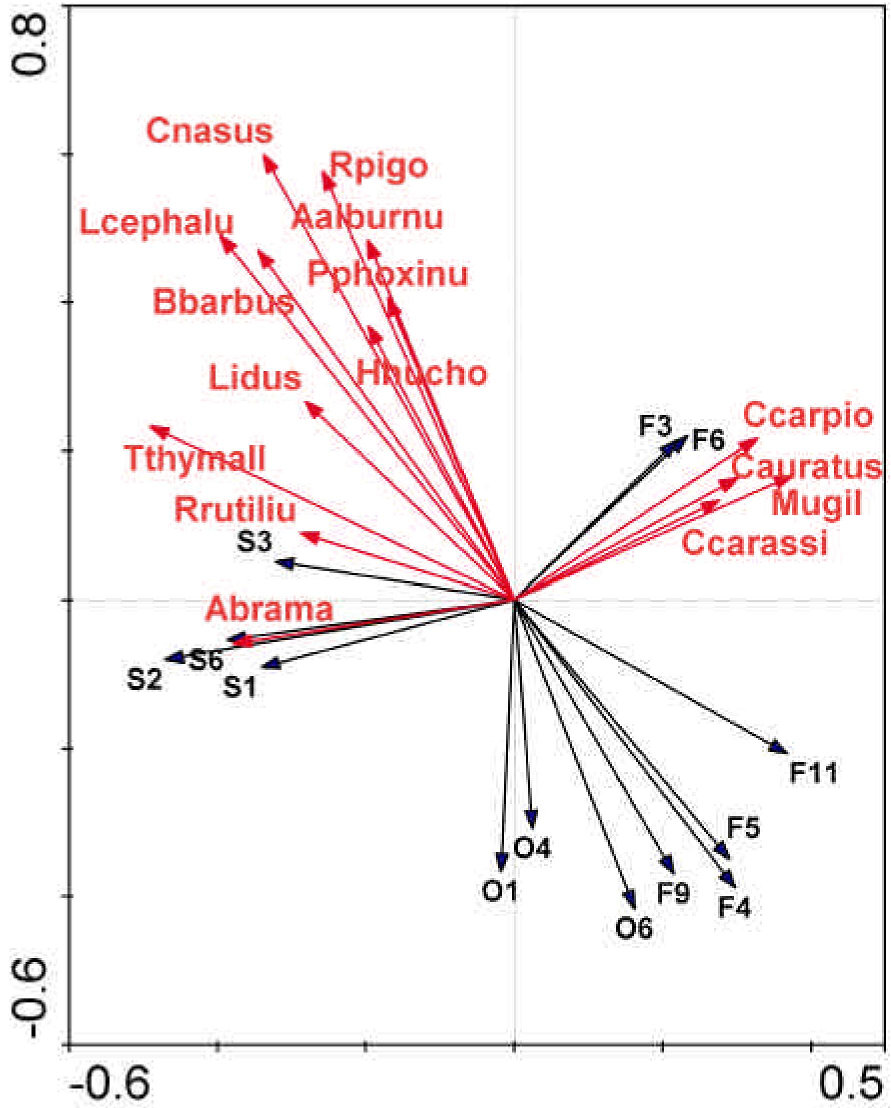

Figure 3.3 Pan-European overview of Cormorant conflicts: fish species and conflict issues. Red arrows indicate descriptive factors, black arrows indicate response factors. For interpretation, see text.
In this figure descriptive variables having a correlation range within –0.19 and 0.19 have been excluded, which means that 15 variables remain. Response variables having a fit range lower than 9% have been excluded, which resulted in 15 remaining variables. Test for first canonical axis: F=22.01, p<0.01, test for significance of all canonical axis: F=2.34, p<0.01 (Sidak correction performed).

The following points emerge from this analysis.

1. The fish species highlighted by the analysis fall into two distinct groups. The first includes four species common in aquaculture systems: Carp (see Table 3.4 for scientific names), Crucian carp and goldfish in freshwaters and mullets in coastal lagoons.

2. The second, larger, group of fish is dominated by nine species of cyprinids (Carp family, see Table 3.4) but also includes Huchen and Grayling.

3. Two 'Fisheries' conflict issues (F3, 6) were closely related to the aquaculture fish species group: reduced value of catch (damage) and reduced catchability through stress/behaviour. The former issue was also closely related to aquaculture stakeholders in Figure 3.2.

4. Three fish 'Stock' conflict issues (S1, 2, 6) were closely related to the cyprinid-dominated fish group: reduced stock through lowered production, effects on population dynamics and community structure, and loss of spawners. These three issues were also closely related to recreational fishery stakeholders in Figure 3.2. A fourth fish 'Stock' conflict issues (S3) was also highlighted in association with the cyprinid-dominated fish group: threats to endangered species.

5. A third group of conflicts was highlighted, covering both 'Fisheries' (F4, 5, 9, 11) and 'Environmental' (O1, 4, 6) issues (and closely related with commercial and nature conservationist stakeholders, respectively, in Figure 3.2). These seven conflict issues were removal of fish from nets, damage to fishing gear, reduced fishing tackle sales, and loss of employment (Fisheries) and eutrophication, lead contamination (birds, environment), and drowning in fishing gear (Environmental). It is clear from these issues that they are not necessarily related directly to fish species and this lack of association is clear from the direction of the arrows in Figure 3.3.

Seasonality of conflicts

Redundancy analysis, based on 23 countries (Ireland was again excluded due to the fact that no specific cases were cited), was based on a descriptive dataset containing 23 factors (i.e. countries) and a response dataset containing 12 months (Figure 3.4).

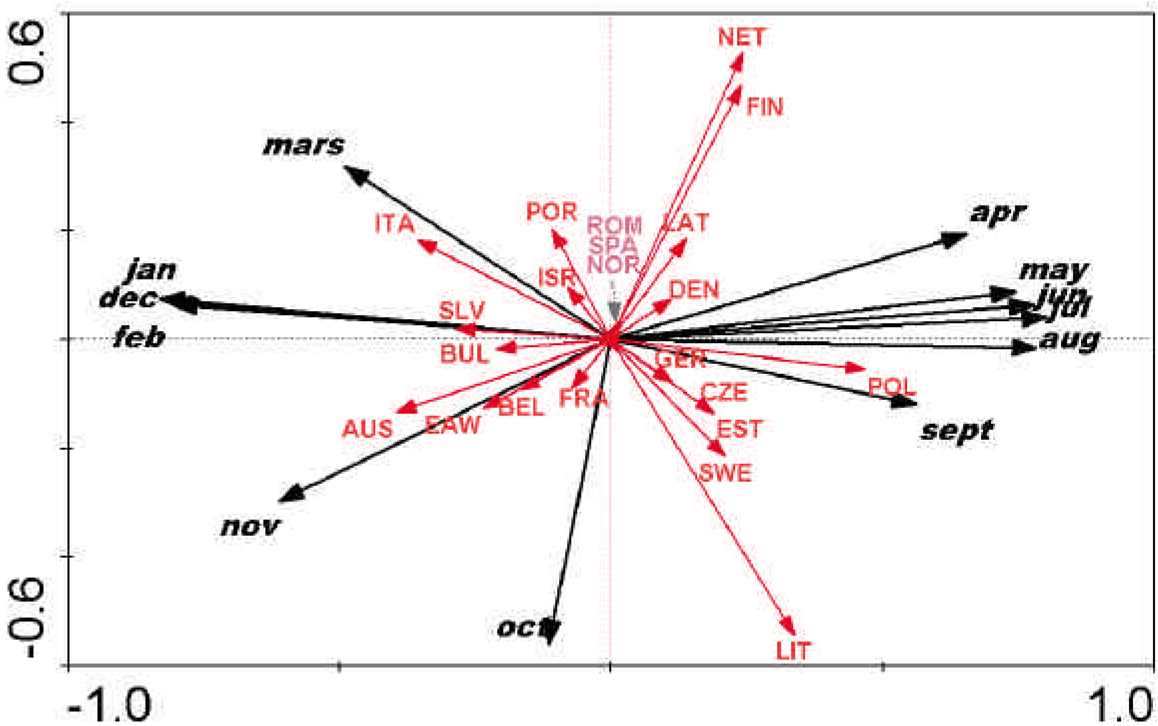

Figure 3.4 Pan-European overview of Cormorant conflicts: timing of conflict by country. Red arrows indicate descriptive factors, black arrows indicate response factors. For interpretation, see text.
In this figure all variables have been included. Test for first canonical axis: $F=269.55$, $p<0.004$, test for significance of all canonical axis: $F=19.21$, $p<0.004$ (Sidak correction performed).

This analysis shows that (1) although countries differ in relation to the months during which Cormorant conflicts are reported, there are two major groups which (2) are associated with conflicts in two time periods: ‘winter’ October-March and ‘summer’ April-September. This, and the other pan-European overviews in this section, are explored in further detail in the following sections.

3.3.3 Conflict site descriptions

National overview

Cormorant conflicts on rivers were reported in 8 countries, on lakes (14 countries), aquaculture ponds (9), coasts, (10) and coastal aquaculture (3). However, in relation to habitat type, only a relatively few countries (i.e. 2-4) hold most (i.e. > 10%) of these conflict cases (Figure 3.5). Thus there are thirteen 'main' countries reporting Cormorant conflicts (Table 3.2).

Habitat type	**Country holding > 10% of reported Cormorant conflict cases**
Rivers	Austria, **Germany**, Slovenia
Lakes	France, **Germany**, **Poland**, UK (England & Wales, Scotland)
Aquaculture ponds	**Germany**, Lithuania, **Poland**
Coasts	Denmark, Finland, Spain, Sweden
Coastal aquaculture	Italy, Portugal

Table 3.2 Thirteen 'main' countries reporting Cormorant conflicts (those in bold have conflicts in more than one habitat type).

Habitat overview

Within rivers, the reported Cormorant conflicts were not distributed randomly in relation to location within river (i.e. reach), its width or altitude. Most reported conflicts were on the 'middle' or 'lower' reaches of rivers, at widths of 10-100m and at altitudes of less than 500 m. Such lowland features were also clear for conflicts on lakes where most records were from sites at less than 500m altitude (Table 3.3).

The majority of Cormorant conflict cases were reported to be on nutrient-rich (i.e. eutrophic) waters. However water quality differed between the five habitat types, tending towards nutrient-poor conditions for rivers and nutrient-rich conditions for lakes and especially freshwater aquaculture ponds. In terms of anthropogenic influences, similar proportions of conflict cases were recorded overall on natural, semi-natural and artificial sites. Again there were differences between the five habitat types with most rivers and coasts being natural and most freshwater aquaculture ponds being artificial (Table 3.3).

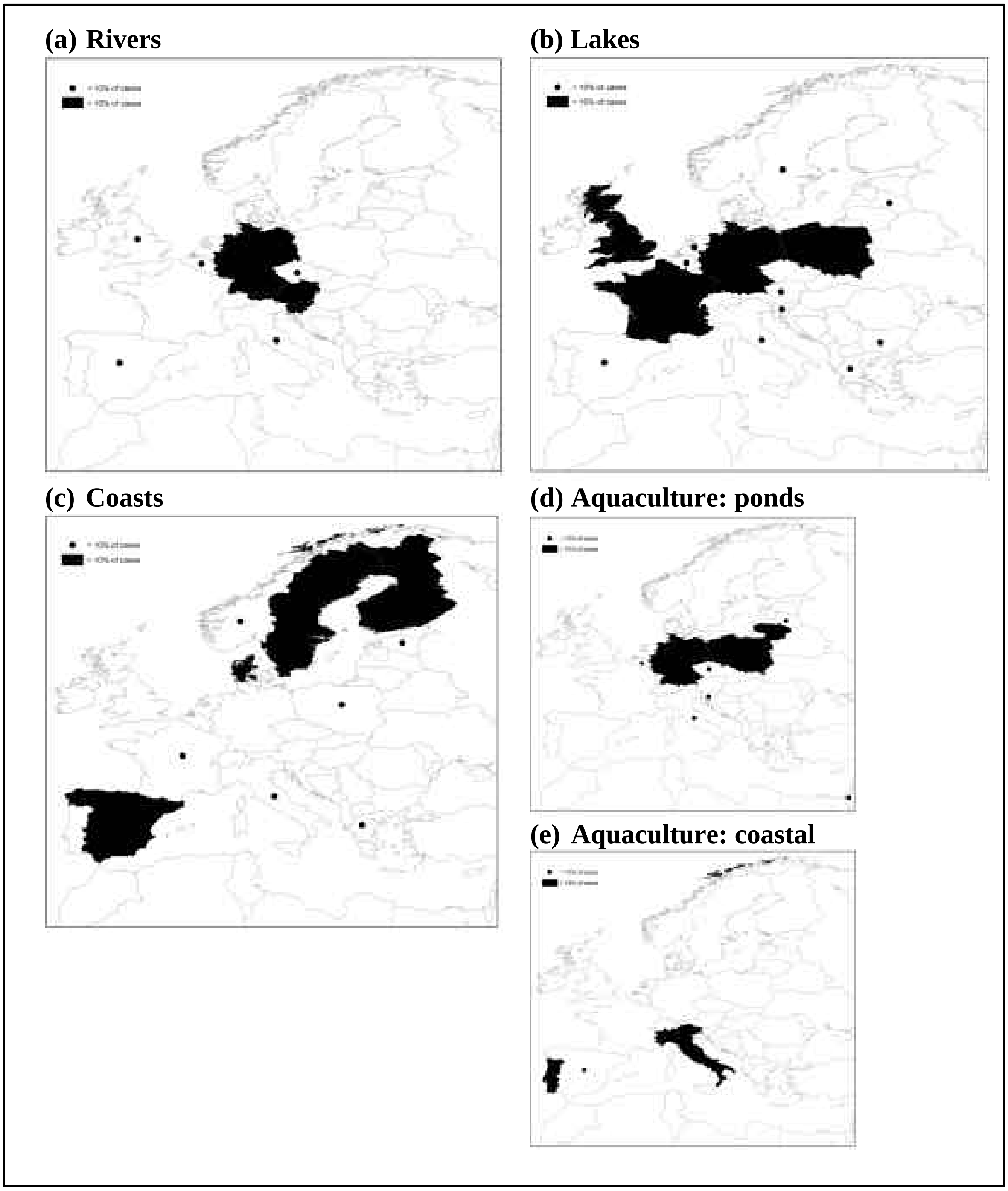

Figure 3.5 Geographic distribution of habitat types affected by conflicts with Cormorants. Shaded countries have over 10% of recorded conflict cases, those indicated by dots have less than 10%.

