


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

REDCAFE

Summary & National Overviews

Edited by D N Carss & M Marzano

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Natural Environment Research Council
Centre for Ecology & Hydrology

CEH Banchory
Hill of Brathens
Banchory
Aberdeenshire
AB31 4BY
Scotland
UK

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

Fax: +44 1330 823303
Internet: d.carss@ceh.ac.uk
Web: www.banchory.ceh.ac.uk

University of Durham
Department of Anthropology

University of Durham
Department of Anthropology
43 Old Elvet
Durham
DH1 3HN
England
UK

Fax: +44 191 374 7527
Internet: mariella.marzano@durham.ac.uk
Web: www.durham.ac.uk

Commissioned by: European Commission
DG XIV Directorate-General for Fisheries
Rue de la Loi 200
Bâtiment J II 99 6/11
B-1049 Brussels, Belgium

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PARTICIPATING ORGANISATIONS

David Carss (Co-ordinator, Steering Group)
Centre for Ecology & Hydrology
CEH Banchory, Hill of Brathens,
Banchory, Aberdeenshire, AB31 4BW
United Kingdom.
d.carss@ceh.ac.uk

Ian Winfield
Centre for Ecology & Hydrology
CEH Windermere, Far Sawrey,
Ambleside, Cumbria, LA22 0LP
United Kingdom.
i.winfield@ceh.ac.uk

Phillip Scott Jones
University of Wolverhampton
Centre for Rural Development and Training,
WS1 3BD, United Kingdom.
Now: Heart of Burton Partnership
tiger.moth@ntlworld.com

Mariella Marzano
CEH Banchory (mama@ceh.ac.uk) and
Department of Anthropology
University of Durham
43 Old Elvet
Durham, DH1 3HN
United Kingdom.
mariella.marzano@durham.ac.uk

Morten Frederiksen
CEH Banchory, Hill of Brathens,
Banchory, Aberdeenshire, AB31 4BW
United Kingdom
mfr@ceh.ac.uk

Erik Petersson
National Board of Fisheries
Institute of Freshwater Research,
Staangholmsvaegen,
S-178 93,
Drottningholm,
Sweden.
erik.petersson@fiskeriverket.se

Henri Engström
University of Uppsala, Dept. Evolutionary Biology Centre/Population Biology
SE-752 36 Uppsala,
Sweden.
henri.engstrom@skb.se

Thomas Bregnballe (Steering Group)
National Environmental Research Institute
Dept. of Coastal Zone Ecology. Kaloe, Genaavej 12,
DK-8410, Roende, Denmark.
tb@dmu.dk

Thomas Keller (Steering Group)
Ex Technical University of Munich
Now: Bavarian State Ministry of Environment, Public Health & Consumer Protection
Rosenkavalierplatz 2
D-81925, Munich
thomas.keller@stmugv.bayern

Mennobart van Eerden (Steering Group)
Institute for Inland Water Management and Waste Water Treatment
RIZA, Directoraat-General Jijkswaterstaat, PO Box 17, NL-8200,
Lelystad, The Netherlands.
m.vEerden@riza.rws.minvenw.nl

Loïc Marion
Department of Ecology, University of Rennes
Université de Rennes 1, ECOBIO-UMR 6553,
U.F.R. S.V.E., CS74205, Avenue du Général Leclerc 236,
F-35042, Rennes, France.
loic.marion@univ-rennes1.fr

Daniel Gerdeaux
Institute of Lacustrine Hydrobiology
Institut National de la Recherche Agronomique,
Station d'Hydrobiologie Lacustre, BP R11,
75 Avenue de Corzent, F-74203, Thonon-Les-Bains,
France.
gerdeaux@thonon.inra.fr

David Grémillet
Centre for Ecological and Physiological Energetics
Centre d'Ecologie et Physiologie Energetiques,
23 Rue Becquerel, F-67087, Strasbourg,
France.
david.gremillet@c-strasbourg.fr

Carlos Garcia de Leaniz, Angel Serdio & Sofía Consuegra
Ex Direccion General de Montes y Conservacion de la Naturaleza
Institute of Freshwater Fisheries - Arredondo,
Arturo Lopez s/n, E-39813, Arredondo, Cantabria, Spain.
Now Dept. of Biological Sciences, University of Wales Swansea, UK
c.garciadeleaniz@swansea.ac.uk

Bruno Broughton
(Independent Fisheries Management Consultant)
European Anglers Alliance
Trenchard, Lower Bromstead Road,
Moreton, Newport, Shropshire,
TF10 9DQ, United Kingdom.
bruno.broughton@virgin.net

Savas Kazantzidis (Maria Panayotopoulou, 2001)
Hellenic Ornithological Society
G. Rodiou 10 St., GR-546 38 Thessaloniki, Greece.
Now: National Agricultural Research Foundation
savkaz@fri.gr

Erich Staub
European Inland Fisheries Advisory Commission
EIFAC, CH-3003, Bern, Switzerland.
erich.staub@buwal.admin.ch

Ido Izhaki & Gadi Katzir
Department of Biology, University of Haifa
University of Haifa at Oranim, IL-36006, Tivon, Israel.
izhaki@research.haifa.ac.il

Zeef Arad
Department of Biology, Institute of Technology
Technion – Israel Institute of Technology – Faculty of Biology,
Technion City, IL-32000, Israel.
zarad@techunix.technion.ac.il

Tamir Strod & Jonathan Harari
The Hula Nature Reserve
P.O.B. 340 Yesud Hamaala,
12105, Israel.
tamir_strod@yahoo.com st.hula@nature-parks.org.il

Harald Kleisinger
Bavarian Bureau of Environmental Protection
Lfu Bayern, Nature Protection and Landscape Planning,
Buergermeister-Ulrich-Strasse 160, D-86179, Augsburg,
Germany.
harald.kleisinger@lfu.bayern.de

Julian Hughes
Royal Society for the Protection of Birds
RSPB, Species Policy Unit,
The Lodge, Sandy, Bedfordshire, SG19 2DL,
United Kingdom.
julian.hughes@rspb.org.uk

Ian Russell
The Centre for Environment, Fisheries & Aquaculture Science
CEFAS Lowestoft Laboratory, Pakefield Road,
Lowestoft, Suffolk, NR33 0HT,
United Kingdom.
i.c.russell@cefas.co.uk

Robert Gwiazda
Institute of Freshwater Biology, Polish Academy of Sciences
Polish Academy of Sciences, Slawkowska 17, Krakow,
PL-31-016,
Poland.
gwiazda@iop.krakow.pl

Redik Eschbaum
Estonian Marine Institute
Estonian Marine Institute, Viljandi Road 18B,
11216 Tallinn, Estonia.
eschbaum@ut.ee

Willem Dekker
Netherlands Institute for Fisheries Research RIVO-DLO
PO Box 68, NL-1970 AB IJmuiden,
The Netherlands.
Willem@rivo.wag-ur.nl

Christian Dieperink
Ex. Danish Institute for Fisheries Research
Now: Waterframe, Hejnaesvej 4,
DK – 8680 Ry,
Denmark.
cd@waterframe.dk

Janis Baumanis
Institute of Biology
Laboratory of Ornithology, Miera st. 3, LV-2169,
Salaspils, Latvia.
jbaumanis@email.lubi.edu.lv

Nils Røv & Svein-Håkon Lorentsen
Norwegian Institute for Nature Research
Tungasletta 2, N-7485 Trondheim, Norway.
nils.rov@nina.no
shl@nina.no

Timo Asanti
Finnish Environmental Institute
Nature and land use Division, Kesäkutu 6, PO Box 140,
FIN-00251, Helsinki, Finland.
timo.asanti@vyh.fi

Petr Musil & Renata Martincova
Charles University, Prague
Department of Zoology, Faculty of Sciences,
Vini ná 7, Praha 2, CV-128 44, Prague,
Czech Republic.
p.musil@post.cz
martincova@cizp.cz

Josef Trauttmansdorf
Otto Koenig Institute
A-2000, Stockerau, Austria.
okido@aon.at

Rosemarie Parz-Gollner
Inst. fuer Wildbiologie und Jagwirtschaft
Univ. f. Bodenkultur Wien, Peter Jordanstrasse 76,
A-1190, Vienna, Austria.
parz@mail.boku.ac.at

Stefano Volponi
Ex University of Ferrara
Now: Istituto Nazionale Fauna Selvatica
Via Ca' Fornacetta, 9
40064 Ozzano Emilia BO
Italy.
svolponi@racine.ra.it

Jean-Yves Paquet
Central Ornithologique Aves
Rue de Blacet 1, 5530 Yvoir, Belgium.
jeanyves.paquet8@yucom.be

Ger Rogan
Marine Institute
Salmon Management Services, Furnace,
Newport, Co. Galway, Ireland.
ger.rogan@marine.ie

Michael Andersen
Danish Fishermen's Association
H.C. Andersens Boulevard 37, PO Box 403,
DK-1504, Copenhagen, Denmark.
ma@fiskeriforening.dk

Szymon Bzoma
Ex University of Gdańsk
Now: Department of Fish Resource
Sea Fisheries Institute
Kollataja St. 1, PL-81-332, Gdynia, Poland
szymbz@poczta.onet.pl

Linas Ložys
Institute of Ecology of Vilnius University
Akademijos 2
Vilnius-21
LT-08412
Lithuania
lozys@ekoi.lt

Ivailo Nikolov
Ex Sofia University
Now: Balkani Wildlife Society
67 Tsanko Tserkovski St./3
Sofia 1421,
Bulgaria.
ivailo_nikolov@abv.bg

Vilju Lilleleht
Estonian Agricultural University
Institute of Zoology and Botany,
Riia 181, EE51014 Tartu, Estonia.
vlill@zbi.ee

Nikolay Kissiov
BG- FishAqua Association
Luna Str. 3, Plovdiv, 4016
Bulgaria.
nkissiov@spnet.net
bg_fishaqua@abv.bg

Botond Kiss
Danube Delta Institute
Str Babadag, Ro8800, Tulcea, Romania.
jbkiss@indd.tim.ro

Miha Janc
Fisheries Association of Slovenia
Trzaska cesta 132,
Slovenia.
miha.janc@siol.net

Catarina Vinagre & Susana Franca
University of Lisbon
Departamento de Zoologie e Anthropologia / Instituto de Oceanografia,
Faculdade de ciencias da Universidade de Lisboa
R. Ernesto de Vasconcelos, 1749-016 Lisbon
Portugal.
cmvinagre@fc.ul.pt
sofranca@fc.ul.pt

Kareen Seiche
On behalf of:
Saxon Ministry of Environment
Archivstrasse 1
01097 Dresden
Germany
kareen.seiche@t-online.de

0.1 Summary

0.1 Background to REDCAFE

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

0.2 Aims and set up of REDCAFE

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

0.3 Cormorant conflicts with fisheries

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

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

0.5 Contents of this report
This report is based on the REDCAFE Final Report (Carss 2003, see also Appendix 1) that detailed the REDCAFE framework, a regional, national and international synthesis of Cormorant-fisheries conflicts, a synthesis of relevant Cormorant ecology and a synthesis of potential management tools in all, or most, countries. It also provides background, description, analysis and evaluation of a 'real world' case study exercise involving conflicts between Cormorants and recreational angling interests in a catchment in south-east England. This second report includes a Chapter for each participating country, in which the current national situation is described in as much detail as possible (up to 2004). Both of the reports, and each individual country Chapter, can be read as stand alone texts.