Habitat	Feature	Category			
	Reach	**Upper**	**Middle**	**Lower**	
Rivers	N = 66 cases[1]	7	**43**	16	
	Width (m)	**< 10m**	**10-50m**	**50-100m**	**100+m**
Rivers	N = 66 cases[2]	10	**37**	11	8
	Altitude (m)	**< 100m**	**100-500m**	**500+m**	
Rivers	N = 62 cases[3]	11	**47**	4	
Lakes	N = 70 cases[4,5]	**38**	28	4	
	Trophic status[6]	**Oligotrophic**	**Mesotrophic**	**Eutrophic**	
Rivers	N = 68 cases	**32**	28	8	
Lakes	N = 49 cases	4	14	**31**	
Aquaculture ponds	N = 50 cases	0	2	**48**	
Coasts	N = 29 cases	10	3	**16**	
Coastal aquaculture	N = 22 cases	**9**	4	**9**	
	Anthropogenic Influence[7]	**Natural**	**Semi-natural**	**Artificial**	
Rivers	N = 67 cases	**40**	27	0	
Lakes	N = 51 cases	**22**	14	15	
Aquaculture ponds	N = 49 cases	0	9	**40**	
Coasts	N = 33 cases	**24**	9	0	
Coastal aquaculture	N = 22 cases	3	**15**	2	

Table 3.3 The number of Cormorant conflict cases reported in relation to habitat (river, lake) and habitat features. Within each habitat/feature category, the highest proportions are highlighted in red.
[1]Most river conflicts were recorded on ‘middle’ reaches (X^2_2 = 15.491, $P < 0.001$), [2]on rivers of 10-50m width (X^2_2 = 13.721, $P = 0.003$), and [3]at 100-500m altitudes (X^2_2 = 24.620, $P < 0.001$). [4]Most lake conflicts were at < 100m altitude (X^2_2 = 17.543, $P < 0.001$) [5]in contrast to those on rivers (X^2_2 = 19.277, $P = 0.0001$). [6]Overall, trophic status differed between habitats, especially in relation to low numbers of eutrophic river cases and high numbers of eutrophic freshwater aquaculture pond cases (X^2_8 = 96.447, $P < 0.001$). [7]Overall, anthropogenic influences differed between habitats, especially in relation to high numbers of artificial freshwater aquaculture ponds (X^2_8 = 135.175, $P < 0.001$).

3.3.4 Birds and fish

Across Europe, three species/races of cormorant were involved in conflicts: both the Atlantic (*Phalacrocorax carbo carbo*) and Continental (*P. c. sinensis*) races of the Great Cormorant and the Pygmy Cormorant (*P. pygmeus*). Only the Atlantic race of the Great Cormorant was recorded in Norway, Scotland and the Republic of Ireland, both races were recorded in England, Wales, France, Spain and Portugal, whilst the only Continental race was recorded in all other countries. In Bulgaria, Greece and Israel, the Pygmy Cormorant was also recorded alongside Continental Great Cormorants (Figure 3.6).

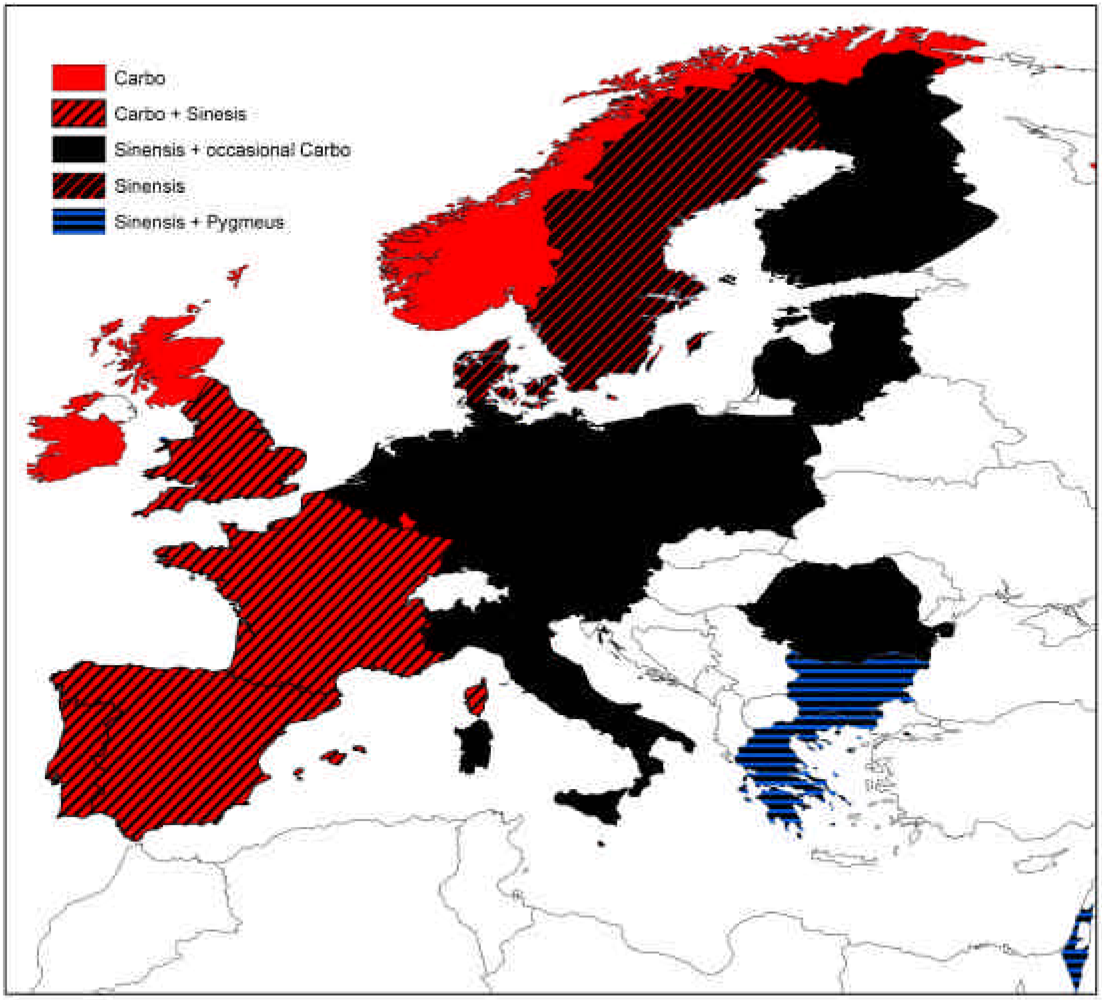

Figure 3.6 Geographic distribution of Cormorant races/species involved in conflicts across Europe.

Information on maximum Cormorant numbers and area of water involved was available for 147 conflict cases: involving 43 lakes, 42 rivers, 42 freshwater aquaculture ponds, and 20 coastal cases. Overall, there were significant differences in the mean density of Cormorants (i.e. maximum number/area) between habitat types (Table 3. 4) with the highest Cormorant densities recorded on rivers. However, there are some problems with the definition of 'area of water' in relation to these conflict cases, particularly for rivers where cases (and hence, associated densities) range from short study sections to the catchment area of the River Danube (see discussion in 3.4).

Nevertheless, statistical analysis showed that the maximum number of Cormorants recorded for each case was influenced by both 'area of water' and 'habitat type' (i.e. lake, river, pond and coast) and also by an interaction between these two factors. Further analysis showed that this interaction was due to the 'rivers' habitat category where maximum Cormorant numbers appeared little affected by the area of water (Figure 3.7). Excluding river cases showed that for lakes, ponds and coasts, area of water was the main factor influencing Cormorant numbers at specific conflict case sites (Figure 3.7).

Habitat	No. cases	Cormorant density (maximum no. ha^{-1})			
		Mean	SE	Minimum	Maximum
Lakes	43	1.9	0.68	0.05	25.00
Rivers	42	4.3	0.89	3.0×10^{-5}	31.25
Aq ponds	42	1.6	0.60	0.06	21.25
Coasts	20	0.5	0.14	0.005	2.67

Table 3.4 Cormorant density (mean, standard error [SE], minimum and maximum) in relation to 4 habitat types. Densities differed between habitats, being highest on rivers, lowest on coasts and intermediate on stillwaters (lakes and aquaculture ponds) ($F_{3,143} = 4.54$, $P = 0.004$).

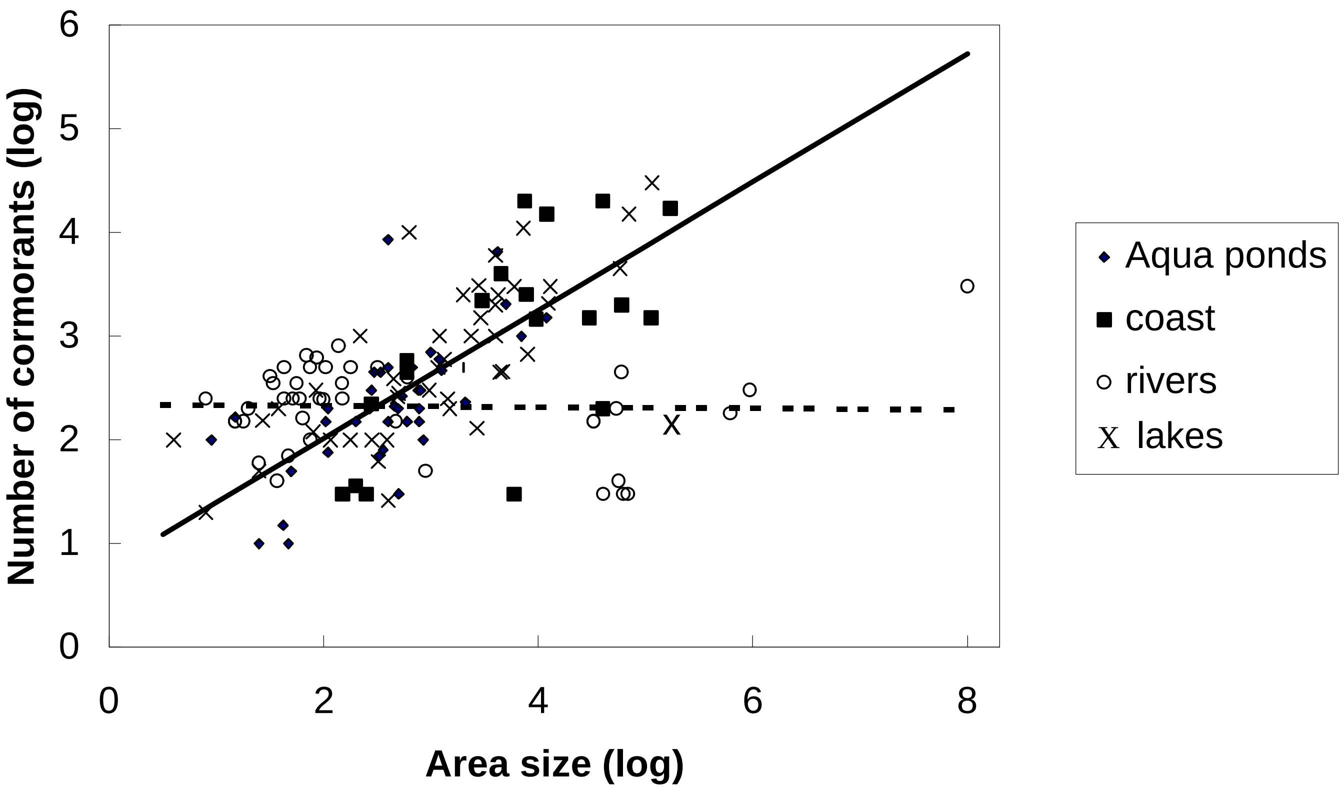

Figure 3.7 Relationship between maximum Cormorant numbers and area of water for conflict cases at four main habitat types. Each point represents one case.

Within lake, pond and coastal habitats, the relationship between maximum Cormorant numbers and area of water was best described by the following equation where water area explains 56% of the variation found in maximum Cormorant numbers:

$$Log_{10}\text{(maximum number of Cormorants)} = 0.6179 \times (Log_{10}[\text{area of water}]) + 0.77798$$

Information on the fish species that are involved in Cormorant conflicts was available for 212 conflict cases: involving 43 lakes, 66 rivers, 48 freshwater aquaculture ponds, 22 coastal aquaculture sites and 33 coastal ones. Overall, 68 species were recorded from 24 Families (Table 3.5).

Fish species were assigned to one of eight categories: (1) Cyprinids; (2) Salmonids; (3) Perch/Pike; (4) Eel and other freshwater species; (5) flatfishes; (6) Cod fishes; (7) Mullet/Sea Bream/Bass; (8) other marine fishes (see Table 3.4). Overall, the highest proportion of fish species recorded in conflicts involving Cormorants were Cyprinids, followed by Salmonids, Perch/Pike and a number of fishes associated with coastal aquaculture. However, different fish groups were identified when conflicts were assigned to one of five habitat types (Table 3.6).

	Habitat type					
Fish group	**River**	**Lake**	**Aquaculture ponds**	**Coast**	**Coastal aquaculture**	**% of records**
Cyprinids	**120**	**41**	**54**	7	0	33.7
Salmonids	109	20	10	**26**	0	25.0
Perch/pike	20	**46**	15	19	0	15.2
Mullet etc.	0	0	0	11	**48**	8.9
Eel + others	6	24	3	15	10	8.8
Flatfishes	0	0	0	15	9	3.6
Marine	0	0	0	**22**	0	3.3
Cod fishes	0	0	0	9	0	1.4
Total number of records = 659						**= 100%**

Table 3.6 The number of records of fishes involved in conflicts with Cormorants in relation to five habitat types. Figures are the number of records for species included in each of eight fish groups, those highlighted in red indicate the most commonly recorded groups in each habitat type.

ANGUILLIDAE[4] - Eels
Eel *Anguilla anguilla*

CLUPEIDAE[6] – Herrings
Herring *Clupea harengus*

COREGONIDAE[2] - Whitefishes
Powan *Coregonus lavaretus*
Vendace *C. albula*
Northern whitefish *C. peled*

SALMONIDAE[2] - Salmonids
Atlantic salmon *Salmo salar*
Brown trout *S. trutta*
Marbled trout *S. marmoratus*
Rainbow trout *Oncorhynchus mykiss*
Arctic char *Salvelinus alpinus*
Brook char/trout *S. fontinalis*
Huchen *Hucho hucho*

THYMALLIDAE[2] - Graylings
Grayling *Thymallus thymallus*

ESOCIDAE[3] – Pikes
Northern pike *Esox lucius*

CYPRINIDAE[1] – Carps
Carp *Cyprinus carpio*
Crucian carp *Carassius carassius*
Goldfish *Carassius auratus*
Gibel carp *Carassius auratus gibelio*
Tench *Tinca tinca*
Bream *Abramis brama*
Zährte *Vimba vimba*
Silver bream *Blicca bjoerkna*
Schneider *Alburnoides bipunctatus*
Bleak *Alburnus alburnus*
Barbel *Barbus barbus*
Italian barbel *B. barbus plebejus*
Nase *Chondrostoma nasus*
Savetta *Chondrostoma soetta*
South European nase *Chondrostoma genei*
Dace *Leuciscus leuciscus*
Ide/Orfe *L. idus*
Chub *L. cephalus*
Soufie *L. souffia*
Silver carp *Hypophthalmichthys molitrix*
Big head carp *Aristichthys nobilis*
Minnow *Phoxinus phoxinus*
Roach *Rutilus rutilus*
Danubian roach *Rutilus pigus*
Rudd *Scardinius erythropthalmus*

SILURIDAE/ICTALURIDAE[4] - Catfishes
Wels *Silurus glanis*
Black bullhead *Ictalurus melas*
Channel catfish *I. punctatus*

GADIDAE[6] – Cod fishes
Cod *Gadus morhua*
Saithe *Pollachius virens*
Burbot *Lota lota*

ZOARCIDAE[8] – Eelpouts
Viviparous blenny/Eelpout *Zoarces viviparus*

BELONIDAE[8] – Garfishes
Garfish *Belone belone*

ATHERINIDAE[7] – Sand-smelts
Big-scale sand-smelt *Atherina boyeri*

COTTIDAE[8] – Sculpins/Bullheads
Fourhorn sculpin *Myoxocephalus quadricornis*
Bull-rout *M. scorpius*

PERCICHTHYIDAE[7] – Sea basses
Bass *Dicentrarchus labrax*

PERCIDAE[3] – Perches
Perch *Perca fluviatilis*
Ruffe *Gymnocephalus cernuus*
Pikeperch/Zander *Sander lucioperca*

SPARIDAE[7] – Sea breams
Gilthead *Sparus auratus*
Striped sea bream *Lithognathus mormyrus*

MUGILIDAE[7] – Grey mullets
Thin-lipped grey mullet *Liza ramada*
Leaping mullet *L. saliens*

SCOMBRIDAE[8] – Mackerels
Mackerel *Scomber scombrus*

SCOPHTHALMIDAE[5] – Left-eyed flatfishes
Turbot *Scophthalmus maximus*

PLEURONECTIDAE[5] – Right-eyed flatfishes
Plaice *Pleuronectes platessa*
Flounder *Platichthys flesus*
Dab *Limanda limanda*

SOLIDAE[5] – Soles
Sole *Solea solea*
Senegal sole – *Solea senegalensis*

VALLENCIIDAE[8] – Killifishes
Valencia toothcarp *Valencia hispanica*

CYPRINODONTIDAE[8] – Pupfishes
Spanish toothcarp *Aphanius iberus*

CICHLIDAE[4] – Cichlids/Tilapia
Mango tilapia *Sarotherodon galileus galileus*

Table 3.5 Fish species recorded in relation to conflicts with Cormorants across Europe. Numbers refer to species categories discussed in the text.

Information on the seasonality of Cormorant conflicts was available for 186 conflict cases. For each, the months during which conflicts occurred were identified. Conflict cases could be split, on a national basis, into four distinct seasonal groups (Figure 3.8). Moreover, these four seasonal groups corresponded to four distinct geographical regions: Western Europe (winter conflicts), Baltic and Netherlands (summer conflicts), Central Europe (conflicts throughout year) and South-eastern Europe (winter conflicts) (Figure 3.9). In Germany, most conflicts in summer were reported in the northern regions where the main breeding colonies are located (i.e Baltic Sea coast), while most winter conflicts were reported from the central or southern (i.e. inland) regions.

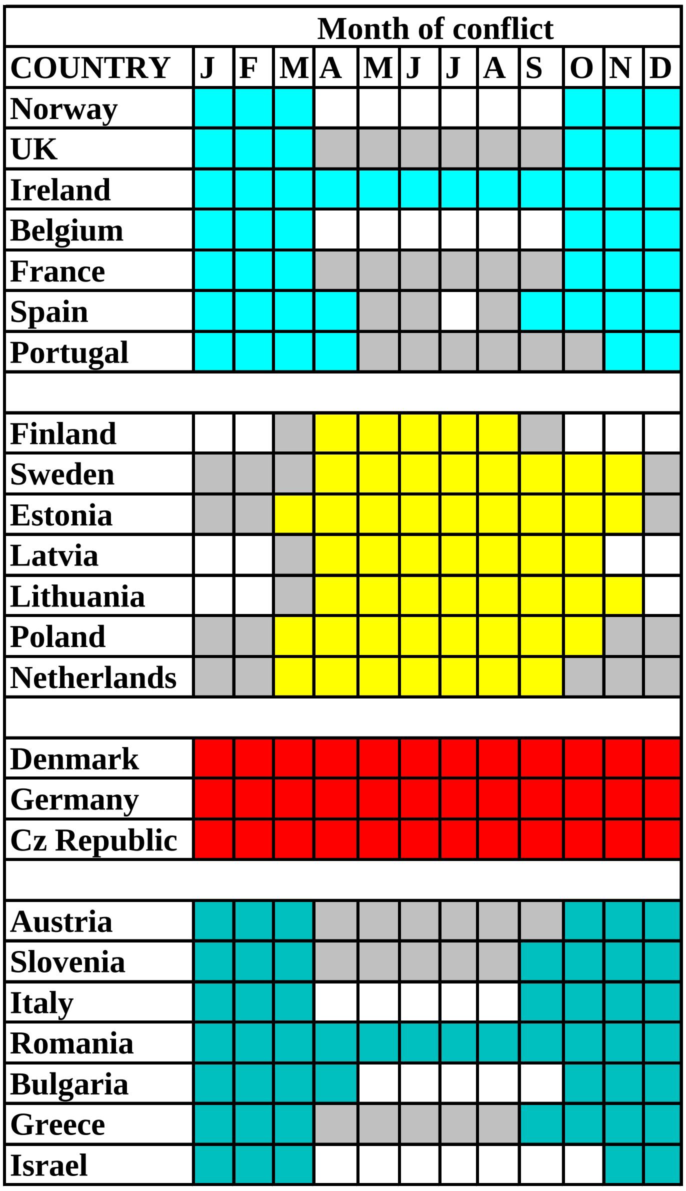

Figure 3.8 The months for which Cormorant conflicts were recorded by country. Coloured boxes indicate the months during which conflicts were recorded in the majority of case studies (blue = winter conflicts in north/west, blue hatch = winter conflicts in south/east, yellow = summer, red = all year). Grey boxes indicate months when few conflict cases were reported and white boxes indicate months with no reported conflicts.

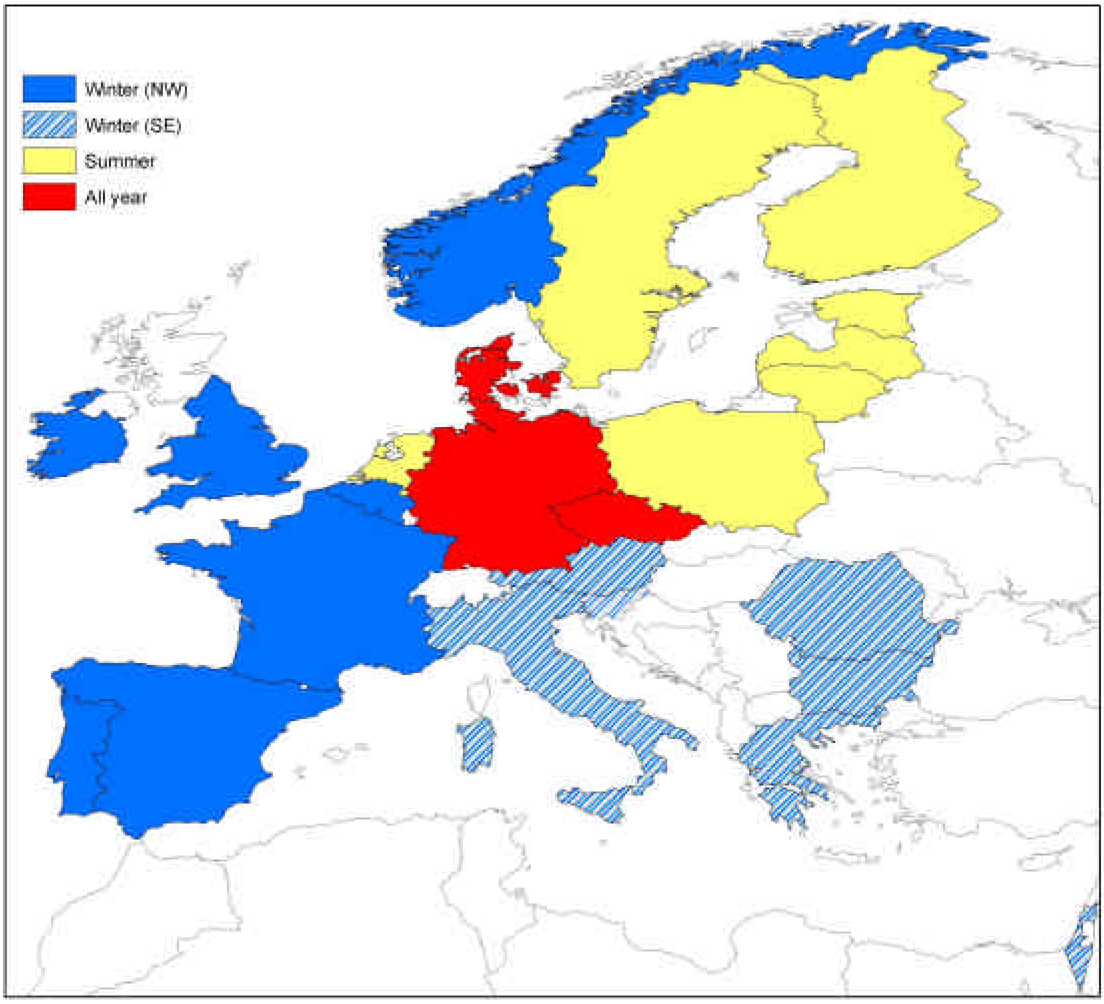

Figure 3.9 Geographical distribution of Cormorant conflicts in relation to country and season (blue = winter conflicts in north/west, blue hatch = winter conflicts in south/east, yellow = summer, red = all year).

3.3.5 Finance

Financial information on the 'costs' of Cormorant predation was recorded for 105 cases. Two pieces of financial information were provided: (a) the annual financial turnover in the system and (b) the turnover loss thought to be due to Cormorants. In one case, this information was derived from a socio-economics model, for the remaining cases, such information came from a variety of different sources (Table 3.7).

Information source	**% of cases**
(a) TURNOVER	
Provided by relevant stakeholder	33.6
Based on fish prices/catch statistics	15.4
Licence payments	1.9
Estimated by REDCAFE participant	32.7
Not stated	16.3
Total number of cases	**104 (= 100%)**
(b) LOSS	
Provided by relevant stakeholder	42.3
Calculated (Cormorant nos, diet, Daily Food Intake, energetic requirements etc)	16.3
Restocking value of lost fish	1
Estimated by REDCAFE participant	20.2
Not Stated	20.2
Total number of cases	**104 (= 100%)**

Table 3.7 Sources of financial information provided for 104 Cormorant conflict case studies. Note: in one other case, both turnover and loss were derived from a socio-economics model.

In an attempt to quantify the 'quality' of the financial information provided, it was requested that the values provided be categorised as either 'actual' or 'estimated'. However, this information was not provided for around 20% of the values recorded for both turnover and loss. Just less than half of the values recorded for turnover were estimates while one-third were categorised as 'actual' amounts (e.g. based on stakeholder accounts). This contrasted (X^2_2 = 25.212, $P < 0.001$) with the values for losses, three quarters of which were estimates and only 7% were considered to be actual values.