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

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

0.7 After REDCAFE: INTERCAFE

An interdisciplinary approach involving the collaboration of biological and social scientific expertise, economic and political interest and practical local experience was seen by REDCAFE as vital to the development and successful implementation of practical cormorant-fisheries conflict resolution strategies across Europe. The challenge was both to continue with relevant research and to improve information exchange, dialogue, participation and trust between all stakeholders involved in such conflicts. This challenge has recently been taken up by a pan- European COST Action, INTERCAFE ("Conserving Biodiversity - Interdisciplinary Initiative to Reduce pan-European Cormorant-Fisheries Conflicts"). COST is an intergovernmental framework for European Co-operation in the field of Scientific and Technical Research, which promotes the building of scientific networks. In INTERCAFE, this involves the collaboration of biological and social science expertise, economic and political interests, and practical local experience. The main objective of INTERCAFE is to improve European scientific knowledge of cormorant-fisheries interactions in the contexts of the interdisciplinary management of human:wildlife conflicts and of sound policy formation, so as to inform policy decisions at local to international levels across Europe and to deliver a coordinated information exchange system and improved communication between all stakeholders. Project participants, currently covering 28 countries in Europe and beyond, will ultimately create a coordinated research network and an information bank that will be used to develop long-term collaborative management solutions to pan-European cormorant conflicts.

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0.2 Preface

The information we provide here was compiled from the REDCAFE Final Report (Carss 2003). This report has been summarised but it has also been updated to best reflect the national situation in participating countries up to autumn 2004. Although everyone involved in REDACE has worked extremely hard to make this review as comprehensive as possible, these National Overviews must be considered as merely snapshots in time. As a form of 'disclaimer', we do not pretend that this review covers everyone's opinions or that it truly represents people's felt needs about Cormorant-fisheries interactions. We could not hope to cover fully ecology, economics, policy, and social science, let alone the diverse experiences of those others affected in some way or other by these issues. However, these national overviews are an attempt to synthesise current pan-European information in as much detail as possible.

It is very clear to us that the Cormorant-fisheries situation across Europe is both multi-faceted and dynamic. Indeed, the situation(s) is/are constantly changing and are much more complex than many of us understood them to be at the start of the REDCAFE project at numerous levels: local, regional, national and pan-European. The dynamics and complexities exist within ecological perspectives (our original starting point) but also within the social, cultural and economic perspectives we have only just begun to investigate in relation to Cormorants and fisheries. Such complexity also applies consequently to such things as mitigation strategies, policy instruments and their interpretation and implementation. Across Europe, there are frequent calls for some form of common standard (generic) 'solution' to Cormorant-fisheries 'problems'. However, given both what has been said above and our current understandings as outlined in this report, we think these calls are perhaps premature and may well, ultimately, be inappropriate.

The information in this report covers a wide range of geographical and spatial scales: from the site-specific to the continental. Moreover, these scales can seldom, if ever, be considered in isolation – they are interconnected in numerous, subtle ways. For example, mitigation actions taken against Cormorants, or changes in the economic value of a particular fishery-type, or the regional interpretation of some piece of relevant legislation in one region/country may have implications and consequences for what happens in another. Even if they do not, there is widespread interest across Europe in what's happening in relation to Cormorant-fisheries issues. Ultimately, we need to keep one eye on the continental scale (this is clearly a European 'problem') and the other on the site-specific level (where conflicts may be best managed). There is thus a considerable need to 'join everything up' through information transfer, careful monitoring and dissemination. The development of INTERCAFE, an interdisciplinary network (see section 27), is thus a welcome move in the right direction. If this report improves people's understanding of the multiple perspectives associated with the deceptively simple phrase 'Cormorant-fisheries conflicts' and if it encourages dialogue and leads to new collaborations it will have achieved its aim. However, the huge body knowledge reflected in this report represents just the start of the process; one that will be continued and developed in INTERCAFE.

Dave Carss & Mariella Marzano, July 2005.

1. Introduction: background and aims of REDCAFE

1.1 Pan-European Great Cormorant populations

Two subspecies of Great Cormorant (hereafter 'Cormorant') occur in Europe: the 'Atlantic' subspecies *Phalacrocorax carbo carbo* and the 'Continental' subspecies *P. c. sinensis*. Latest (1995) breeding estimates for *carbo* are of 40,000 pairs, mostly on the coasts of Norway, UK, Ireland and northern France, representing over 80% of the world population of the nominate race (Debout *et al*. 1995). Although there are no estimates for *sinensis* populations during the 19th century or the first half of the 20th, it is likely that numbers in the remainder of Europe had declined to an unprecedented level of around 800 breeding pairs in the Netherlands in the early 1960s. Thereafter, numbers increased dramatically to over 150,000 pairs throughout the region in 1995 (van Eerden & Gregersen 1995) and it is likely that the species is now more numerous than ever before.

The geographical range of these populations has also expanded with Cormorants returning to some areas after a long absence whilst also moving into areas previously never occupied. Recent DNA studies have shown one consequence of such population increases and associated range expansion. *Sinensis* birds are breeding in inland colonies in the UK, living sympatrically, and probably hybridising, with *carbo* populations there (Goostrey *et al*. 1998).

The reasons for such expansion are unclear but possible causal factors include a "*non-limiting food supply*" (i.e. populations are not limited by a lack of food), protection of breeding sites and reduction in persecution throughout Europe (van Eerden & Gregersen 1995, Bregnballe & Gregersen 1997). The expansion of the European Cormorant population must be considered in the context of unprecedented landscape and social changes during the late 20th century. For instance, industrial activity in western Europe created many wetland habitats as a result of such things as gravel extraction and the construction of reservoirs. On the other hand, the recent decline in heavy industry in east/central Europe has led to reductions in aquatic pollution and an associated recovery of fish populations. Furthermore, the aquaculture industry has expanded across the whole continent, leading to areas of intensive freshwater fish production and enhanced stocks through the release of hatchery-reared fish.

Undoubtedly, protective legislation, particularly EEC Directive 79/409 on the Conservation of Wild Birds, has also been an extremely important factor in the increase of Cormorant populations throughout the region (van Eerden *et al*. 1995). Other important protective legislation in the EU includes the Bern Convention on the Conservation of European Wildlife and Natural Habitats and the Bonn Convention on the Conservation of Migratory Species of Wild Animals and, in the EU and elsewhere, the Ramsar Convention on Wetlands of International Importance especially as waterfowl habitat.

1.2 Basic conflicts between Cormorants and fisheries

Cormorants are generalist fish-eating predators taking a wide variety of species in shallow coastal seas, freshwater fisheries (natural and stocked artificially) in lakes and rivers, and both traditional/extensive and intensive aquaculture systems (Cramp &

Simmons 1977). In almost all countries where Cormorants occur, their increasing numbers and geographical spread has led to a growing number of conflicts with commercial fisheries and recreational angling interests (e.g. Bildsøe *et al*. 1998 and Suter 1995, respectively).

These conflicts arise either through direct consumption of commercial or rare fish species or through fears of indirect effects such as injury to fish and the spread of diseases and/or parasites that increase fish mortality and reduce their market value. There are clear cases of Cormorant damage to fishing gear and ensnared fish, as well as documented cases of considerable impact at fish farms and small water bodies (see van Dam & Asbirk 1997). Demonstrating the impact of Cormorants in large rivers and other water bodies is difficult because of ecological complexities. Nevertheless, annual losses as a result of Cormorant predation have been variously estimated at over 4 million ECU for European fishery yields in 1992 (Adamek *et al*. 1997) and at 163.7 million ECU for losses of commercial fish during the winter in relation to recreational angling, a sport for at least 23 million EU citizens (EAA, 1998).

1.3 International legislation, conservation and management plans

Given these conflicts, where a species causes "*serious damage*" to specified interests such as fisheries and where other satisfactory solutions are lacking, several European Member States have derogated from their protective provisions with regard to the Cormorant under Article 9 of the EU Bird Directive. Although Article 9 derogations, or a national equivalent, have been applied on a local scale, the calls for further measures to reduce the population size of Cormorants made by some fisheries interests, particularly those in regions where Cormorants over-winter, increased during the 1990s. In particular, the governments of Denmark and the Netherlands - the countries where ca. 36% of the European Cormorants breed - were urged to address this issue. Thereafter, discussions were aimed at placing Cormorant management in the international legal framework of the Bonn Convention (Conservation of Migratory Species of Wild Animals). The underlying ethos was that the Cormorant, although not currently at risk, might be threatened again by illegal killings, if not properly managed. Moreover, there was also a need to protect two endangered cormorant species in the region, the Pygmy cormorant *P. pygmaeus* and the Socotra cormorant *P. nigrogularis*. These discussions resulted in a draft recommendation on the management of cormorants in the African-Eurasian region being presented to, and adopted by, the Conference of Parties at the fourth meeting of the Bonn Convention in 1994 (see van Dam & Asbirk 1997).

In 1996, the European Parliament adopted a 'resolution on the cormorant problem in European fisheries' (see van Dam & Asbirk 1997) considering it appropriate to take special temporary measures by means of scientific projects approved by the European Commission. These measures should aim at reducing the Cormorant's impact on the environment by, for example, preventative action to restrict the reproduction of Cormorants and by the temporary exclusion of *P. c. sinensis* from Annex 1 of the Bird Directive. This resolution also called on the Council to take effective action to restore depleted fish stocks and ensure that the Common Fisheries Policy maintains fish at levels that can support both human fisheries and natural predators.