Financial information provided for the 105 conflict cases gave a cumulative total for annual turnover at these sites of 154,002,380 euro. Associated losses due to Cormorants were given at 16,994,801 euro, an overall loss of 11%.

For each case, loss claimed due to Cormorants was calculated as a percentage of the annual turnover value provided. Resulting 'percentage financial loss' figures were then examined in relation to four main types of stakeholder groups providing information: recreational anglers on rivers (n = 23 cases), aquaculturists on freshwater ponds (41), Commercial fishermen on lakes (23) and on coasts (13). For each stakeholder group, most of the calculated values for percentage financial loss were clustered around values of less than 50% but there were some exceptionally large values. Thus, the most appropriate measure of the central tendency for this information is median reported percentage financial loss (Table 3.8).

STAKEHOLDER/HABITAT	No. CASES	MEDIAN REPORTED FINANCIAL LOSS	% OF CASES WHERE REPOTED LOSS > 50%
Recreational anglers – rivers	23	57%	43.5
Aquaculture – freshwater ponds	41	9%	2.4
Commercial - lakes	23	12%	13.0
Commercial - coasts	13	10%	30.8

Table 3.8 Median financial loss due to Cormorants reported by stakeholders (values are loss as percentage of annual turnover). Proportions of cases where reported financial loss was greater than 50% of annual turnover are also given.
Based on $\log_{10}$ transformed data, recorded financial losses were highest for recreational anglers, lowest for aquaculturists and intermediate for commercial fishermen on lakes and coasts ($F_{3,95} = 9.92$, $P < 0.001$).

Information provided showed that the estimated median financial losses due to Cormorants were similar, at around 10% of annual turnover, for aquaculturists at freshwater ponds and commercial fisheries on both lakes and coasts. However, for coastal commercial fishermen a higher proportion of financial losses was relatively high. These records contrasted sharply with those provided by recreational anglers on rivers. This stakeholder group claimed generally higher financial loss than did the others, median losses claimed were around six times higher for these stakeholders. Similarly, a greater proportion of financial losses reported by recreational anglers on rivers exceeded 50% of annual turnover.

3.3.6 Conflict issues: magnitude of conflict

Original REDCAFE discussions identified 25 potential Cormorant conflict issues (see Figure 3.1). Although stakeholders were free to add other issues, none did. Thus analyses were based on the original 25 issues identified, which were categorised as being related to ‘fisheries’ or ‘fish stocks’ or ‘environmental’ (i.e. more general issues relating to the wider environment). This section examines these conflict issues in relation to their magnitude (see 3.2 for details) as reported by stakeholders.

Analyses including all magnitude codes (not presented) showed very similar patterns to those for magnitude 3 scores only. Thus, for simplicity, analyses of conflict issues were restricted to those given a magnitude coding of 3 which categorised the conflict issue as having a ‘major effect’ for stakeholders. Stakeholders gave magnitude 3 ratings (hereafter referred to as ‘major conflict issues’) on 771 occasions (Table 3.8).

Two things were clear from the overall dataset in Table 3.9. First, that stakeholders recorded major conflict issues differently: nature conservationists seldom recorded major conflict issues (4.0% of all records) whilst recreational anglers did frequently (48.5% of all records). Second, stakeholders recorded major conflict issues in different categories. Specifically, the majority of major conflicts identified by recreational anglers related to fish stock issues, by commercial fishermen and aquaculturists related to fisheries issues and by nature conservationists related to environmental issues.

Category of conflict issue	Stakeholder Group			
	Recreational	**Commercial**	**Aquaculture**	**Nature conservation**
Fisheries	43.6%	55.4%	55.5%	6.4%
Fish Stocks	55.3%	36.4%	35.6%	29.0%
Environmental	1.1%	8.2%	8.9%	64.5%
Total no. records (= 100%)	**374**	**220**	**146**	**31**

Table 3.9 Categorisation of major (i.e. magnitude 3) conflict issues by stakeholders. Figures are percentages of the total number of records provided by each stakeholder group, highest values are shown in red.
Stakeholders recorded major conflict issues differently (X^2_3 = 183.221, $P < 0.001$) and recorded major conflict issues in different categories (X^2_6 = 197.456, $P < 0.001$).

Examining all 25 conflict issues separately also highlighted significant differences between stakeholders in terms of the number of times major issues were recorded (Figure 3.10). All three 'fishery related' stakeholders most frequently highlighted either fisheries or fish stock conflict issues. In contrast, fisheries issues were scarcely recorded by nature conservationists, although this stakeholder group did cite concerns over many fish stock issues.

Commercial and aquaculture stakeholders both recorded very similar major conflict issues, the most regularly cited issue being reduced catches. These two stakeholder groups were also both concerned about Cormorants causing a loss of fishery earnings. Perhaps not surprisingly, aquaculturists were also concerned with losses of aquaculture stock and commercial fishery stakeholders were concerned about reduced fish stocks in relation to lowered production. This latter issue was the most regularly cited conflict issue by recreational angling stakeholders, followed equally by effects on fish population dynamics/community structure and reduced fish catches.

Nature conservation stakeholders differed from the three 'fishery related' stakeholders in that nine out of the eleven 'Fisheries' conflicts were unrecorded as major issues. Furthermore, several major conflict issues were cited with the same frequency, thus six issues were included in the top three recorded. Three of these issues were related to fish stocks: reduced fish stocks in relation to lowered production, effects on fish population dynamics/community structure and loss of juvenile fish – lowered recruitment. However, the remaining three (scaring/shooting disturbance, drowning in fishing gear, damage to vegetation/landscape) were categorised as 'Environmental' issues and were only infrequently recorded by other stakeholders. The exception was scaring/shooting disturbance, an issue also in the top ten recorded by aquaculturists.

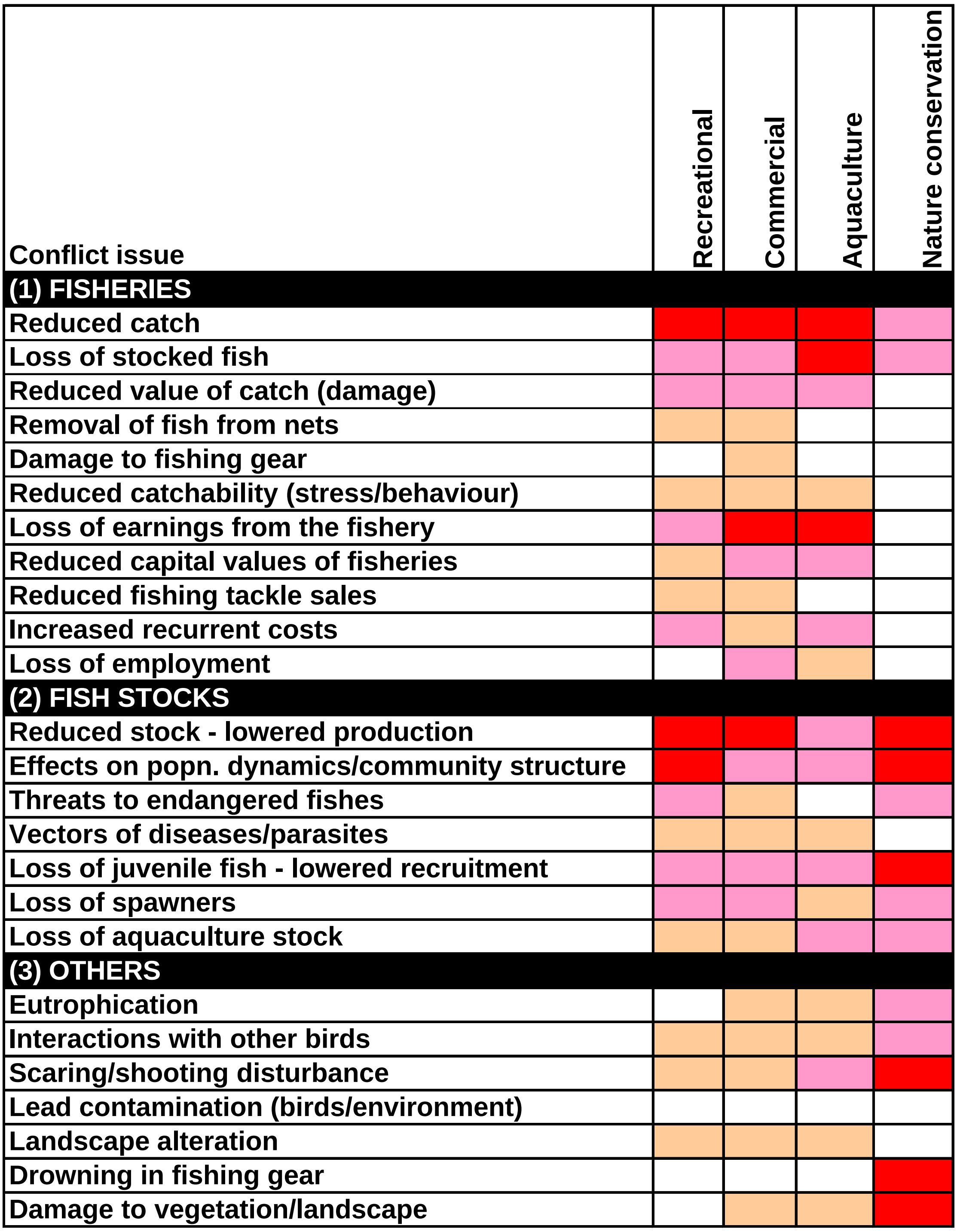

Figure 3.10 Major Cormorant conflict issues as recorded by four different stakeholder groups. Red indicates the top three conflict issues for each stakeholder (note that the top issue for each stakeholder group is hatched and that several issues are shared amongst the top three for nature conservationists), pink indicates other issues in the top ten for each group. Orange indicates major conflict issues recorded less frequently and blank boxes indicate issues not considered by stakeholders to be major ones. The number of major conflict records for each issue was closely correlated ($P < 0.001$) for commercial and aquaculture stakeholders (correlation coefficient, $r = 0.81$), for commercial and recreational stakeholders ($r = 0.79$) and for recreational and aquaculture stakeholders ($r = 0.65$). However, there was no correlation for records from nature conservationists and any of the three other stakeholders.

3.3.7 Conflict issues: status of information used by stakeholders

As well as recording the magnitudes of various conflict issues, stakeholders also provided details of the status of information they used to inform their opinions on them. Such information was categorised broadly as being (a) popular literature/discussions, (b) official reports and unpublished 'grey' literature, and (c) refereed, scientific publications. Stakeholders listed the literature references for categories (b) and (c), and this information is given in Volume 2 of this report. In some cases, stakeholders provided further details on information sources in the 'popular' category (a) and these are discussed later in this section.

Overall, stakeholders provided 3,870 records for the status of the information they used to inform themselves about Cormorant conflict issues. Most records (50.7%) were in the 'popular' category, followed by 'grey literature' (33.9%) and 'scientific literature (15.3%).

Across all 25 conflict issues there were significant differences between stakeholders in terms of their use of different sources of information. (Table 3. 10).

Status of information	**Stakeholder group**			
	Recreational	**Commercial**	**Aquaculture**	**Nature conservation**
Popular	45.9%	52.3%	54.6%	53.2%
Grey literature	39.5%	40.3%	25.8%	23.1%
Scientific literature	14.5%	7.4%	19.6%	23.7%
Total no. records (= 100%)	**1356**	**1000**	**907**	**607**

Table 3.10 Categorisation of the status of information used by stakeholders to inform themselves about Cormorant conflict issues.
Stakeholders recorded the status of information differently ($X^2_6 = 153.701$, $p < 0.001$).

Commercial stakeholders recorded the smallest proportion of scientific literature and nature conservationists the largest whilst nature conservationists and aquaculturists used less grey literature than did commercial and recreational stakeholders. For all four stakeholder groups, 'popular literature' was the most frequently recorded source of information informing them about conflict issues. From information provided by stakeholders, this category included a wide-range of individual sources (Table 3.11).

The most common sources of 'popular' information were provided by stakeholders themselves and could be categorised as local expert knowledge. Apart from records of general discussions and communications between stakeholders, the next most regularly cited source of information was the media, a category that included many different forms of communication. Although all records came from the 'popular' category, 16% of them were clearly identified as having a scientific basis.

Source of ‘popular’ information	No. of records	Frequency of records
(A) Local expert knowledge		
Stakeholders: direct observations	240	
Stakeholders: data/information	130	
Stakeholders: opinion	38	
“Local knowledge”	63	**35.6%**
(B) Media		
Newspapers, magazines, TV, radio, WWW/internet, letters of compliant to authorities and associated discussions	295	**22.3%**
(C) Other discussions		
Various discussions/personal communications	306	**23.1%**
(D) Administrative sources		
Regional administrative documents/management plans	9	
Local meeting/workshop discussions	31	**3.0%**
(E) Scientific information		
Discussions on the implications of scientific studies	138	
Unpublished scientific information	40	
Popular science articles	34	**16.0%**
Total no. records (= 100%)	**1324**	

Table 3.11 The number (and % frequency) of records for different sources of ‘popular’ information used by stakeholders to inform themselves on Cormorant conflict issues.

It was possible to examine the relationship between the number of records for each ‘major conflict issue’ (see Figure 3.1) and the associated number of records for the use of ‘scientific literature’ (Figure 3.11). Although nature conservation stakeholders do not record many ‘major’ conflicts, they use a relatively large amount of scientific literature. Both aquaculture and commercial stakeholders record more major conflicts than do nature conservationists but are informed by scientific literature less frequently than are conservationists. Nevertheless, aquaculturists make consistently more use of scientific literature than do commercial fisheries stakeholders. Recreational angling stakeholders record major conflicts more frequently than did any other stakeholders and, for the most commonly cited conflicts at least, appear to be informed by the scientific literature.

It is possible to determine the major conflict issues for which the four stakeholder groups are using scientific literature (Figure 3.12). For recreational stakeholders these were reduced catch, loss of stocked fish, reduced fish stocks in relation to lowered production, effects on fish population dynamics/community structure, and loss of juvenile fish through lowered recruitment. For commercial stakeholders, these were reduced catch and effects on fish population dynamics/community structure. For aquaculturists, these were reduced catch, loss of stocked fish, reduced fish stocks in relation to lowered production and loss of aquaculture stock.

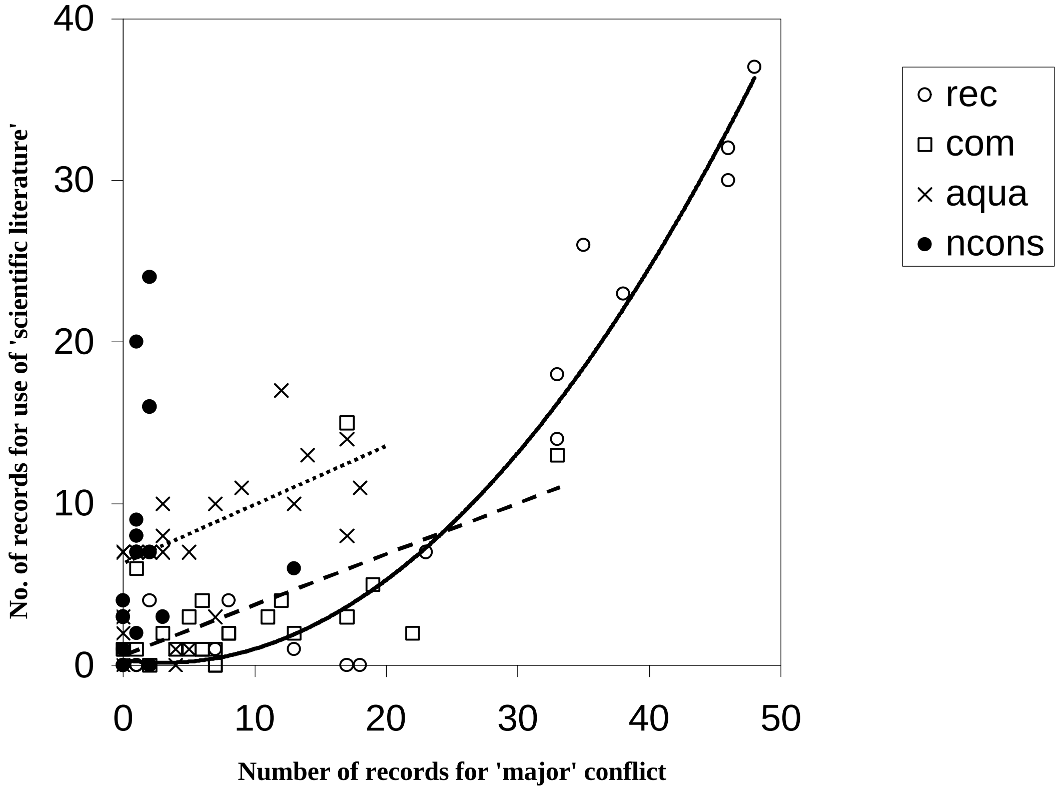

Figure 3.11 Relationship between the number of records for 'major' conflict and for the use of 'scientific literature' as a source of information for four stakeholder groups. Each point represents one conflict issue.

Although conservationists recorded high use of science for three conflict issues, reduced catch, reduced fish stocks in relation to lowered production and effects on fish population dynamics/community structure, they seldom recorded these issues as having a major effect. This is a distinctly different pattern to those of the three 'fishery' stakeholders described above who also used scientific literature to inform themselves on these issues and recorded them very frequently as major conflicts.

3.3.8 Gaps in knowledge

The 'major conflict/science' dataset shown in Figure 3.12 can also be used to identify conflict issues for which there were few, or no, records of the use of 'scientific literature' (Figure 3.13). This process can be used to give a broad picture of possible gaps in current scientific knowledge in relation to the four stakeholder groups.

There were nine major conflict issues for which there were few, or no, records of the use of scientific literature, six of these in the 'Fisheries' category, two relating to 'Fish Stocks' and one 'Environmental' conflict issue. Four of the issues were shared between two or more stakeholders whilst the remaining five were particular to one stakeholder group.

The issue of loss of earnings from the fishery was common to all three 'fishery' stakeholders but appeared to be poorly served by the scientific literature. Similarly, concerns over the issues of reduced value of catch and loss of aquaculture stock were shared between recreational and commercial stakeholders but with little associated scientific literature. The same was true for reduced fish catchability, reduced capital value of fisheries and of increased recurrent costs for recreational stakeholders and for the issues of loss of stocked fish and reduced stock through lowered production for commercial fishermen. Concerns over the disturbance effects of Cormorant scaring and shooting were shared by both commercial and nature conservation stakeholders but, again, there appeared to be little supporting scientific literature (see section 3.7.3).

Conflict issue	Recreational conflict	Recreational science	Commercial conflict	Commercial science	Aquaculture conflict	Aquaculture science	Nature conservation conflict	Nature conservation science
(1) FISHERIES								
Reduced catch	46	30	33	13	18	11	1	20
Loss of stocked fish	35	26	12	4	17	14	1	9
Reduced value of catch (damage)	23	7	11	3	7	3	0	4
Removal of fish from nets	2	0	6	4	0	2	0	3
Damage to fishing gear	0	0	6	1	0	3	0	3
Reduced catchability (stress/behaviour)	8	4	7	1	4	1	0	1
Loss of earnings from the fishery	17	0	22	2	17	8	0	4
Reduced capital values of fisheries	13	1	8	2	9	11	0	1
Reduced fishing tackle sales	1	0	4	1	0	0	0	0
Increased recurrent costs	18	0	5	3	5	1	0	1
Loss of employment	0	0	8	2	4	0	0	0
(2) FISH STOCKS								
Reduced stock - lowered production	48	37	19	5	14	13	2	24
Effects on popn. dynamics/community structure	46	32	17	15	7	10	2	16
Threats to endangered fishes	33	14	6	1	0	7	1	8
Vectors of diseases/parasites	2	4	1	6	3	10	0	4
Loss of juvenile fish - lowered recruitment	38	23	17	3	13	10	2	7
Loss of spawners	33	18	13	2	3	8	1	7
Loss of aquaculture stock	7	1	7	0	12	17	1	2
(3) OTHERS								
Eutrophication	0	0	1	1	2	7	1	7
Interactions with other birds	1	0	3	2	3	7	1	8
Scaring/shooting disturbance	2	0	5	1	5	7	13	6
Lead contamination (birds/environment)	0	0	0	1	0	7	0	3
Landscape alteration	1	0	2	0	1	7	0	3
Drowning in fishing gear	0	0	0	1	0	7	2	0
Damage to vegetation/landscape	0	0	7	0	2	7	3	3

Figure 3.12 The number of records for 'major' conflicts and for the use of 'scientific literature' for 25 Cormorant conflict issues in relation to four stakeholder groups. For each stakeholder group, issues with frequent records of both major conflicts and use of scientific literature are highlighted.

Conflict issue	Recreational conflict	Recreational science	Commercial conflict	Commercial science	Aquaculture conflict	Aquaculture science	Nature conservation conflict	Nature conservation science
(1) FISHERIES								
Reduced catch	46	30	33	13	18	11	1	20
Loss of stocked fish	35	26	12	4	17	14	1	9
Reduced value of catch (damage)	23	7	11	3	7	3	0	4
Removal of fish from nets	2	0	6	4	0	2	0	3
Damage to fishing gear	0	0	6	1	0	3	0	3
Reduced catchability (stress/behaviour)	8	4	7	1	4	1	0	1
Loss of earnings from the fishery	17	0	22	2	17	8	0	4
Reduced capital values of fisheries	13	1	8	2	9	11	0	1
Reduced fishing tackle sales	1	0	4	1	0	0	0	0
Increased recurrent costs	18	0	5	3	5	1	0	1
Loss of employment	0	0	8	2	4	0	0	0
(2) FISH STOCKS								
Reduced stock - lowered production	48	37	19	5	14	13	2	24
Effects on popn. dynamics/community structure	46	32	17	15	7	10	2	16
Threats to endangered fishes	33	14	6	1	0	7	1	8
Vectors of diseases/parasites	2	4	1	6	3	10	0	4
Loss of juvenile fish - lowered recruitment	38	23	17	3	13	10	2	7
Loss of spawners	33	18	13	2	3	8	1	7
Loss of aquaculture stock	7	1	7	0	12	17	1	2
(3) OTHERS								
Eutrophication	0	0	1	1	2	7	1	7
Interactions with other birds	1	0	3	2	3	7	1	8
Scaring/shooting disturbance	2	0	5	1	5	7	13	6
Lead contamination (birds/environment)	0	0	0	1	0	7	0	3
Landscape alteration	1	0	2	0	1	7	0	3
Drowning in fishing gear	0	0	0	1	0	7	2	0
Damage to vegetation/landscape	0	0	7	0	2	7	3	3

Figure 3.13 The number of records for 'major' conflicts and for the use of 'scientific literature' for 25 Cormorant conflict issues in relation to four stakeholder groups. For each stakeholder group, issues with frequent records of major conflicts and infrequent records for the use of scientific literature are highlighted.

Fifth, the conflict synthesis spreadsheet (Figure 3.1) was subsequently considered by REDCAFE participants to be a rather simplistic device for obtaining information from stakeholders. Nevertheless, this was the first attempt to allow stakeholders to articulate their knowledge and understanding on Cormorant conflict issues across so much of Europe. However, the extent to which fishermen's knowledge can be articulated has implications for how other stakeholders understand these issues (an important aspect of co-management, see 3.7). This is particularly true in relation to organising this knowledge into a format that can be used for management purposes and to make sure that fishermen retain equitable control over the knowledge base (Wilson 2000). Wilson differentiates between 'discursive' knowledge (i.e. that which is shared and expressed) and 'tacit' knowledge (i.e. that which is not easily expressed) and asks: "To what degree is the knowledge that various stakeholder groups have about the resource tacit or discursive knowledge?". Discussions are complicated further when we consider the important role that tacit knowledge plays in fishing. Wilson (citing Pálsson, 1995; 2000) argues that fishermen's knowledge is inextricably linked to the skills they have in fishing and their immersion in the everyday fishing world. Thus, fishermen may find it hard to explain what they know, and why they know it, because the knowledge associated with their skills is often innate and thus not easily expressed. Thus, while information provided by stakeholders for this synthesis was based largely on discursive knowledge, time and logistical constraints meant it was probably not possible to record much, if any, tacit knowledge. However, knowledge of this type was experienced and recorded during more lengthy discussions with stakeholders in relation to the specific case study of recreational angling described in Chapter 6.

Sixth, quantifying Cormorant conflicts in this synthesis was relatively crude, involving a small number of broad 'magnitude' codes (Figure 3.1). In many ways this was an inevitable consequence of the project's relatively short time scale, the language and communication difficulties described above, and the simple, standardised method for REDCAFE's necessarily broad-brush approach. However, the broad magnitude codes were, to some extent at least, open to interpretation and none of the records provided could be checked.

Seventh, the status coding for literature references (Figure 3.1) was similarly not always easily interpreted by stakeholders. For example, Stakeholders experienced some difficulties in categorising particular sources of information as 'scientific literature', a term open to interpretation. Although in many countries a scientific publication is synonymous with one that has been externally refereed, this was not always the case for every country. Obviously, although such national differences in interpretation are interesting and should be borne in mind, no attempt was made to alter in any way the records provided by stakeholders for this, or any other aspect, of the conflict synthesis spreadsheet.

One further issue requires discussion. At this stage it would be tempting for REDCAFE participants (i.e. stakeholders with training, or familiarity with western science) to say things like "there was no guarantee that other stakeholders were providing accurate information or even being truthful and none of the information provided for this synthesis was tested by independent means." However, we have to be careful: accuracy and truth are subjective terms and are also open to interpretation. In social terms, testing whether somebody is telling the truth (based on your own values and beliefs) is in danger of being ethnocentric and not necessarily useful. It was very clear that stakeholders were willing to spend time contributing to this synthesis and that they appeared genuinely interested in the process and in REDCAFE in general. Thus the information included in this synthesis was considered to give a good impression of stakeholders' perceptions of Cormorant conflicts on a pan-European scale. Furthermore, the present synthesis was more comprehensive than any previous one.

3.5 General synthesis of Cormorant conflicts

3.5.1 Overview

This synthesis was based on information provided for 235 conflict cases across 24 European countries. It was an attempt to report the concerns of numerous stakeholders and allowed REDCAFE to consider Cormorant conflicts (see footnote #2) in terms of human interests:

"A list of cormorant-fisheries conflict situations will, of course, reflect the perceived problems of the person making the list. Thereby I hope to state that any list may to some extent be subjective. I think of cormorant-fisheries matters as a conflict between human interest groups. The birds and the fish they hunt are the subjects of the conflict, not a part of it. I would list the conflict situations based on the human stakeholders. Realising that the conflict is a matter of human interests may turn out to be the most productive way when attempting to come up with solutions."
(Christian Dieperink, Danish REDCAFE participant)

Cormorant conflicts were reported from a wide variety of habitats and fishery types (Table 3.1). About 30% of case studies included in this synthesis related to rivers, around 20% each to lakes, freshwater aquaculture ponds and coasts and around 10% to coastal aquaculture sites. Although it was not possible to determine whether this spatial distribution reflected the true 'availability' of these habitat types across Europe, it demonstrated the widespread geographical distribution of conflicts. Furthermore, conflicts were reported by four different stakeholder groups representing recreational, commercial and nature conservation interests and covered a wide variety of fishery types, suggesting that the nature of conflicts will also differ on a geographic scale.