Under the auspices of the Bonn Convention, there followed a workshop '*Towards an International Conservation and Management Plan for the Great Cormorant*' (Lelystad, the Netherlands, October 1996). An international meeting of experts to complete an Action Plan for the Management of the Great Cormorant in the African-Eurasian Region (Copenhagen, Denmark, September 1997) was held in the following year. This Action Plan aimed to minimise the conflict between fisheries interests and the Cormorant by "*ensuring that best practice is followed in mitigating, preventing and reducing their reported impacts on fisheries, while maintaining a favourable conservation status for the species.*" The Action Plan also stated that Range States should try to achieve this, in the following order of preference, through (a) appropriate site-specific management, (b) local management and control of Cormorants, and (c) co-ordinated management and control of Cormorants between Range States.

The *Action Plan for the Management of the Great Cormorant in the African-Eurasian Region* was sent to all European Range States with a request to implement the recommendations included therein. Any response to the action Plan was left to the discretion of individual Range States. Individual Range States appeared to largely ignore the Action Plan and continued with their own regional or national cormorant mitigation policies based on national and international legislation. There was little evidence that advice was being made available to Range States on the implementation of the Action Plan, nor was there facilitation to co-ordinate its implementation at the international level. Thus, in practice, and certainly for many affected by the 'cormorant problem', the Action Plan appeared to be ineffectual.

1.4 Aims of REDCAFE

The REDCAFE project was designed to complement and develop the previous work described above. It also addresses several of the main uncertainties highlighted during the development of the Action Plan (see van Dam & Asbirk 1997). For example, (a) the total size, long-term trends and movements/dispersal of the European Cormorant population, (b) the lack of reliable estimates of the social/economic aspects of Cormorant conflicts with commercial and recreational fisheries, and (c) the lack of reliable estimates of the efficacy and cost-effectiveness of methods of Cormorant control. REDCAFE aims were realised through synthesising available Cormorant/fisheries information, through identifying methods of reducing the current Europe-wide conflict between Cormorants and fisheries interests, and through collating expert evaluations of their practical use. REDCAFE took a novel approach to delivering solutions to these problems by, for the first time, bringing together avian, fisheries and social scientists and many relevant 'stakeholders'[1] to discuss and report on these issues in a rigorous, co-ordinated and equitable manner.

1.5 REDCAFE set up

During the years 1995 through 1999, it became increasingly apparent to many 'Cormorant researchers' that further progress towards Cormorant-fisheries conflict

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[1] The word 'stakeholders' is a difficult one: it means different things to different people and it is not easily translated into some languages. In the context of this report, the term 'stakeholders' is taken to mean (a) people who are affected (either positively or negatively) by a particular problem or activity or (b) people who can influence (either positively or negatively) the outcome or end result of a particular process. For further details see (Ramírez 1999).

resolution required three important elements: first, a genuine pan-European approach to the problem; second, better integration of avian and fisheries science; third, a link between biological and social scientists and constructive dialogue between these groups and other stakeholders. Realising this, an initiative was taken by a group of natural scientists to propose an international network in order to synthesise relevant knowledge and to further progress pan-European Cormorant-fisheries conflict resolution.

REDCAFE was proposed as a Concerted Action under the EU's 'Quality of Life and management of Living Resources' Fifth Framework Programme. Concerted Actions are "*Designed to encourage collaboration between teams of interested researchers and other actors, combining their accumulated expertise in a research network, to find solutions to problems common to all European Member States, but with better chances of solution through European collaboration.*" and " … *can be considered when pooling of data would facilitate common interpretation of facts and contribute to the development of harmonised standards, procedures and methodologies…*"

The European Commission agreed to award a financial contribution of 100% of the costs for REDCAFE, paying for co-ordination staff time and the costs of four international Workshops. REDCAFE ran for 24 months (01/12/00 – 30/1/02, this report is updated to 2004) and was based on a pan-European network of project participants comprising 49 individuals representing 43 organisations in 25 countries (Figure 1.1) and included seven main stakeholder groups: commercial fishermen, recreational fishermen, aquaculturists, avian/wetland conservationists, fisheries scientists, avian ecologists and social scientists.

Figure 1.1 The 25 countries participating REDCAFE (2000-02).

In the first phase of REDCAFE, available information on Cormorant conflicts with fisheries was synthesised. In the second phase, available information on Cormorant ecology, focussing on those factors leading to conflicts with fisheries, was synthesised. In the third phase, a set of potential management tools, from continental to site-specific, was compiled. In each of these phases, as well as synthesising available knowledge, critical deficiencies and uncertainties were also highlighted. In the fourth phase a specific Cormorant-fishery case study was selected as a model for conflict resolution and to determine whether a useful framework could be established for future conflict resolution elsewhere.

The REDCAFE Final Report (Carss 2003, see also Appendix 1) detailed the project's framework, a regional, national and international synthesis of Cormorant-fisheries conflicts, a synthesis of relevant Cormorant ecology and a synthesis of potential management tools in all, or most, countries. It also provided relevant national and international overviews as well as background description, analysis and evaluation of a 'real world' case study exercise involving conflicts between Cormorants and recreational angling interests in a catchment in south-east England.

This second report includes a Chapter for each participating country, in which the current national situation is described in as much detail as possible (up to 2004). Both of the reports, and each individual national overview, can be read as stand alone texts.

Individual REDCAFE participants drafted major contributions to this report, each is named at the beginning of the relevant Chapter. To all colleagues and friends participating in this project, the Editors extend grateful and heartfelt thanks for their enthusiasm and hard work. Additionally the Editors would like to thank the following people for their input to REDCAFE Work Packages: Joep de Leeuw, Maarten Platteeuw, Terry Mansbridge, Dennis Meadhurst and Adrian Taylor. Thanks also to: Denise Wright and Malcolm Collie (CEH Banchory) for invaluable IT help and advice throughout the project; Ian Cowx (University of Hull International Fisheries Institute) for hospitality and help during the project's first Work Package meeting; administrative staff at CEH Banchory, RIZA (Lelystad) and NERI (Kalø/Horsens) for meeting preparation. Most importantly, our thanks go to local stakeholders – fishermen, fisherwomen and conservationists – for making our field visits so informative and rewarding.

2. Introduction: information collection

2.1 Introduction

Much of this report comprises a series of national overviews for each of the 25 countries involved in the REDCAFE project. Each country is given a separate stand-alone Chapter comprising three sections. First, a country overview written by the national REDCAFE participant(s) and based on their knowledge and experience. Second, a synthesis of information provided by stakeholders on Cormorant conflicts with fisheries. Third, a summary of Cormorant management actions carried out within each country. Each Chapter end with a list of stakeholders consulted as a bibliography. Methodological details are important to the interpretation of the information given in these Chapters. The following sections thus explain how the information was collected.

2.2 Cormorant conflicts with fisheries

2.2.1 Background

Part of REDCAFE's work 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],

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[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 the relevant Chapters, 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

dialogue and collaboration. The REDCAFE pan-European Cormorant conflict 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 presented as an indication of stakeholders' perceptions of Cormorant-fishery conflicts. These perceptions are very important as they are informed by stakeholders' 'values'. 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.

2.2.2 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 2.1). 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; *P.c. carbo* or

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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.

sinensis), 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 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 Table 2.1). 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 report. Stakeholders recorded (see Table 2.1) 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 Table 2.1 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 further details of the literature references cited. These literature references are provided in a bibliography for each country in this report.

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 for each country in the relevant Chapter). Although every effort was made to ensure that the information included in this synthesis was derived from the stakeholders themselves, in a few cases (i.e. 21% of countries and 9% of cases) the only information available was that provided by REDCAFE participants (i.e. Belgium, Finland, Israel and Romania).

After completion, spreadsheets were returned to REDCAFE participants and then collated on a national basis. Resulting data for each country are presented in this report. However care must be taken when interpreting this information. Methodological limitations and difficulties are thus discussed in the following section.

2.2.3 Methodological limitations and difficulties

REDCAFE participants experienced several difficulties in producing this synthesis of Cormorant conflict issues. Understanding these difficulties is important for two reasons. First, they highlighted the difficulties involved in creating and managing dialogue between stakeholders from many countries and diverse backgrounds. Second, they highlighted several of the 'non-biological' issues at the heart of many people-wildlife conflicts and attempts to resolve and/or manage them. The major difficulties and limitations faced during this synthesis process are described below.

First, at a national level, the case studies provided may not be fully representative. This was almost certainly the case for France, a country with an important wintering population of Cormorants and widespread recreational and aquaculture interests. It is clear that the six case studies reported for France did not represent the complete situation here. Although the available conflict case studies refer to lakes and coasts, the majority of conflicts are thought to occur on rivers (with angling interests) and fish ponds (with aqauculture). This disparity was thought to be due to the interpretation of the term 'case studies'. In France, case studies were considered to be those that had been the subject of scientific investigation and these, as reported in this report, were on lakes or coasts. However, the ‘true picture’ for France would involve most conflicts occurring at fish ponds followed by rivers, with relatively few conflicts on lakes and practically none on the coasts.

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

Table 2.1 Spreadsheet template completed by stakeholders to provide information for REDCAFE pan-European Cormorant conflict synthesis.

Second, perceptions of conflict may depend on the 'organisational level' of stakeholders, thus an institutional view may not reflect that of people affected by conflicts at first hand. The difficulty was therefore to determine at what 'level' contact should be made with local stakeholders. Given time constraints, selection of the most appropriate stakeholders to provide information for this synthesis was made on a national basis by REDCAFE participants on the basis their own knowledge and experience. However, in this task, REDCAFE participants also benefited greatly from invaluable discussions with stakeholders themselves.

Third, there were general difficulties in language. The information spreadsheet (Figure 2.1) was originally devised and written in English but was translated if necessary. There were also misunderstandings over the nature of the form. Provision of information thus often involved close dialogue between REDCAFE participants and stakeholders. As one REDCAFE participant stated: "*for me it has been difficult to get the feedback (from stakeholders) wanted. Nobody outside our little group seem to understand the (spreadsheet) schemes, and the only way to obtain answers was to contact organisations and individuals directly…*"

Fourth, many REDCAFE participants experienced considerable difficulties in getting responses back from stakeholders. Participants were asking stakeholders to provide information, and to spend time doing so, with no guarantee of confidentiality or of how the information would be used. This raised issues of trust. However, through close dialogue with stakeholders, REDCAFE participants often partly guided them through the spreadsheet and partly interviewed them. Although this was time consuming, it has built a degree of trust between many REDCAFE participants and stakeholders and will allow them to work more closely together on Cormorant-fisheries management issues in the future. It was thus clear from this experience that future work should include more appropriate social science methodology both to improve information and knowledge transfer and to promote the interdisciplinarity essential for addressing Cormorant-related conflicts across Europe.

Fifth, the conflict synthesis spreadsheet (Figure 2.1) 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. 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.

Sixth, quantifying Cormorant conflicts in this synthesis was relatively crude, involving a small number of broad ‘magnitude’ codes (Figure 2.1). 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 2.1) 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.

2.3 Cormorant management actions

2.3.1 Introduction

Part of REDCAFE’s work was an attempt to synthesise potential Cormorant management tools for resolving the kinds of conflicts synthesised elsewhere in the project. Potential management tools were assessed at the ‘site-specific level’ and, as far as possible, took into account the efficacy (i.e. effectiveness, practicability, acceptability, and cost of measures. The primary source of information was those REDCAFE participants with experience of site-specific Cormorant control. However, in addition, contributions were invited from relevant stakeholders in order that the synthesis was as complete as possible.

2.3.2 Methods

Three types of information were collected for the present synthesis of site-specific actions taken against Cormorants. First, general information on those actions taken against Cormorants in each country. Second, details of national and regional Cormorant management plans and legal regulations in each country. Third, the types of Cormorant damage control activities undertaken in different Cormorant feeding habitats, including semi-quantitative information on their effectiveness (i.e. how long the technique works for), practicability (i.e. how easy the technique is to use), acceptability (i.e. how the technique is viewed by both stakeholders and the general public) and costs. Although not always relevant to every country, five types of feeding habitat were distinguished in relation to Cormorant damage control activities: (A) small rivers (width < 100m), (B) large rivers (width > 100m), (C) small still waters (< 100 ha) not used for aquaculture, (D) very large water bodies (> 100 ha, still waters and coastal waters) and (E) aquaculture sites. REDCAFE participants at the national level provided this information, although often after discussions with local stakeholders over their experiences.

Information was provided on standard spreadsheets and in order to standardise the information collection procedure as much as possible, comprehensive instructions were provided (Table 2.2).

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

Table 2.2 Instructions for the provision of information relating to site-specific actions taken against Cormorants.

3. Austria

3.1 National overview

By Rosemarie Parz-Gollner & Josef Trauttmansdorff

3.1.1 Background

The Great Cormorant was a breeding bird in Austria until World War One with a colony east of Vienna (from 1880 – 1917 there were between 160 – 300 pairs; from 1919 – 1926, less than 100 pairs) and around Linz (in 1951 there were around 40 pairs). The last few or single pairs of Cormorants were shot around 1971 along the River March (Prokop 1980, Aubrecht 1991). The following reasons have been given for the disappearance of Cormorants as a breeding bird:

- Direct persecution from humans
- Shooting
- Environmental changes in river-landscapes
- Changes in cultivation practices

For 30 years there was no stable breeding colony in Austria and any single attempts were normally followed by immediate human persecution. However, recently (status 2004), the Great Cormorant has returned as a breeding bird on Austrian territory again. Currently two small colonies have been established, both situated very close to the national border, directly adjacent to neighbouring countries. However, the Cormorant has long been a frequent migrant during the winter months in Austria. Since the mid-1980s (when there were approximately 1,500 birds), increasing numbers of wintering (October-March) migrating Cormorants can be found dispersed over the country. At present, wintering Cormorants in Austria number about 4,000 – 4,500 birds. Actual climatic conditions (ice, low temperatures) as well as availability, amount and access to food regulates the number of birds present, their spatial distribution and the duration of their stay in Austria. The area around the Danube is home to more than 60% of the migrants.

The River Danube: stretch of impounded river section in Lower Austria. Many key Cormorant roost sites are located in the flood plain forests along the border of the Danube.

Severe conflicts have occurred in Austria with anglers as Cormorant numbers have increased and birds have started to visit new feeding grounds. Tensions between Cormorants and anglers during the winter months are mainly concentrated along tributaries holding Grayling (see Appendix 2 for scientific names) and Brown Trout.

3.1.2 Lakes, Rivers and Ponds.

Lakes play a minor role in commercial fishery operations in Austria. There are approximately 150 people still involved in lake-fisheries at the local scale. Between 1995 and 2000 total annual landings from lake fisheries amounted to 400–450 tonnes per year. In 2001 the total annual landing was 362 tonnes. From the nineteenth century up until World War One, commercial fishing was common along the Danube but now there are no commercial fisheries interest in big rivers due to landscape modifications, the building of power plant stations and the damming of rivers.

Today, fishing interests are concentrated around aquaculture. Fish farming in ponds focus mainly on salmonids (70% of production) and Carp (30%) production. The species with the highest commercial value is Rainbow Trout. The total sum of aquaculture production (total yield) for direct marketing (food) and stocking was approximately 4,000 tonnes a year between 1990-1998 and 3,400-3,600 tonnes in 2001 (Butz 2003, BM f. Land- und Forstwirtschaft 2000, Spindler 1997, Statistik Austria 2001).

3.1.3 Angling

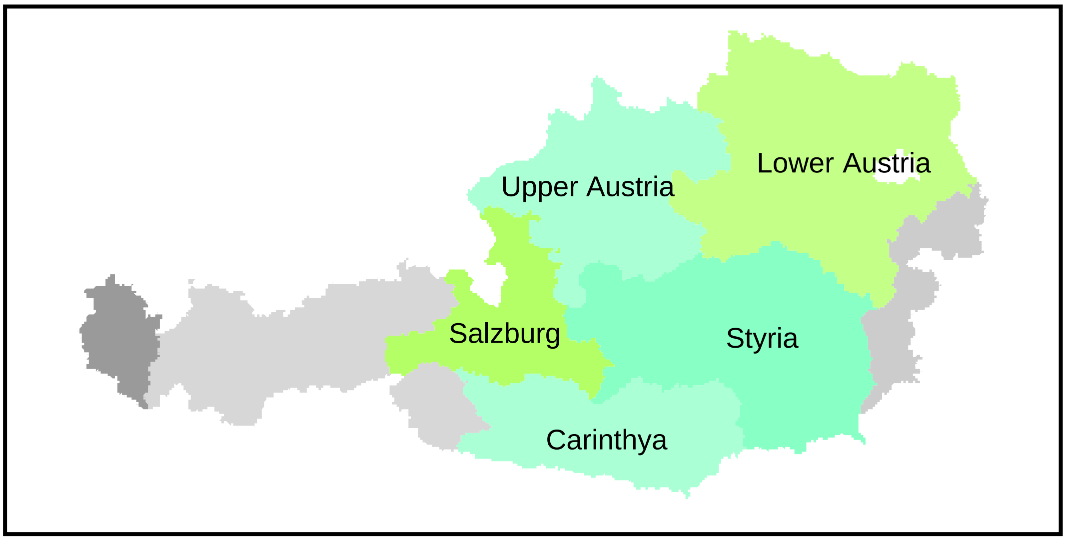
Austria has a dense network of surface water where 100,000 km of running water systems (smaller rivers) and about 9,000 still water bodies (natural and artificial) offer a variety of angling opportunities. Since 1950 there has been a marked increase in private angling clubs. Anglers are generally organised into registered associations with a few umbrella groups representing the interests of their members. Depending on membership numbers, these representatives can play a significant role by influencing public opinion and political discussions. The official number of active anglers is approximately 200,000 including permanent licences holders and (daily) guests (Spindler 1997). The overall number of people interested in fishing however is considered to be more than 400,000 (this number is based on estimates given by umbrella organisations, clubs and public opinion polls such as Oekf [2000]).

3.1.4 Impact of angling

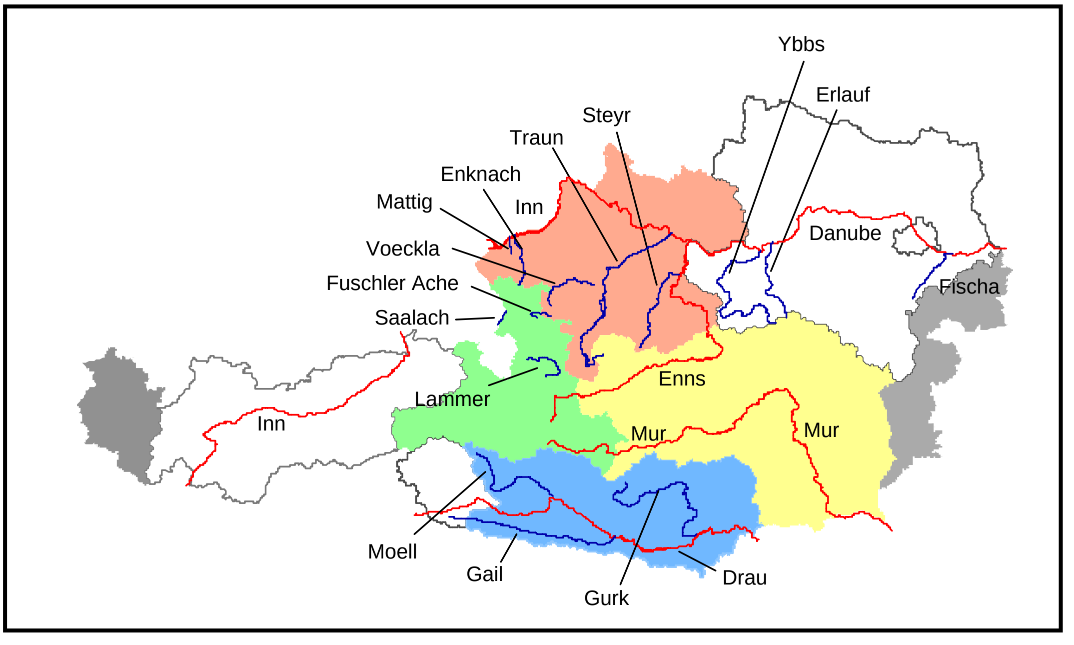
There has been a strong increase in the number of people interested in angling and this has lead to over-fishing in many places. Excessively stocked water bodies are problematic, especially as the number of fish and species composition in most fishing grounds are now strongly modified by stocking manipulations.

“Put-and-take” fisheries are common in Austrian rivers with Rainbow Trout being the most preferred stocking species. Only an estimate can be given as to the amount of fish taken by anglers because no official statistics exist and few clubs record catches. The only information available (not in the public domain) are stocking numbers and stocking costs for specific fishing grounds. From stocking records it can be estimated that anglers take an estimated 1,000 tonnes of fish annually.

Demand for stocking material is increasing. Inland production (more than 1,200 tonnes per year) is not sufficient to cover demand and additional stocking material, approximately 20-30 tonnes, is imported every year. The amount and origin (i.e. foreign) of stocking material is to a great extent influencing the local fish populations especially in smaller rivers but negative biological effects are often overruled by economic interests. Prime locations where there are still small, natural river stretches with endemic Grayling or Brown Trout populations have become exclusive fishing spots with high licence fees. Thus anglers are concerned that Cormorants, new invaders in these river sections, will cause great damage.