Although Cormorant conflicts were reported from all 24 countries surveyed, they appeared to be most prevalent in 13 'main' countries (Table 3.2). Again this picture could have been influenced by the intensity of reporting in different countries and this was not investigated (though see 3.4 for France). Nevertheless, it was clear that stakeholders from Sweden and Finland in the north, to Spain, Portugal and Italy in the south, and from the United Kingdom in the west, to Poland and Lithuania in the east, reported numerous conflicts with Cormorants.

3.5.2 Waterbodies

Cormorant conflicts were reported mostly from lower altitudes (< 500m, Table 3.3). Most, if not all, Cormorant colonies are at altitudes of < 500m and all the major ones are very close to sea level. It is thus perhaps not surprising that summer conflicts were reported at these lower altitudes. Conflicts also occurred during the winter months (i.e. October-March, see below), and at this time birds often forage on freshwaters that do not normally freeze (Marion *et al*., in Hagemeijer & Blair 1997a). Thus, although foraging-site choice will depend ultimately on prey abundance and availability, the relationship with altitude was presumably due, in part at least, to minimum winter temperatures and the risk of ice conditions on foraging grounds (e.g. Van Eerden & Munsterman 1995) particularly those at higher altitudes.

Within river systems, Cormorant conflicts on a pan-European scale, showed similar distribution patterns to those documented for birds on individual river systems (e.g. France: Marion 1995; Scotland: Richner 1995; England: Davies & Feltham 1997). Cormorant conflicts were very much restricted to the lower and middle reaches, and hence relatively wide (i.e. 10-50m) stretches, of rivers (Table 3.3). Similar, restricted distribution patterns were clear for conflict cases on the coast. The ten countries reporting conflicts with Cormorants in coastal habitats (Figure 3.5c) were all those that had access to shallow (< 50m deep) inshore coastal water (see Figure 1B in van Eerden *et al*., 1995).

Overall, most conflict cases were reported on nutrient-rich (i.e. eutrophic) waters, particularly freshwater aquaculture ponds, lakes and coasts (Table 3.3). Across European waters, there was a general increase in nutrient levels (phosphates and nitrates) during the last century (de Nie 1995). It was not possible to determine whether the spatial distribution of the conflicts reported here reflected the true 'availability' of these eutrophic waters across Europe. However, the information supported the idea that Cormorant distribution is, in part at least, determined by the nutrient status of these waters. For example Cormorant density on Swedish lakes is closely correlated to the total phosphorous levels there (Engström 2001) and similar patterns are evident for Swiss lakes (Suter 1995). In Sweden, lake productivity (as measured by total phosphorous) were also be considered a surrogate measurement for fishery yield (Engström 2001), supporting the idea of a relationship between nutrient status and fish populations. On a wider scale, there is a general pattern amongst fish populations to increasing eutrophication (de Nie 1995). This trend is towards unstable fish populations dominated by small, shoaling, short-lived, early-maturing fish species such as Perch (see Table 3.5 for scientific names), Ruffe, Smelt *Osmerus eperlanus* and/or cyprinids, mainly Roach and Bream (de Nie 1995). Such species are commonly recorded in the diet of Cormorants across Europe (see below) and, at the landscape scale, this is associated with a preference for eutrophic lakes that support high densities of such fish species (Suter 1997). In France, larger concentrations of Cormorants occur on artificial and eutrophic lakes established on rivers for electricity production and water resource management (Marion 1994). Even at the pan-European scale, information provided by stakeholders suggested that Cormorant conflicts are often associated with eutrophic waters, particularly lakes, freshwater aquaculture ponds and on coasts.

3.5.3 Cormorant distribution, seasonality and abundance

Two species of cormorant were recorded in conflicts (Figure 3.6), the Great Cormorant (*Phalacrocorax carbo* – both the Atlantic *P.c. carbo* and continental *P. c. sinensis* races) and the Pygmy Cormorant (*P. Pygmeus*). The geographical distributions of both species, as recorded in conflicts, followed closely their known breeding and/or wintering distributions. It was clear from the information provided that stakeholders were aware of the presence of both races of Great Cormorant in many countries, providing more detailed records than are available in many published accounts (cf. Marion *et al*. in Hagemeijer & Blair 1997a). Indeed, both *carbo* and *sinensis* races were recorded in conflicts in England, Wales, France, Spain and Portugal and *sinensis* plus occasional *carbo* were recorded in Sweden and Denmark. Similarly, Pygmy Cormorants were recorded mainly in Bulgaria and Greece but also in Israel (though in association with *sinensis* birds), countries within their known distribution (Michev & Weber in Hagemeijer & Blair 1997b).

With a population of around 13,000 pairs, Pygmy Cormorant is classified as Vulnerable in Europe (Species of European Concern category 2), as its global population is concentrated in Europe and this is in decline (Tucker & Heath 1994). Drainage and hydrological disruption of large wetlands, disturbance and shooting are considered the main threats, and it is the subject of a European Species Action Plan, adopted by the European Union and the Council of Europe (http://europa.eu.int/comm/environment/nature/directive/birdactionplan/phalacrocoraxpygmeus.htm). This promotes protection from hunting and positive management of wetlands as critical to the species' recovery. The conservation status of the Great Cormorant is considered to be Secure (Tucker & Heath 1994), now that populations have recovered sufficiently from earlier declines. This recovery resulted in the removal of the *sinensis* race from Annex I of the EU Birds Directive (79/409) during the early 1990s.

The Pygmy Cormorant is listed on Annex I of the EU Birds Directive, requiring Member States to protect wetlands and ensure the survival and reproduction of the species, particularly (though not exclusively) through the designation of Special Protection Areas. Member States are also required to take similar measures for Great Cormorants (as one of an assemblage of migratory species) across its breeding, wintering and moulting areas and migration stopover points.

In assessing conflicts with fisheries, the synthesis has not differentiated those involving Great Cormorants from those involving Pygmy Cormorants. Clearly, given the different population trends and conservation priority afforded to each species, management approaches will differ, with the range of options for conflicts with Pygmy Cormorants likely to be less than for Great Cormorant. Shooting Pygmy Cormorants is illegal in all range states.

Information on the seasonality of Cormorant conflicts was also available (Figures 3.8 and 3.9). Again, these patterns fitted closely with the known seasonal movements of birds across Europe that are roughly along a north-south axis (Reymond & Zuchuat 1995). Most continental *sinensis* Cormorant populations, breeding in northwest Europe and the southern Baltic, are completely migratory. Wintering quarters occur all over the Mediterranean basin, along the Atlantic shore and also inland. Lower numbers also winter along the southern North Sea close to breeding grounds. Birds from the Netherlands mainly winter in France and the western Mediterranean while many Danish birds winter from the Swiss lakes south through Italy and beyond (van Eerden *et al*., 1995). Traditionally, Atlantic *carbo* Cormorants are less migratory but birds may travel as far south as the French Atlantic coast or the west coast of the Iberian Peninsula (van Eerden *et al*., 1995). As a consequence, the broad pan-European picture of Cormorant conflicts has three elements. First, winter (October-March) conflicts in those countries where birds overwinter, either towards the north west or south east. Second, summer (April-September) conflicts, presumably involving breeding birds, in the Netherlands and almost all countries bounding the Baltic. Third, conflicts throughout the year in the 'centre' of Europe (Denmark, Germany and the Czech Republic), presumably involving both breeding birds and others overwintering there from the north. In Germany, most conflicts in summer were reported in the northern regions where the main breeding colonies are located (i.e Baltic Sea coast), while most winter conflicts were reported from the central or southern (i.e. inland) regions.

At a local scale, Cormorant abundance increases with water surface area as shown for birds using Czech Carp ponds over 10ha in area (Musil & Janda 1997). Conflict case records showed a similar pattern on a pan-European scale for stillwater lakes, freshwater aquaculture ponds and coasts (Figure 3.7). Indeed, water surface area explained 56% of the variation in maximum Cormorant numbers across these habitats. It was clear from the information provided, that there was no relationship between water surface area and Cormorant numbers on rivers. Although there may be a biological explanation for this finding, it may also be due to differences experienced in estimating water surface area. Estimating area for standing waters and coasts is relatively straightforward, however stakeholders estimated the area of rivers in different ways: some were calculated for study sections (i.e. length x average width = water surface area), others were measurements of total catchment area. Nevertheless, even when these catchment areas were excluded from analysis, the relationship between Cormorant numbers and surface area of rivers appeared to be different to that for other habitats. Clearly, such apparent differences require further investigation, particularly as information collected to date suggests that average Cormorant density on rivers is significantly higher than that in other habitats (Table 3.4). Furthermore, particularly in small streams, Cormorants are sometimes considered to exert disproportionately high predation pressure on populations of threatened fish species (e.g. Grayling, Nase, Marbled Trout, see Table 3.5 for scientific names). For example, some Slovenian angling clubs are considering giving back to the Government their management rights for rivers under high predation pressure from fish-eating birds. This is because they have become frustrated by regularly stocking streams with costly juvenile indigenous fishes (which is mandatory) just to apparently feed Cormorants and Grey Herons (*Ardea cinerea*).

3.5.4 Fish species involved in conflicts

There have been a large number of Cormorant dietary studies across Europe. For example Marquiss *et al*. (1998) summarised the results of 37 European studies conducted in a variety of freshwater and marine habitats. Although these studies recorded at least 77 species of fish as Cormorant prey, only about a third of these species were reported regularly. However, within habitats, different studies have shown similar prey spectra despite different diet assessment methods (see Carss *et al*. 1997 for methodological review). In the sea, Cormorants mainly feed on bottom-dwelling fishes, wrasses (Labridae) and cods (Gadidae) over rocky and weed-covered substrates and flatfish (e.g. Pleuronectidae) over soft substrates, and Eel (see Table 3.5 for scientific names) and Eelpout in a variety of areas. Sometimes small, shoaling, midwater fishes such as herrings (Clupeidae) are taken. In estuaries, Flounder, Brown Trout, Eel and Saithe are most frequent prey and Sand-smelt, Mullets (Mugilidae) and Sea Bass are important in southern Europe. On rivers, diet varies according to stream characteristics. Salmonids are the main prey in fast-flowing streams, cyprinids in slower, deeper ones and flatfish in the lowest reaches. On lakes by far the commonest recorded prey are Roach, Perch and Eel. Other cyprinid prey in nutrient-rich lakes include Bream, Rudd and Tench, other percids, notably Ruffe and Pikeperch. Finally, Cormorants frequently use waters stocked artificially for recreational angling (Brown and Rainbow Trout) as well as Carp aquaculture ponds.

These dietary patterns were also evident in the information provided by stakeholders in the present synthesis (Table 3.6). A wide variety of species were recorded in relation to coastal conflicts, these included many of the fishes mentioned above but also a high proportion of salmonids, perch and pike. Although not considered truly marine species, these fishes also occur in brackish waters such as the Baltic Sea and many of the coastal conflicts recorded in this synthesis were from the surrounding countries, Finland and Sweden but also Estonia and Poland (Figure 3.5c). As expected from the dietary summary of Marquiss *et al*. (1998), cyprinids and salmonids were the main groups of fish recorded by stakeholders in relation to Cormorant conflicts on rivers. Similarly cyprinids, especially Carp, plus some salmonids, Perch and Pike were involved in conflicts at freshwater aquaculture ponds. Many conflicts were reported at Carp ponds throughout Europe and these sites are considered highly attractive to Cormorants in places such as the Czech Republic (Musil *et al*. 1995), Bavaria, southern Germany (Keller *et al*. 1997), and France (Marion 1997). Indeed such farms are thought to have played an extremely important role in the increase of Cormorant numbers across much of Europe, particularly in the east (e.g. Belarus: Samusenko & Kozulin 1997 Bologna p75). A small group of fishes including mullets, sea basses and sea breams were involved in conflicts at coastal, often extensive lagoon, aquaculture sites of southern Europe (Figure 3.5e).

These striking similarities between previous dietary studies and records of fish species involved in conflicts as documented by stakeholders in the present synthesis, are perhaps not surprising. This is because many, probably the vast majority, of Cormorant dietary studies have been instigated as a response to concerns over the birds' potential damaging effects at fisheries (Marquiss *et al*. 1998). Nevertheless, there were strong associations between particular fish groups recorded in conflict cases and particular habitat and fishery types. Many of the fish species involved in conflicts have high commercial value, particularly those farmed at aquaculture sites or those targeted of coastal fishery exploitation. However, the list of recreational angling quarry species was lengthy (Table 3.5) and it is more difficult to put monetary value on them. Nevertheless, angling quarry species do have commercial value, albeit not in the same sense as do those harvested by aquaculturists and commercial fishermen (see 3.5.5).

3.5.5 Financial information

REDCAFE participants experienced several problems in relation to the disclosure by stakeholders of economic information in relation to conflicts. These are discussed in detail in section 6.5.4 (Box 6.7). Nevertheless, financial information was provided by fishery-related stakeholders for 105 conflict cases, approximately 45% of those recorded in the present synthesis. It is interesting, but perhaps not surprising, that nature conservation stakeholders did not provide any financial information in relation to any of the conflict cases they recorded.

Fishery stakeholders provided information on the annual financial turnover in their fishery system and the turnover loss due to Cormorants (Table 3.7). In around 30% of cases, stakeholders categorised their turnover values as 'actual' (e.g. based on licence payments, fish prices or catch statistics), in contrast only 7% of their loss values were recorded as 'actual'. This disparity presumably highlights the difficulties in quantifying financial losses to Cormorants. Most values for loss (either provided by stakeholders or by REDCAFE participants) were thus estimates, of unknown accuracy, sometimes based on crude calculations of Cormorant numbers, diet, daily food intake and residence time at the fishery. As a consequence, care must be taken when interpreting the financial information collected in this synthesis.