Five Austrian provinces (Lower Austria, Upper Austria, Salzburg, Styria, Carinthia) where conflict case studies have been reported.



Location of Austrian case study rivers. Red lines: main river systems: Danube, Drau, Enns, Inn, Mur. Blue lines: small rivers; only local points or small streches/parts of the rivers have been investigated and described as case studies (for details refer to literature cited).

3.1.5 Conflicts

The main Cormorant-fisheries conflict involves private anglers fishing in smaller river systems and Grayling and Trout regions. Here, studies report severe declines in Grayling population sizes. Predation pressure from Cormorants is often cited as the most critical threat to Grayling populations in Austria. However, in an intensive study of numerous population and habitat factors at 14 sites, Uiblein *et al*. (2001) found evidence for significant predation at only one site (Fuschler Ache): the most common threats to the Grayling populations studied were habitat structure, stocking and interspecific competition. No overall solution for resolving conflicts with Cormorants exists in Austria; there are nine provinces and thus nine different responses (see Section 3.2). Scaring and shooting activities mainly take place along small river systems with the aim of displacing Cormorants from the middle and upper sections down to the River Rhine forests, gravel pits or bigger lowland rivers.

River Mattig: an example of a small river (Photograph E. Kainz).

Distributing birds over a wider area is thought to reduce the impact for the individual owner of a fishing ground. Various solutions in the form of time- and area-restricted Cormorant regulations (regional management) have been issued under Art.9 of the EEC 1979 Birds Directive. Additional allowances for more sustained scaring and shooting are allocated to owners of fishponds and fish hatcheries. Extra protection is given in some tributaries for fish migrations during the spawning period.

However, following seven years of monitoring, it has been recognised that scaring and shooting has not reduced the overall number of migrating Cormorants. To date this applies to sites in all provinces observed. No major shifts of flocks, due to scaring, have occurred. In fact, on a local and regional scale, birds may react quickly and are changing their behaviour by visiting known and new feeding grounds during early morning hours, founding new roosting sites and flying in smaller flocks. The actual overall picture of Cormorant roost sites mirrors, to a great extent, the anthropogenic modified river systems in Austria. For example, impounded river sections are highly attractive to Cormorants who have tended to establish new roosting sites in these areas over the past 15 years. Moreover, further conflict exists between fisheries and NGOs such as WWF and BirdLife Austria who contest the extent of damage claimed by fishermen. These organisations demand scientific proof and careful studies dealing with this subject. However, no studies from the nature conservation side exist concerning the effects or impacts of Cormorants on aquatic systems and fish stocks.

Bigger river systems are generally designated as retreat areas. No scaring is officially allowed along most big rivers, natural lakes or any key roosting sites. To date there have been relatively few problems with Cormorants reported from natural lakes and lowland big river systems. Recently, however, there have been discussions about the Danube, particularly over existing fish biomass in this big river and whether Cormorants cause serious damage to the system. Fishers also want to scare Cormorants away along the bigger river systems to protect “sensitive spots” like wintering grounds for fish or the confluences of tributaries where fish concentrate during migration in spring etc.

However, fish data indicate that population figures (the basis for various calculations including possible estimates about the impact of fish-eating birds) have been greatly underestimated but it is extremely difficult to quantify the fish population in extremely dynamic big river systems. Data provided by current research projects (e.g. LIFE-Nature project on Danube Salmon[1]) using telemetry and wire-tagged fish should help to highlight the impact on fish populations in big rivers caused by human-induced environmental changes.


(Left) R. Enns: An example of a medium sized river, (Right) R. Steyr: tributary river of the Enns (Photographs E. Kainz).

Quantifying the amount of Cormorant impact on fisheries depends on the views of stakeholders involved as well as looking at the size of the area under investigation. Environmental conditions and existing habitat parameters in rivers (e.g. barriers, etc.) may increase the vulnerability of fish populations. River regulations – damming, stretching of rivers, and cutting off tributaries – improves the possibilities for the successful foraging of Cormorants. The productivity of a river should also be considered. For example, most water bodies are out of balance due to stocking while too many people expect a certain amount of guaranteed catch. Nevertheless, every action taken which improves the habitat quality for fish population could help

[1] "Wachau" study: Zauner, G. (2002): Überprüfung des Kormoraneinflusses auf die fischereilichen und fischökologischen Verhältnisse der Donau in der Wachau. University of Natural Resources and Applied Life Sciences, Vienna.

mitigate the effects of Cormorant predation. Shooting birds alone does not change the environmental conditions for fish fauna, scaring actions are fighting the symptoms not addressing the causal reasons (although people involved do feel better). Every measure taken should be accompanied by monitoring to evaluate the effects of scaring and shooting actions on bird and fish populations.

3.2 Cormorant conflicts with fisheries

Care must be taken when interpreting information provided in this section. Please refer to section 2.2.3 (*Methodological limitations and difficulties*).

3.2.1 Conflict site descriptions

Twenty Cormorant conflicts were reported from Austria: on 14 rivers/sections of rivers (Gail, Steyr (2 sections), Enns (2 sections), Mattig, Vöckla, Mur, Drau, Danube, Ybbs, Grosse Erlauf (4 sections), Traun, Fuschler Ache, Fischa (2 sections), Inn-Au Reikersdorf (Table 3.1). Most conflicts were reported from the middle reaches of rivers and at widths of 10-50m and altitudes of 100-500m. Most of these rivers were natural and of moderate nutrient status.

Habitat	**Feature**	**Category**			
	Reach	**Upper**	**Middle**	**Lower**	**Whole river**
Rivers	N = 20 cases		14	4	2
	Width (m)	**< 10m**	**10-50m**	**50-100m**	**100+m**
Rivers	N = 18 cases	1	12	3	2
	Altitude (m)	**< 100m**	**100-500m**	**500+m**	
Rivers	N = 19 cases		19		
	Trophic status	**Oligotrophic**	**Mesotrophic**	**Eutrophic**	
Rivers	N = 20 cases	8	12		
	Anthropogenic Influence	**Natural**	**Semi-natural**	**Artificial**	
Rivers	N = 20 cases	11	8	1	

Table 3.1 The number of Cormorant conflict cases reported from Austria in relation to habitat and habitat features.

3.2.2 Birds and fish

In Austria, Cormorants reported to be involved in conflicts were *P.c. sinensis*. Reported Cormorant densities in the 15 river cases for which data were provided are given in Table 3.2

Habitat	**No. cases**	**Cormorant density (maximum no. ha^{-1})**			
		Mean	**SE**	**Minimum**	**Maximum**
Rivers	15	6.1	2.73	3.0×10^{-5}	33.33

Table 3.2 Cormorant density (mean, standard error [SE], minimum and maximum) for Austrian cases in relation to habitat type.

Based on 20 river cases, 14 fish species were reported to be involved in conflicts (Table 3.3), the most commonly reported being Grayling, Brown Trout and Rainbow Trout.

3.2.3 Seasonality

Cormorant conflicts in Austria were reported to occur in winter (i.e. Oct-Mar): grey boxes indicate months where fewer conflict cases were reported.

Month of conflict												
COUNTRY	J	F	M	A	M	J	J	A	S	O	N	D
Austria												

Species	Frequency (% of 20 cases)
Grayling	85
Brown Trout	60
Rainbow Trout	45
Chub	24
Nase	19
Barbel	14
Roach	10
Huchen (Danube Salmon)	10
Ide	10
Bream	5
Perch	5
Pikeperch	5
Pike	5
Tench	5

Table 3.3 Fish species reported to be involved in conflicts with Cormorants in 20 cases from Austrian rivers.

3.2.4 Finance

Financial information on the 'costs' of Cormorant predation was reported for only 3 river conflict 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. It was requested that the values provided be categorised as either 'actual' or 'estimated' but this information was not provided for Austrian cases. Based on the 3 cases, average turnover for 2 recreational fisheries was 8,500 euro and average loss was 4,500 euro (53% of turnover) and turnover for the commercial fishery was reported as 150,000 euro and loss as 100,000 euro (67% of turnover).

3.2.5 Conflict issues: magnitude of conflict

Cormorant conflicts with recreational fisheries stakeholders on rivers were the most frequently reported (n = 20 cases) in Austria. Commercial fisheries stakeholders reported 4 conflict cases on rivers and nature conservation stakeholders reported 3. Recreational fisheries stakeholders on rivers identified 11 conflict issues relating to either fisheries or fish stocks. The most commonly cited major conflicts in each of these categories were increased recurrent costs and reduced stock through lowered production, respectively (Table 3.4).

3.2.6 Conflict issues: status of information used by stakeholders

Overall, stakeholders provided 246 records of the status of the information they used to inform themselves about Cormorant conflict issues in Austria. The highest proportion of records (39%) was for ‘popular’ articles, followed by ‘scientific literature’ (33%) and ‘grey literature’ (28%). Overall, there were differences in the use of popular, grey and scientific literature sources between the 3 stakeholder groups providing information (Table 3.5).

Conflict issue	Not claimed/not applicable	No impact	Minor effect	Major effect
(1) FISHERIES				
Reduced catch		1	2	7
Loss of stocked fish		1	3	4
Reduced value of catch (damage)			1	4
Loss of earnings from the fishery			3	4
Reduced capital values of fisheries			5	4
Increased recurrent costs		1	2	10
(2) FISH STOCKS				
Reduced stock - lowered production		2	4	17
Effects on popn. dynamics/community structure		4	4	13
Threats to endangered fishes		2	3	6
Loss of juvenile fish - lowered recruitment		1	3	8
Loss of spawners		1	1	13

Table 3.4 Cormorant conflict issues as recorded by recreational angling stakeholders for Austrian rivers (n = 20 cases). Each figure is the number of times a particular issue was cited by stakeholders.

Status of information	Stakeholder group			
	Recreational	**Commercial**	**Aquaculture**	**Nature conservation**
Popular	43.7%	66.7%	-	4.8%
Grey literature	23.0%	23.8%	-	50.0%
Scientific literature	33.3%	9.5%	-	45.2%
Total no. records (= 100%)	**183**	**21**	**None**	**42**

Table 3.5 Categorisation of the status of information used by stakeholders to inform themselves about Cormorant conflict issues. Nature conservationists used less popular literature and more grey literature than expected, commercial fisheries stakeholders used less scientific literature than expected ($X^2 = 32.299$, df = 4, $P < 0.001$).