Nevertheless, the 105 conflict cases gave a cumulative total for annual turnover of about 154 million euro and associated losses to Cormorants were given at about 17 million euro, an overall loss of 11%. However, there were significant differences in the scale of financial losses reported by the relevant stakeholders for different habitats and fishery types: recreational anglers predominantly on rivers, freshwater pond aquaculturists and commercial fishermen on lakes and coasts (Table 3.8). Truly commercial (i.e. 'income-producing') stakeholders (aquaculturists and both types of commercial fishermen) might be expected to provide the most accurate financial values because of the commercial nature of their businesses. However, perhaps against expectations, all three groups independently were remarkably consistent in their views on relatively low financial losses due to Cormorants, recording average values of 9-12% of annual turnover. This is not to say that all financial losses recorded by these stakeholder groups were small: around 2% of aquaculturist, 13% of commercial freshwater fishermen and 31% of commercial coastal fishermen recorded losses greater then 50% of the annual financial turnover in their fishery.

In contrast to commercial stakeholders, recreational anglers recorded considerably higher financial losses due to Cormorants (Table 3.8), averaging 57% of annual turnover. Furthermore, in 43% of cases, anglers recorded financial losses greater then 50% of the annual turnover in their fishery. Although the disparity between commercial and recreational stakeholders' perceptions of financial losses due to Cormorants was clear from the information provided, the explanation for it was not. We do not know how recreational anglers calculated/estimated their financial losses to Cormorants and thus can not draw too much by way of conclusion from this. It could be that because anglers pay to catch fish from their own disposable income, as opposed to commercial fishermen to whom such costs would be a financial investment in an income-producing venture, they may value the cost of their quarry more highly. For example, the cost of angling includes the purchase of equipment, supplies, meals, lodgings, transport and the right to fish in certain locations as well as expenditures in time (Conover 2002). Alternatively, the disparity may have less to do with variations in the value of fish and could be a true reflection of higher levels of Cormorant predation at the fisheries (predominantly rivers) exploited by recreational anglers providing information for this synthesis. A third alternative is that anglers were doing crude calculations of financial losses based on the number of Cormorants, their Daily Food Intake and the cost of restocking (or some other factor).

From the information recorded in this synthesis, it is clear that the highest perceived financial losses due to Cormorants are related to recreational activities rather than to commercial ones. This may have important implications in terms of quantifying rigorously the losses due to Cormorants and any possible conflict- and/or fisheries-management actions taken. However, it is important to recognise that although financial losses to commercial stakeholders appear considerably smaller than those for recreational ones, this does not mean that their conflicts with Cormorants are any less 'important'. Commercial stakeholders are trying to produce income and long-term financial security from their fisheries, these are often traditional and have high local and national cultural value, and recorded financial losses in some cases represent a high proportion of the annual turnover of the fishery. Whatever the reasons for the higher recorded financial losses at recreational fisheries, the apparent disparity with commercial ones certainly deserves further study. Finally, in relation to economic losses due to Cormorants, any estimates made may be influenced by perceptions of the problem. Conover (2002) believes that such 'wildlife damage' can alter people's perceptions about wildlife, particularly when the damage has exceeded stakeholders' tolerance. However, he questions the accuracy of many local perceptions about wildlife damage, particularly as the "consciousness" of a species can influence these perceptions: highly visible species often taking most of the blame for damage. This fact is particularly true for Cormorants (e.g Bezzel 1997).

3.5.6 Cormorant conflicts: issues and their magnitude

Stakeholders provided information on specific conflict issues in relation to each case study reported. Data sheets listed 25 potential conflict issues based on initial discussions between REDCAFE participants. Although stakeholders were free to add new conflict issues to this list, none did. Thus, the conflicts included in this synthesis apparently covered all the issues concerning stakeholders taking part. Conflict issues fell into three broad categories, being related to 'fisheries' or fish stocks' or more general 'environmental' issues (Figure 3.1). Independently, both commercial and aquaculture stakeholders categorised the conflict issues important to them in a very similar manner (Table 3.9): the majority was related to fisheries, about 36% to fish stocks and less than 10% to environmental issues. Recreational stakeholders categorised conflict issues differently, though not significantly so: the majority was related to fish stocks, over 40% to fisheries but only 1% to environmental issues. However, nature conservationist stakeholders categoried conflict issues very differently to the three other, fishery-related, stakeholder groups: the majority of recorded conflicts were related to environmental issues, around 30% to fish stocks and around 6% to fisheries issues.

In relation to specific conflict issues, nine were most commonly cited as being major conflicts for stakeholders (Figure 3.10). For both aquaculturists and commercial fishermen the issue of **reduced catches** was most important whilst for both recreational anglers and nature conservationists the most important issue was **reduced fish stock through lowered production**. Recreational stakeholders also most frequently reported conflicts over reduced catches and **effects on fish population dynamics and community structure**, an issue that was also important to nature conservationists. Both aquaculturists and commercial fishermen were concerned over **loss of earnings from the fishery**, the former stakeholders cited conflicts over **loss of stocked fish** and the latter ones cited conflicts over reduced stock through lowered production. Finally, nature conservationists also frequently recorded concerns over **loss of juvenile fish and lowered recruitment**, **scaring/shooting disturbance**, **drowning of Cormorants in fishing gear** and **damage to vegetation and landscape**. Thus, although stakeholder groups frequently shared concerns over specific major conflict issues, some concerns were specific to particular groups. Most importantly, nature conservationists cited broader 'environmental' issues more frequently than did the three fishery-related stakeholder groups.

All three fishery-related stakeholder groups recorded most of the remaining 25 conflict issues as being 'major' ones for some cases (Figure 3.10), although not as frequently as those issues discussed above. In contrast, nature conservation stakeholders seldom recorded fisheries issues as being major conflict issues, the exceptions being reduced catches and loss of stocked fish.

Overall, this synthesis has shown considerable, and consistent, similarities between the opinions of both income-producing stakeholder groups involved in fisheries: commercial fishermen and aquaculturists. Although recreational anglers shared many of the concerns of these other fishery-related stakeholder groups, they also recorded some different major conflict issues. However, the biggest differences were between fishery-related stakeholders and nature conservationists. Nature conservationists, in general, were most concerned with wider conflict issues. They recorded concerns over fish stocks at the 'ecosystem level' (e.g. those relating to reduced stocks, productivity and recruitment, and to population dynamics and community structure) and broader 'environmental' issues such as disturbance, damage to vegetation and landscape, and the drowning of Cormorants in fishing gear.

3.5.7 Cormorant conflicts: information sources used by stakeholders

Stakeholders provided over 3, 500 records of the type of information they used to inform themselves about Cormorant conflict issues (Table 3.10). Although most records were categorised as 'popular', this category included a whole range of diverse sources (Table 3.10). From a purely scientific perspective, 'popular' is sometimes viewed as a derogatory term by scientists to whom the most 'useful' knowledge is that published in the peer-reviewed scientific literature. Overall, only 15% of information sources used by stakeholders were assigned to the scientific literature. For all stakeholder groups, scientific literature was the least frequently recorded information source[6]. However, analysis showed that a further 16% of the 'popular' literature references was obviously science-based (Table 3.11). Nevertheless, the importance of 'popular' sources of information to all four stakeholder groups contributing to this synthesis was clear (Table 3.10). All groups consistently used this source more frequently than they did any other.

For natural scientists, many of whom have been required to deliver solutions for environmental problems such as those involving Cormorant and fisheries, the findings of the

[6] Though see nature conservationists' sources of information in Table 3.9

present synthesis represent a challenge. Perhaps most important is the challenge to their traditional hierarchy of 'useful' knowledge (i.e. scientific literature > grey literature/reports > popular articles). It was clear that this hierarchy is inappropriate to Cormorant-conflict issues, at least, because scientific literature was the least frequently cited source of information for all stakeholder groups. However, it is interesting to note that most, if not all, Cormorant-related management and conservation policies are 'science-based' and so science will continue to be an essential element of future efforts to resolve and manage Cormorant-fisheries conflicts.

Nevertheless, for several specific conflict issues, different stakeholder groups claimed to be informed by scientific literature yet considered the magnitude of such conflicts to be very different. It would be interesting to compare the science used by recreational and nature conservation stakeholder groups and who come to such different views on the magnitude of conflicts (Figure 3.11). Do these groups interpret the same science differently based on their own knowledge and experience or do they have access to different pieces of scientific information? It is clear that there is a need for better dissemination of scientific information and for better understanding of the limitations of science.

3.5.8 Concluding remarks

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 (see 3.2, 3.4), many clear pictures emerged and these have been discussed above. Many of the patterns emerging from this synthesis are intimately linked to the ecology of Cormorants and these important links are examined in Chapter 4 of this report. 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. Through these discussions it was clear that conflicts with Cormorants are not the only ones facing many fisheries and environmental stakeholders. The following section (3.6) therefore provides wider context to the Cormorant –fisheries conflicts discussed above.

3.6 Cormorant-fisheries conflicts in a wider context

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 (Daniels & Walker 2001). 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[7] 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.

Until recently, academic contributions to fisheries management have usually been dominated by those from biologists and economists whose understanding are influenced by their own discipline (Couper & Smith 1997). However, policy makers are now also paying

[7] There is often no common understanding among stakeholders of what is meant by 'sustainable'. Some stakeholders use 'sustainable' purely as an economic term, some as a term to describe the process by which resources are not over-harvested, others use it in relation to 'sustainable development'.

attention to the human element in fisheries management by including an appreciation of fishermen's perceptions (see 3.7) and territorial rights. Often, these are long-held: "Many fishermen have deeply embedded beliefs in a right to fish, a strong sense of territory, and a view which, in Europe for example, goes back to the seventeenth century when the common property nature of fish stocks was enshrined in the early stages of development of the modern law of the sea. At that time stocks were plentiful and belonged to no one until caught" (Couper & Smith 1997).

One overlying issue affecting all fisheries stakeholders, and others, is the long-held concern over increasing pressure on limited aquatic resources. Symes (1996) notes that overfishing has been acknowledged by fishermen, administrators and scientists for over a hundred years and that by the mid-1990s the Food and Agriculture Organisation had estimated that some 70% of the world's fish stocks were overfished. Fishing takes places in uncertain and diverse environments, including both the biological and the social setting in which these activities are undertaken (Acheson 1981). This not only relates to commercial fisheries but also to aquaculture, another income producing fisheries activity, (see Noakes *et al*. 2003) and to recreational angling (where social settings seem particularly important, see Chapter 6). Thus, attempts to create sustainable fisheries must extend to all aspects of the fishery system, from the fish stocks and ecological considerations to the social, cultural and economic structure of fishing groups and management institutions (Symes 1996; Charles 2001). Current Cormorant-fishery conflicts must therefore be viewed as but one of many diverse issues within the complex context of sustainable fisheries.

In order to incorporate these diverse issues, future fisheries policies will probably be set within the wider context of environmental management (Symes 2001). However, fisheries management must also take into account the "uncertainty factor" resulting from the behaviour of fishermen (individually and collectively through organisations) which is increasingly influenced by socio-economic and political marginalisation and increasingly insecure livelihoods (Symes 2001)[8].

Finland provides an example of the inherent conflicts between policy makers and local people over access rights and decision-making within fisheries (Box 3.1). In some cases, fisheries are also affected by decisions taken by others over which they have no control. One such case identified frequently to REDCAFE participants involved changes to market economies. The fishery sectors of many post-communist countries have encountered serious problems, particularly in relation to privatisation and changes in policy (Vetemaa *et al*. 2000) as the example from Estonia shows (Box 3.2).

Other post-socialist countries have also experienced similar tensions in relation to fishing. Bell *et al*. (2001) note that privatisation of the marketing system in Romania and Lithuania has led to the expansion of black market trading and to overfishing of certain species. There are also considerable conflicts between fishermen and Cormorants in these countries and in others covered by REDCAFE, including Poland and the Czech Republic. Stakeholders' perceptions of Cormorant conflicts in these post-socialist countries thus often appear to be linked to the consequences of major international changes in market economies operating on their fisheries.

Dialogue between REDCAFE participants and stakeholders over Cormorant conflict issues highlighted a range of other environmental and social concerns. These concerns will

[8] In this context, the fisheries co-management concept is discussed further in section 3.7.

have to be acknowledged and incorporated into future attempts to best manage Cormorant-fisheries conflicts. The present synthesis should thus be seen as only the first stage of a process of dialogue, participation and collaboration between natural scientists and local stakeholders. For this process to continue successfully, natural scientists need to better understand the views of stakeholders and devise new ways of working with them. These issues are discussed below in section 3.7.2.

In Finland, fisheries management operates in a hierarchical way on multiple levels, where responsibility is shared between the Government Fishing Authorities (nationally), Fisheries Regions (regionally) and Statutory Fisheries Associations at the local level (Salmi *et al*. 2000). Like land ownership, most inland and coastal water areas are privately owned, typically by a collective (a shareholders' association) represented by the Statutory Fishing Association that embodies the interests of individual shareholders (Vihervuvori 1992 in Salmi & Muje 2001). At the national level, the Ministry of Agriculture and Forestry is responsible for ensuring the sustainable use of water areas for commercial and recreational fishing while the provincial Fishing Authorities implement policy at the regional level (Salmi *et al.*, 2000). Fisheries Regions, although not an official branch of Government, act as a forum to encourage co-operative decision-making amongst the various stakeholders.