3.3 Potential Cormorant management tools

Information (summarised in the following tables) was provided on (1) general actions taken against Cormorants in Austria, (2) management plans/legal regulations, (3) actions at small rivers, (4) at large rivers, and (5) at small stillwaters. By law in all Austrian provinces it is officially not allowed to disturb Cormorants on roosting sites. This seems to be practicable for big traditional sites, but new foundations along smaller rivers might be (or already have been) disturbed by local members of stakeholder groups (illegal actions); methods taken: non lethal and lethal use of live ammunition, various audio frightening techniques, presence of humans.

NAME OF RESPONDENT AND YOUR AFFILIATION	**R.Parz-Gollner, J. Trauttmansdorff (plus various pers. verbal informations)**
COUNTRY	**Austria**
REGION / PROVINCE / etc. (if applicable)	**all provinces**
Period which is concerned [year(s)]	**2000 - 2002**

General information on actions against Cormorants in Austria (annual numbers)

	Total numbers		Regional numbers						
	National numbers	**Count/Estimate?**	**Lower Austria**	**Upper Austria**	**Salzburg**	**Carynthia**	**Styria**	**Tyrol**	**Vorarlberg**
Number of breeding colonies destroyed/disturbed *New breeding attempts at Lake Constance (2001: one pair, 2002: 20 pairs), development and status of site is insecure because commercial fishing is taking place in the same area.	**0**								
Number of nests destroyed	**0**								
Number of nestlings killed	**0**								
Number of adults killed in the non-breeding season *Official reported numbers are too low (illegal shooting happens).	**ca. 260-410**		100/200	ca.40	ca.30	<10	60-100	0	ca. 20-30
Number of night roosts destroyed or disturbed *Illegal actions.	**> 4**		> 2?	> 1?	?	?	> 1?	?	?

Management plans / legal regulations (Austria 1995-2002)

	Total country		Lower Austria	Upper Austria	Salzburg	Carynthia	Styria	Tyrol	Vorarlberg
Are there any management plans in effect? Please list all national or regional plans and give details	**yes**		yes	yes	yes	yes	yes	yes	yes
Are there any regulations in effect that allow Cormorant culling? Please list all national or regional regulations and give details	**no**								
Are there any coordinated culling programmes in your country?	**no**								
Is it mandatory to obtain single permits for Cormorant killing?	**yes**								
* it depends, distinction between fish-ponds or fish-hatcheries vs. small rivers; in general commercial fisheries can ask for extended permissions to harass or kill cormorant; permissions for anglers are more restricted in time and location.									
Has a general permit for Cormorant killing been issued?	**(yes)**								
Is there any financial compensation for fish losses?	**no**								
Is there any financial aid for the construction of Cormorant exclosures or for scaring programmes, etc.?	**no**								

Remarks (on General information & on Management plans /legal regulations):

Management Plans: all non-lethal and killing of birds have a high acceptance by fishermen; especially shooting is not accepted by nature conservationists-groups (fighting against symptoms does not solve the problems of habitat situation for fish-fauna).

Fishing-, hunting- and nature protection laws in Austria are subject of regulation by provincial governments; therefore nine different laws exist; concerning cormorants: every province has formulated own rules (shooting-areas, time-period, amount etc.), for all regulations the EU-bird directive has to be taken into account.

Overall aim of all management plans: primarily to keep cormorants away from small rivers systems (grayling and trout sections, or other sensitive fish-grounds) and an attempt to define alternate areas (with no disturbances) for the birds along bigger river systems, reservoirs, big lakes etc. Acceptance of this general agreement depends on the various stakeholder groups involved.

Lower Austria: shooting zones (from - to) defined in the legislative text along a number of tributaries (running water systems), no limit for shooting exist; no shooting on/around roost sites, further no-shooting zones (including Danube and March) are defined in the text. Additional exceptions for pond-fishery exists.

Upper Austria: within the distance of 100m around every water body shooting is allowed; limit 5% of winter-population, if amount of birds exceeds 1500 indiv. shooting of 10% is allowed. No shooting on roost sites, further no-shooting zones are defined in the text.

Styria: legal directive exists, possibility to shoot cormorants on request; no shooting on/around roost sites.

Carinthia: possibility to shoot cormorants on request; no shooting on/around roost sites.

Salzburg: official general shooting time (not in accordance with the EU-bird directive).

NAME OF RESPONDENT AND YOUR AFFILIATION	**R.Parz-Gollner, J. Trauttmansdorff**							
COUNTRY	**Austria**							
REGION / PROVINCE / etc. (if applicable)	**Lower Austria, Upper Austria, Styria, Carinthia - main involved provinces**							
Period which is concerned [year(s)]	**1995 - 2002**							
C. Feeding Sites								
C1. Small Rivers (Width < 100 m)								
Cormorant Damage Control Activities								
1. Resource Management	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Habitat management								
Improve habitat quality for fishes	rarely	years	2	1	1	e.g. Fischa, Pielach (Life-Danube Salmon), rest unknown	rebuilding of migration barriers, frequently fish passes	rare or no written information
Fish management								
Altering fish stocking regimes. Please give details								
(a) timing	regularly	months	1	1	1	all influenced systems	change from autumn strocking to spring stocking	no written official information, private decision by owner
(d) stocked fish sizes	regularly	months	1	1	1	all influenced systems	depends on private decision	
2. Bird-proof barriers (overhead barriers and peripheral fencing/netting)	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Wire, lines or string in grid patterns (please give spacing	rarely used - see remarks						spawning area for grayling (Carinthia), some spots defined as sensible fish-grounds for the grayling (Styria)	single cases mentioned; no results about effects in Carnithia because no spawners are left in the moment, project in Styria seems to function at the moment, recently under monitoring)
Submersed fish refuges (please specify)	unknown						on the contraty, fishermen remove sunken wood etc from the river system	
3. Wildlife Management								
3.1 Non-lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Human harassment								
Human patrol on foot or in vehicles	regularly	days	1	1	1/5		depends on effort taken by stakeholder groups, no coordination (would be much too expensive!), not practicable because not enough persons are involved or available;	
Audio frightening techniques								
Vehicle horns	rarely	not efficient						
Pyrotechnics / Fireworks (shell crackers, screamers, whistling projectiles, exploding projectiles, bird bangers, flash/detonation cartridges)	rarely	days, not efficient, birds not affected	2	3	4		depends on effort taken by stakeholder groups	
Visual frightening techniques								
Animated scarecrows (moving and/or in combination with automated sound devices)	unknown or rarely used	days	2	1/5	?	Styria	depends on effort taken by stakeholder groups; animated scaring works a little bit better, but after complaints from neighbours (disturbence by noise) the use of this technique was officially forbidden	verbal reference (one location mentioned); birds get familiar and accustomed to this scaring technique.
3.2 Lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Shooting adults and immatures								
to reinforce non-lethal harassment	regulary	days and weeks	1	1	1 - 2	most tributaries of main rivers like the Danube; also along all small river systems in all other Austrian provinces	depends on cooperation between fishermen and hunters, shooting should protect upper regions /grayling and trout sections/ from cormorant attacks; few private owner of fishing grounds pay poll tax per shot bird	Parz-Gollner & Trauttmansdorff 2001
to reduce bird numbers at specific sites	regulary	in general not efficient	1	1	1	some hot spots in grayling and trout sections	depends on location involved, in general quick replacement of shot birds due to migration (main migration route, flyway); actual weather situation plays an important role! Altenate feeding sites must/should be available;	activity of stakeholder groups involved, owners of fishing grounds - no written information available, no official documentation.

NAME OF RESPONDENT AND YOUR AFFILIATION	**R.Parz-Gollner, J. Trauttmansdorff**							
COUNTRY	**Austria**							
REGION / PROVINCE / etc. (if applicable)	**all provinces concerned**							
Period which is concerned [year(s)]	**1995 - 2002**							
C. Feeding Sites								
C2. Large Rivers (Width > 100 m)	**Danube, Mur, Drau**							
Cormorant Damage Control Activities								
1. Resource Management	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Habitat management								
Improve habitat quality for fishes	in discussion for the Danube, state of application						possible cormorant impacts are not the cause for discussion about the improvement of habitat quality	
Fish management								
Altering fish stocking regimes. Please give details	not used						in general - efforts are taken to reintroduce e.g. Danube salmon (LIFE Project)	contact with BOKU Univ., Inst. of Hydrobiology
3. Wildlife Management								
3.1 Non-lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Audio frightening techniques								
Pyrotechnics / Fireworks (shell crackers, screamers, whistling projectiles, exploding projectiles, bird bangers, flash/detonation cartridges)	rarely	not efficient					illegal	
3.2 Lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Shooting adults and immatures								
to reinforce non-lethal harassment	very rarely	not efficient				high risk for hunters, (techniques!), other stakeholder groups are carefully watching situation;	illegal according to existing law, various provinces	
to reduce bird numbers at specific sites	not used	not efficient						

NAME OF RESPONDENT AND YOUR AFFILIATION	**R.Parz-Gollner, J. Trauttmansdorff**
COUNTRY	**Austria**
REGION / PROVINCE / etc. (if applicable)	**Lower Austria, Upper Austria, Styria, Carninthia**
Period which is concerned [year(s)]	**1995 - 2002**
C. Feeding Sites	
C3. Small Still Waters (< 100 ha); plus aquaculture!	**small waters in general, fish hatcheries, carp production, (angling ponds, gravel pits)**

Cormorant Damage Control Activities								
1. Resource Management	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Habitat management								
Improve habitat quality for fishes	rarely used	months	1	1	5	Lower Austria	depends on existing habitat structures; macrophytes serve as a shelter for fish	verbal information
Fish management								
Altering fish stocking regimes. Please give details								
(a) timing	rarely used	not efficient	1	3	2	Lower Austria	stocking in spring in carp ponds	verbal information
(b) frequency	not used, not possible							
(c) density	rarely used	not efficient	1	3	2	Lower Austria	carp-pond owners increase stocking	verbal information
(d) stocked fish sizes	not used, not possible							
2. Bird-proof barriers (overhead barriers and peripheral fencing/netting)	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Wire, lines or string in criss-cross patterns (please give spacing)	rarely used	?	3	1	1	small trout hatchery	daily work and handling is handicapped	verbal information
Wire, lines or string in grid patterns (please give spacing)	rarely used	?	3	1	1	small trout hatchery	daily work and handling is handicapped	verbal information
3. Wildlife Management								
3.1 Non-lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Human harassment								
Human patrol on foot or in vehicles	rarely	days/not efficient	1	1	3		most still waters are too big to be controlled efficently by humans; effect for days: needs permanent patrols, high effort (man costs)!	verbal information
Audio frightening techniques								
Pyrotechnics / Fireworks (shell crackers, screamers, whistling projectiles, exploding projectiles, bird bangers, flash/detonation cartridges)	rarely/regular	days/not efficient					pond-farming (private property): owner has to be hunter also; on public land - conflicts with other interest-groups	verbal information
3.2 Lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Shooting adults and immatures								
to reinforce non-lethal harassment	regulary	days, months	3	1/5	1		most ponds are big, great distances make it difficult to hunt cormorants, very attractive habitats- high fish desities! (also for otters in some locations); high harassment effect depends on effort taken (regular shooting, daily patrols)	private notes, protocols of pond owners; high acceptance by fishermen, no acceptance by nature conservationists
to reduce bird numbers at specific sites							displacement of birds!	