Local fishermen have an important role to play in the whole organisational system in Finland, particularly as they manage the Fishery Associations (Salmi & Muje 2001). However the potential for conflict exists amongst the stakeholders, particularly between local fishermen and conservationists and scientists. Salmi *et al.* (2000) describe current conflicts involving a fish-eating predator the Saimaa Ringed Seal (*Phoca hispanida saimensis*) but the potential exists for similar conflicts to occur over Cormorants, particularly as their numbers are increasing (Rusanen *et al.* 2003). Current concerns over the conservation of seals have created tensions because local fishermen, the water owners, who feel resentment against 'outsiders' (i.e. in-coming residents, conservationists, scientists). Locals feel that these groups are unable to understand their views because they do not live or work in the area. Importantly, fishermen often consider that these other stakeholder groups do not have the right to interfere. As Salmi *et al*. (2000) point out: "Although most of the commercial fishermen consider that there are no severe problems in the coexistence of the seals and the fishery, research activities and knowledge about conservation are not always appreciated. For instance, some of the fishermen stress that the number of seals is not as low as that stated by the researchers or that the research activities cause more harm to the seal population than the fishery itself…Finnish lake fisheries include strong tensions concerning, especially, the owners' power to decide about fishing and the local way of life in general, which reflect problems of cultural identification". More emphasis on co-management and encouraging dialogue would thus work towards managing fisheries conflicts (Salmi & Muje 2001), including access rights, especially if user groups and other stakeholders such as nature conservationists are given similar and sufficient representation in the decision-making process.

Box 3.1 Finnish case study: access rights and decision-making within fisheries.

In Estonia, there have been considerable changes in the fishing industry since the 1990s (Eschbaum *et al*. 2003). These changes began in the late 1980s with the transition to a market economy following the breakdown of the Soviet economic system and the declaration of independence in 1991 (Vetemaa *et al*. 2000). Following independence, people employed in agriculture and other rural sectors encountered considerable difficulties, as traditional markets (particularly in the former USSR) were lost. In addition, subsidies at the heart of the centrally planned economy, were discontinued leaving the agricultural industry and other linked enterprises unprofitable and often unable to continue. However, at the same time, the fishery sector provided a new area of employment and income generation, particularly as trade liberalisation allowed coastal fisheries to expand their markets (Vetemaa *et al*. 2000).

Vetemaa *et al*. (2000) detail how, during the Soviet period, all water bodies were state owned and commercial fishing was carried out by collectives with produce oriented towards the markets of socialist countries. A number of changes occurred following independence. First, there was a high demand for fish and a rapid increase in exports so that ‘first buyer’ prices for fish rose dramatically. Second, most fishermen formally connected to collectives were given the chance to privatise fishing boats and gear at low cost. In addition, the oppressive border regime was abandoned allowing fishermen free access to the sea.

The increase in fishermen and fishing activity along Estonia’s coast resulted in unsustainable pressure on fish stocks. This pressure has been difficult to control because fishing is now such an important livelihood strategy (Vetemaa *et al*. 2000). Nevertheless, while revenue in the fishing industry was high during the early 1990s, profitability has declined in recent years, exacerbated by increasing costs and declining stocks. Within the troubled fishing industry, the debate over Cormorant predation has highlighted potential conflict, particularly in certain regions such as Väinameri where many commercial fishermen believe that Cormorants are to blame for declining catches (Eschbaum *et al*., 2003).

Box 3.2 Estonian case study: changes to market economies.

3.7 The way forward

3.7.1 From people:wildlife conflict to people:people conflicts

One of the main findings of the present synthesis was the disparity in opinion between nature conservationist stakeholders and those stakeholder groups involved with fishing. Fishing is always potentially in conflict with conservation. Bell *et al*. (2001) believe that inevitable tensions arise from the juxtaposition of the aims of fishing with those of conservation: “In ecological terms humans who fish are predators, albeit ones who respond to and reflect upon their role as predators (whilst) conservation is a set of ideas and measures intended to ensure the maintenance, and possible enhancement, of populations of fauna and flora within their natural habitats”. In the Romanian Danube Delta, for example, Bell *et al*. (2001) highlighted how local villagers feel that their needs as local fishermen have taken second place to conservation efforts to preserve wildlife. Part of the problem, they say, is one of values, especially those placed on fish-eating species such as Cormorants. Indeed, Cormorants are commonly held in contempt by fishermen across Europe but are valued by ecologists (Bell *et al*. 2001) as top predators in many aquatic systems.

Goodwin (1998) examined disputes between local people and conservation stakeholders (often with some scientific training). He highlighted how conservation agencies have responded to calls for more equitable involvement in environmental decision-making by promoting local participation[9]. Goodwin (1998) argued that participation can be seen as a desirable process if it shifts the decision-making towards those people who have to live with the consequences of these decisions. By forging links with local people, it is hoped that conservation is made more relevant to local interests and will foster better understanding of environmental issues. Moreover, participation encourages greater dialogue between local people and others involved in environmental management and conservation. Cormorant-fishery conflicts, and others discussed above, are emerging as real conflicts surrounding natural resources management at the pan-European level.

3.7.2 Fisheries co-management

While REDCAFE focused on Cormorant-fishery conflicts, other tensions were recognised by the project as influencing them, and many of these have also been highlighted elsewhere. For example, Pinkerton (1989) discussed several major fisheries conflict issues that also emerged through REDCAFE's dialogue with stakeholders. First, there is often a lack of faith in the ability of governments to solve management problems. Second, fishermen want a voice in the decision-making process to ensure more appropriate and equitable management[10]. Third, there is an evident lack of trust: fishermen feel that governments (or the scientists they commission) have inadequate data and accuse them of interfering while governments can see fishermen as "unrelenting predators". The problem is complicated further when local people feel they cannot trust the reliability of scientific data but nevertheless feel they need to use it in order to be recognised as legitimate stakeholders when dealing with governments and policy-makers. Fourth, there may be conflicts over distribution. For example Pinkerton (1989) notes that fisheries organisations are often factionalised and that "there may be more grounds for conflict than for co-operation among fishermen or fishing groups" Thus, governments and policy-makers may follow the path of least resistance and allocate resources disproportionately to the most powerful lobby group. As well as being an uncertain enterprise, fishing, particularly as a commercial business, is also a competitive one which is aggravated further by the free access nature of many fisheries (Acheson 1981). Thus, many fisheries conflicts are also inherently mixed-motive situations where there is often both motivation to compete and some incentive to co-operate (Daniels & Walker 2001).

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 (Symes 1996). Rettig *et al*. (1989) suggest that participatory co-management in fisheries, where fishermen and managers co-operate in drafting policy, may facilitate successful management while also offering the possibility of reducing public costs. They suggest that developing fishery regulations, collecting and analysing biological information, the planning process and administration and enforcement are all costly, especially if fishermen suspect that administrators do not understand or take heed of their views. One particular benefit of co-management relates specifically to the formation of relationships (see Pinkerton 1989). She

[9] Details of REDCAFE's conflict case study workshop involving local participation towards the development of Fisheries Action Plans are given in Chapter 6.

[10] For example there are often problems associated with the government allocation of individual fishing quotas. The government perceives these quotas as 'transferable commodities', which will flow freely. However, fishermen do not consider quotas to be a saleable commodity, particularly as the 'right to fish' is intricately linked to culture and community. Many fishermen have difficulty envisaging themselves as a "mobile labour force" that can pull up roots and move away from their communities (Pinkerton 1989).

states: “Once the relationship among actors is changed by establishing an area of co-operation, enlarging co-operation to other management functions becomes easier. This is because co-management is not only about new institutions, but more fundamentally about the new relationships resulting from them. Institutions and legal arrangements can only permit, support, and create incentives for new relationships: it is the new relationships which generate the communication, trust, and willingness to risk innovation which the benefits of co-management actually materialise”.

However, the involvement of local people in fisheries planning and decision-making can however be fraught with difficulties. Hampshire *et al*. (in review) state that there is rarely a single “public discourse” and that, in the majority of situations, there is likely to be a range of contested views and values in relation to natural resources. Indeed, the present synthesis has shown a range of contested views and values specifically in relation to Cormorant-fishery conflicts, just one are of concern for fisheries management. It should be noted that this synthesis process has dealt mostly with ‘discursive’ knowledge and may well have excluded other types of knowledge (e.g. ‘tacit’, see 3.4). Thus, understanding stakeholders’ behaviour (i.e. what people think, what they want, and why they do what they do) is complex because people often say one thing and do another (Hampshire *et al*. in review). If natural resource management is to be sustainable in the long term, an understanding of human behaviour is vital (Hampshire *et al*. in review). The need for collaborative links between natural and social scientists was indeed recognised by REDCAFE participants (see Chapter 6). Furthermore, work for the present conflict synthesis also established an area of co-operation between natural scientists, local environmental stakeholders (fishermen and conservationists) and policy makers.

3.7.3 Future research

A major challenge for natural scientists will be to make their work more relevant and useful to stakeholders. It is clear, from the information provided and discussed throughout this Volume, that there is a high degree of uncertainty surrounding much of the scientific information available on Cormorant-fisheries conflicts. Furthermore, it is clear, from the information presented and discussed in this Chapter, that the ‘decision stakes’ concerning Cormorant conflicts are high. Decision stakes refer to the ‘costs, benefits, and commitments of any kind by the parties involved’ (Funtowicz & Ravetz 1991). Under these conditions, traditional academic (so-called ‘normal’) science (which is often curiosity-driven and orientated to problem-solving), could be augmented by so-called ‘post-normal’ science. Funtowicz & Ravetz (1991) have “adopt(ed) the term ‘post normal’ to mark the passing of an age when the norm for effective scientific practice could be a process of puzzle-solving in ignorance of the wider methodological, social and ethical issues raised by the activity and its results. The scientific problems which are addressed can no longer be chosen on the basis of abstract scientific curiosity or industrial imperatives. Instead, scientists now tackle problems introduced through policy issues, where typically, facts are uncertain, values in dispute, stakes high, and decisions urgent.” It is not possible to provide a thorough discussion of this topic here but see Tacconi (2000, pp23-41) for further details.

It is clear from the present synthesis 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. Such scientific research could be both academically- and action-oriented (see Tacconi 2000). Action-oriented research would acknowledge that stakeholders, other than researchers, do have considerable relevant knowledge but that their opportunity/ability to undertake research may be limited. Some form of participatory approach may even be possible within some of the academically-oriented research.

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 (Figure 3.13). The issue of **loss of earnings from the fishery** was common to all three 'fishery' stakeholders but appeared to be poorly served by the scientific literature. Concerns over the issues of **reduced value of catch** and **loss of aquaculture stock** were shared between recreational and commercial stakeholders but with little associated scientific literature. The same was true for the issues of **reduced fish catchability**, **reduced capital value of fisheries** and of **increased recurrent costs** for recreational stakeholders and for the issues of **loss of stocked fish** and **reduced stock through lowered production** for commercial fishermen. Concerns over the disturbance effects of Cormorant **scaring and shooting** were shared by both commercial and nature conservation stakeholders but, again, there appeared to be little supporting scientific literature. These nine conflict issues thus appeared to be ones most likely to benefit from further scientific investigation. Though, given the points discussed above, 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.

3.7.4 Concluding remarks

Conflicts over natural resources are often ongoing, signalling the different values and interests of the people involved. The complexity of a conflict increases "when it is driven by people's fundamental values – about right and wrong, about entitlements, about humans' role in nature, and so on" (Daniels & Walker 2001). As discussed in this Chapter, this is certainly the case for most, if not all, Cormorant-fisheries conflicts recorded in the present synthesis. The fundamental challenge for fisheries management in this context is to find ways of expanding technical expertise whilst increasing collaboration in decision-making processes. In the past there has been much co-operation between fishermen and scientists at the individual level but a more organised management structure is required to bring these, and other, groups together Couper & Smith (1997). Moreover, Daniels & Walker (2001) suggest that while it is possible for specific disputes to be *resolved*, many conflicts are complex and continuing. Thus: "Complex conflict situations may never be resolved in the sense that the parties reach an agreement that ends the core incompatibilities that give rise to the conflict. Rather many complex conflicts can be *managed* well, so that they do not become destructive."

The REDCAFE Cormorant-conflict synthesis has demonstrated clearly that such conflicts are indeed 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. As discussed above, 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.

4 Cormorant ecology: factors leading to conflicts

4.1 *Introduction and methods*

Any successful resolution, or management, of the conflicts between Cormorants and fisheries interests on a pan-European scale must include careful consideration of the best available biological information on Cormorant populations throughout the region. This Work package was an attempt to synthesise aspects of Cormorant ecology that lead to the conflicts synthesised in Chapter 3. The conflict synthesis highlighted that Cormorants were widespread across Europe, that they were migratory (at least in part) and that they were highly flexible in relation to choice of foraging habitats and prey.

The aims of this Work Package were thus to (i) achieve information exchange at a European level (ii) summarise existing knowledge on Cormorant ecology (especially factors leading to conflicts), (iii) clarify certain ecological topics (focussing on feeding ecology), and (iv) synthesise common facts in a general synthesis giving a broad, pan-European overview.

Relevant ecological factors included in the synthesis were: Cormorant population status and distribution, movements and dispersal, breeding/over-winter site fidelity, foraging site selection, foraging ecology, feeding behaviour and daily energy expenditure. These factors were categorised into four main themes:

- General ecology and habitat features
- Migration and the annual cycle
- Fish communities and Cormorant diet
- Cormorant ecology and impact at fisheries

These main themes were discussed in a series of topical reviews presented by a REDCAFE participant and the main points arising from each are summarised in this Chapter (sections 4.3, 4.5, 4.6, 4.7). In addition, wherever appropriate, subsequent discussions between REDCAFE participants are also reported. Two discussion workshops were also held to discuss and synthesise broad habitat issues: the environmental requirements of Cormorants and habitat 'vulnerability' (i.e. its attractiveness) to the species. The resulting consensus on these habitat syntheses (presented in sections 4.4, 4.8) are reported here in the form of tables. A pan-European synthesis is then given (4.9) along with three sets of conclusions arising from it (4.10).

Finally, the pan-European synthesis was achieved by incorporating information from the topical reviews and discussion workshops and combining it with information on the inter-relationship between Cormorant density and distribution across Europe based on site-specific information reported by REDCAFE participants in a standard format (Table 4.1)