Note: freezing temperatures with frequent icing of small still waters means, that cormorants switch to feeding grounds in/on small rivers (open water surface); actual temperature plays an important role - number of birds present and local distribution;

carp-ponds: depends on the location (ice-cover or not); problems may occure either in spring or late autumn for a short period of time; majority of ponds are not stocked (adult fish) during winter; ponds with hatchlings are sometimes situated closer to human buildings; size of most ponds does not allow overhead barriers (costs, not practicable).

3.4 Stakeholders consulted

(1) Bundesanstalt fuer Wasserwirtschaft, Inst. F. Gewaesseroekologie, Fischereibiologie und Seenkunde; Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management.
(2) Austrian Federal Ministery of Agriculture, Forestry, Environment and Water Management, Division Internat. Trade Policy, Fisheries Policy.
(3) BOKU – University of Natural Resources and Applied Life Sciences, Department of Hydrobiology, Fisheries and Aquaculture (HFA), Vienna (Fishbiology).
(4) University of Vienna, Department of Ecology, Limnology, (Fishbiology).
(5) Niederösterr. Landesregierung, Abt. Agrarecht, Abt. Forstwirtschaft, (authorised fishery expert of the provincial government).
(6) OeFG Österreichische Fischereigesellschaft, gegr. 1880, Anglers Association; umbrella organisation.
(7) ÖKF Österreichisches Kuratorium für Fischerei, Anglers Association, umbrella organisation.
(8) Österreichischer Arbeiterfischereiverband, Anglers Association; umbrella organisation.

Various comments and input from official authorised experts (provincial governments) in all relevant Austrian provinces were also received. As were those from individual representatives, regional membership organisations, angling clubs:

(9) Ooe Landesfischereiverein (umpire, provincial level).
(10) Fisch. Gem. Egg-Hermagor (umpire, regional level).
(11) Schaumpurg-Lippe'sche FV (manager, regional level).
(12) SCA Mattig-Braunau (umpire, regional level).
(13) FV Fischamend (regional level).
(14) Fish farm /Koettl (commercial production, private owner of fish farm).

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4. Belgium

4.1 National Overview

Belgium is a federal country, split between the French-speaking Walloon Region in the south and the Dutch-speaking Flanders Region in the north. Thus, each region tackles nature conservation and fishery-related affairs separately.

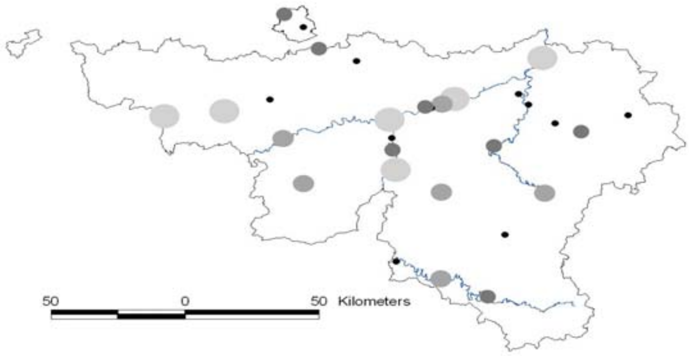

Figure 4.1 Distribution of Great Cormorant night roosts in Wallonia and Brussels (January 2004). The main roosts are located along the Meuse Valley. Black indicates between 2- 50 birds; Dark grey indicates between 51 – 100 birds; Middle grey indicates 100-200 birds; Light grey indicates more than 200 birds.

4.1.1 Wallonia (Southern Belgium)

By Jean-Yves Paquet

Background

Almost no scientific studies on Cormorant impacts are available in Wallonia as conflicts have only surfaced as recently as 1994. However, potential clashes are growing with people's concerns described in a fishermen's publication ("le Pêcheur Belge") or in newspapers ("Le Soir Magazine"). Further information was gathered following discussions with fishermen or fish farmers and stakeholders (see section 4.4). Data presented here were mostly collected in 2001-02. Since then, an interdisciplinary research team has conducted an in-depth study of the conflicts involving Cormorants in Wallonia. A technical report (web site: http://environnement.wallonie.be/crnfb/), which updates the data presented here, has been published by the Centre de Recherche Nature, Forêt, Bois.

The Great Cormorant first appeared as a regular wintering bird in Wallonia during 1991-1992. The wintering population subsequently developed rapidly, first along the main valley of the Meuse River and then along the tributaries and other water systems. The total mid-winter count in January 2002 was 3,900 individuals, with 2,600 birds in the Meuse valley. The wintering population is still increasing slowly in the smaller river systems, primarily due to colonization of new fishing grounds (Paquet & AVES, 2002). Since 1992 a still growing small breeding population of 250 pairs has been established in two colonies within Wallonia but they have not shown any sign of expanding yet.

Great Cormorants (Left) at a night roost at Chertal, Meuse Valley and (Right) along the Liege, Meuse Valley (Photographs Marc Fasol).

4.1.1.1 Legal status of the Great Cormorant in Wallonia

The Cormorant is still strictly protected (regional law on wild indigenous birds from 14/07/1994). The regional law from 8/10/1998 allows financial compensation for damage caused by protected birds to professional fisheries but these compensations are considered too low or too difficult to obtain by fish farmers, for whom the fish farming activity is mostly a supplementary job.

4.1.1.2 Fish farming in Wallonia

The fish farming sector in Wallonia has recently been reviewed (Rollin *et al*. 2000). There are 3 main production sectors: (1) intensive production of Rainbow Trout (50 fisheries, 800 tonnes produced annually), (2) production of Carp (see Appendix 2 for scientific names), Roach and Tench (150 tonnes produced annually) (3) intensive production in warm water (one farm). Table 4.1 shows some examples of conflicts concerning fisheries, but other cases have been reported.

Fish farmers from other smaller sites are also claiming damages to cyprinid farming through their Professional Associations. During the winter of 2000-2001, a Great Cormorant roost settled at a major cyprinid fish farm in Freux (Luxembourg) and damages are expected to be high. Most conflicts arise within cyprinid fisheries, those fisheries being particularly subject to Great Cormorant predation consist of large ponds (>1 ha) with easy access and high fish density. However, damages claimed are usually substantiated by comparison of expected yield, obtained yield and estimation of biomass taken by Great Cormorants based on bird counts. As the profit margin is low with most cyprinid fish farming, even a small amount of stock loss through predation could make aquaculture unprofitable.

Place	Fishery type	Damage claimed	Annual prodn.	Remarks
Gozée (Hainaut)	Cyprinid	84% of the expected annual production	43kg/ha (expected: 270 kg/ha)	
Grand-Leez (Namur)	Cyprinid	50% of 1.5t of stocked fish	?	calculation from bird counts
Thorembaix (Namur)	Cyprinid	60% of the expected annual production	0.6t (1.5 expected)	
Virelles (Hainaut)	Cyprinid mainly	'significant': estimated to be 6t in one winter from bird counts	11.6t in 1999 (harvest every two year)	Pond in 80 ha nature reserve: extensive fish farming is additional funding.
Ermeton (Namur)	Rainbow Trout	almost 100% on 25,000 recently stocked small trout	?	Damage costs estimated by the fish farmers: about 5000 Euro

Table 4.1 Details of claimed Cormorant losses at Wallonian fish farms.

Great Cormorants along the Liege, Meuse Valley (Photographs Marc Fasol).

4.1.1.3 Conflict in rivers and streams

There are two main types of rivers in Wallonia: (1) large rivers, namely the Meuse and the Sambre, which are in the ecological "roach zone" (meandering, slow-flowing, silted, but largely canalized), (2) small tributaries in the "trout" or the "grayling" zones (fairly fast-flowing, well oxygenated, pebbles/gravel, some aquatic vegetation). Angling is very popular in these two river types (with 77,089 fishing permits sold in 1999). Most local angling associations complain about Great Cormorants, mainly using their presence at fisheries to estimate predation impact.

Roach

Recent claims of low yields of Roach in the Meuse River have led to the funding (by the Fisherman Fund) of a study on the impact of Great Cormorant predation on Roach. This study, concerning a limited sector of the Meuse River heavily frequented by the Cormorants, began in 2002, and is led by the Laboratory of Freshwater Ecology at the University of Namur (Prof. J.C. Micha).

Grayling

Fishermen have voiced their fears about over-predation on Grayling populations particularly on the River Lesse and River Amblève (V. Franck pers. comm.). A sound fish population assessment is needed to investigate these claims, not yet demonstrated by electro-fishing (P. Gérard pers. comm.).

Some 'solutions' already in use

String devices have been used at some fish farms as well as across some stretches of river important for fly-fishing (V. Franck pers. comm.). This method is efficient but costly. Illegal culling of Great Cormorants is probably limited, although difficult to assess. The use of a fishing hook fixed into small live or dead fish and used as bait for the birds has been known to occur (B. Jardon pers. com.). Disturbance of night roosts rarely happens although it has along some small rivers. Breeding colonies are located in protected/private sites.

4.1.1.4 Conclusions

(i) More studies are needed of the impact of wintering Great Cormorants, particularly on smaller rivers (e.g. Semois, Lesse, Amblève).
(ii) Wallonia is a good area to assess conflicts with Cormorant in the context of a 'no killing' policy.
(iii) Good communication with fish farmers and anglers about the problems they face and possible solutions is urgently needed.

Great Cormorant and roost site at Jambes, Meuse Valley (Photographs Marc Fasol).

4.1.2 Flanders

By K. Devos (Flemish Institute for Nature Conservancy), H. Verreycken, D. de Charleroy & C. Belpaire (Institute for Forestry and Game Management)

Background

The Great Cormorant disappeared as a nesting bird in Flanders (Northern Belgium) in 1965 and only returned in 1993. Since then the breeding population has increased from 8 pairs in 1993 to 443 in 1999 with a wintering group of between 2,000 and 2,500 birds. The total (ecological and economical) impact of this large number of fish-eating birds on a small area like Flanders (with only 257km^2 water surface) needs urgent investigation. The diet of the Great Cormorant mainly consists of Roach and other cyprinids, Perch and Ruffe with only a few Eel. However, the impact of Great Cormorant predation on fish stocks is difficult to assess because of lack of data on fish populations. Moreover, economic losses can only be deduced roughly from numbers of birds and their daily food requirement.

4.1.2.1 The Conflict

In Flanders there are very few commercial fisheries and no specific studies on Great Cormorants. Nevertheless the population has increased considerably during the last decade and damage to fish farms and ponds was considered to be a major problem. For the extensive aquaculture facilities in Flanders, losses in yields are estimated to be almost 50% and economical losses are even higher as investments have to be made to prevent further damage. Thus, the impact of the Great Cormorant on fish stocks and fisheries in Flanders can be highlighted as follows:

(i) Ecological problems: preference for Roach rather than Bream which resulted in depleted Roach stocks; habitat alteration and predation on rare species.
(ii) Pathologic problems: wounding of fish and causing stress as well as the spread of diseases.
(iii) Social problems: decrease in the number of fishermen/anglers.
(iv) Economic problems: loss of income because of lower fish yields; fewer fishing/angling permits sold.

A survey, carried out in 1995 and 2001, involved questionnaires (sent to eight main fish culturists), asked about production and financial losses from Great Cormorants and whether any preventative measures were used to reduce damage. Five fisheries (62.5%) responded, claiming overall that there was a 32% yield loss from Great Cormorants costing 130,760 euros per year. When applied to all fisheries in Flanders, the cost of Cormorant damage to commercial fisheries could be high as 632,000 euros. However, fisheries may have ‘exaggerated their loss’ because of the possibilities of financial compensation and the fact that they are taxed on the expected yield per ha. Although these figures are of unknown accuracy, losses of fish to Cormorants in extensive aquaculture sites are considered severe and Government actions necessary. Consideration of Cormorant Management in Flanders laid emphasis on financial support and/or compensation for fish culturists rather than the reduction of the Cormorant population.

4.1.2.2 Conclusions:

(i) Further investigation is necessary to assess possible ecological damage.

(ii) Damage to fish farms and ponds is a major local problem highlighting the necessity for government intervention in the form of financial compensation and/or subsiding of scaring technology. Passive deterrents are not possible for very large ponds and are not allowed in nature reserves.

4.2 Cormorant conflicts with fisheries

Care must be taken when interpreting information provided in this section. Please refer to section 2.2.3 (*Methodological limitations and difficulties*). The conflicts described hereafter should be taken as a representative example and not considered as a complete overview of conflict cases occurring in Belgium. An up-to-date synthesis of the conflicts in Wallonia has recently been published (see Maréchal, 2004).

4.2.1 Conflict site descriptions

Four Cormorant conflicts were reported from Belgium: on 2 rivers (Meuse, Semois) and one lake (Grand-Leez ponds) and one aquaculture pond (Roly ponds) (Table 4.2). Most conflicts were reported from the middle reaches of rivers and at widths of 10-100m and altitudes of <500m. Both rivers were semi-natural and of relatively low nutrient status.

	Feature	**Category**		
Habitat	**Reach**	**Upper**	**Middle**	**Lower**
Rivers	N = 2 cases		2	
	Width (m)	**< 10m**	**10-50m**	**50-100m**
Rivers	N = 2 cases		1	1
	Altitude (m)	**< 100m**	**100-500m**	**500+m**
Rivers	N = 2 cases	1	1	
Lakes	N = 1 case		1	
Aq. pond	N = 1 case		1	
	Trophic status	**Oligotrophic**	**Mesotrophic**	**Eutrophic**
Rivers	N = 2 cases	1	1	
Lakes	N = 1 case			1
Aq. ponds	N = 1 case		1	
	Anthropogenic Influence	**Natural**	**Semi-natural**	**Artificial**
Rivers	N = 2 cases		2	
Lakes	N = 1 case			1
Aq. ponds	N = 1 case		1	

Table 4.2 The number of Cormorant conflict cases reported from Belgium in relation to habitat and habitat features.

4.2.2 Birds and fish

In Belgium, Cormorants reported to be involved in conflicts were *P.c. sinensis*. Reported Cormorant density on the single aquaculture pond was 1 bird ha^{-1}. Cyprinids were recorded in conflict with Cormorants in the single Belgian aquaculture pond case study reported. Based on 2 river cases, 2 fish species were reported to be involved in conflicts: Roach and Grayling.

4.2.3 Seasonality

Cormorant conflicts in Belgium were reported to occur in winter (i.e. Oct-Mar): grey boxes indicate months where few conflict cases were reported.

Month of conflict												
COUNTRY	J	F	M	A	M	J	J	A	S	O	N	D
Belgium												

4.2.4 Finance

Financial information on the ‘costs’ of Cormorant predation was reported for only 1 aquaculture pond conflict case. 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. It was requested that the values provided be categorised as either ‘actual’ or ‘estimated’. The information provided for Belgium was an estimate. Based on this case, turnover for the fisheries was 12,000 euro and loss was 4,800 euro (40% of turnover).

4.2.5 Conflict issues: magnitude of conflict

As the number of cases reported from Belgium was small (n = 4), information from all was combined. Cormorant conflicts with recreational fisheries stakeholders on rivers were the most frequently reported (n = 2 cases) in Belgium. Recreational fisheries and aquaculture stakeholders reported a total of 10 conflict issues relating to fisheries, fish stocks or the environment. The most commonly cited major conflict was reduced catches (Table 4.3).

4.2.6 Conflict issues: status of information used by stakeholders

Overall, stakeholders provided 24 records of the status of the information they used to inform themselves about Cormorant conflict issues in Belgium. The highest proportion of records (75%) was for ‘popular’ articles, followed by ‘grey literature’ (25%) and no records for ‘scientific literature’. Overall, samples were too small to examine differences in the use of popular, grey and scientific literature sources between the 2 stakeholder groups providing information (Table 4.4).

	Stakeholder group			
Status of information	**Recreational**	**Commercial**	**Aquaculture**	**Nature conservation**
Popular	85.7%	-	-	-
Grey literature	14.3%	-	100.0%	-
Scientific literature	-	-	-	-
Total no. records (= 100%)	**21**	**None**	**3**	**None**

Table 4.4 Categorisation of the status of information used by stakeholders to inform themselves about Cormorant conflict issues.

Conflict issue	Not claimed/not applicable	No impact	Minor effect	Major effect
(1) FISHERIES				
Reduced catch			2	2
Loss of stocked fish				1
Loss of earnings from the fishery				1
(2) FISH STOCKS				
Reduced stock - lowered production			2	1
Effects on popn. dynamics/community structure			1	
Threats to endangered fishes				1
Loss of aquaculture stock			1	1
(3) ENVIRONMENTAL				
Eutrophication			1	
Landscape alteration			1	
Damage to vegetation/landscape			1	

Table 4.3 Cormorant conflict issues as recorded by recreational angling and aquaculture stakeholders for Belgian waters (n = 4 cases). Each figure is the number of times a particular issue was cited by stakeholders.

4.3 Potential Cormorant management tools

Information (summarised in the following tables) was provided on (1) general actions taken against Cormorants in Belgium, (2) management plans/legal regulations, (3) actions at roosts, (4) at small rivers, (5) at large rivers, and (6) at aquaculture sites.

NAME OF RESPONDENT AND YOUR AFFILIATION	**Jean-Yves Paquet, Aves** (Belgian French-speaking bird study association) (with information from Inne Vught - Flemish Region; Vincent Frank, Damien Rouvroyand and Pierre Gérard - Wallon Region)				
COUNTRY	**Belgium**				
REGION / PROVINCE / etc. (if applicable)	**Wallon Region**				
Period which is concerned [year(s)]	**2001-2002**				
General information on actions against Cormorants in Belgium (annual nos)					
	Total numbers		**Regional numbers**		
	National numbers	**Count/Estimate?**	**Wallon Region**	**Brussels Region**	**Flemish Region**
Number of breeding colonies destroyed or disturbed	**0**	**count**	**0**	**0**	**0**
Number of nests destroyed	**0**	**count**	**0**	**0**	**0**
Number of nestlings killed	**0**	**count**	**0**	**0**	**0**
Number of adults killed in the non-breeding season	**0**	**count**	**0**	**0**	**0**
Number of breeding adults killed	**3**	**count**	**0(3)**	**0**	**0**
Number of night roosts destroyed or disturbed	**2 - 3**	**count**	**2-3**	**0**	**0**

Management plans / legal regulations (Belgium 2001-02)				
	Total country	**Wallon Regon**	**Brussels Region**	**Flemish Region**
Are there any management plans in effect? Please list all national or regional plans and give details	**no**	no	no	no
Are there any regulations in effect that allow Cormorant culling? Please list all national or regional regulations and give details	**no**	no	no	no
Are there any coordinated culling programmes in your country?	**no**	no	no	no
Is it mandatory to obtain single permits for Cormorant killing?	**yes**		no permit given	
Has a general permit for Cormorant killing been issued?	**no**	no	no	no
Is there any financial compensation for fish losses?	**yes**	yes (1)	?	?
Is there any financial aid for the construction of Cormorant exclosures or for scaring programmes, etc.?	**(yes)**	no/yes (2)	no	?

Remarks (on General information & on Management plans /legal regulations):

(1) The Government has to pay any economic losses attributed to the action of a protected species (including the Cormorant).
Damage has to be estimated by a Water & Forestry Department agent.
Only those who run a fishery as their main professional activity are able to request compensation.
Compensation is thus available to vey few people in Wallonia, and has - to date- not been payed out (P. Gérard pers.comm)
(2) The above-mentioned compensation is offered providing that "protection measure has been taken to prevent any further losses".
(3) Reports (from various oral sources) of fisherman or fish-farmers illegally culling Cormorant are not rare. Numbers illegally killed every winter is not known but should be low.

COUNTRY	**Belgium**							
REGION / PROVINCE / etc. (if applicable)	**Wallon Region**							
Period which is concerned [year(s)]	**2001-2002**							
B. Roosting Sites								
Cormorant Damage Control Activities								
1. Avoid foundation of new roost sites	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Scaring by human presence	rarely	months	2	2	4	One recreational fishery pond and a river	Minor site (person in charge living on the site) or river with a lot of fishing activities	Pers. obs.
2. Existing roost sites: Hinder cormorants from roosting	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Scaring by use of live ammunition	rarely	not efficient	5	5	4	Meuse river	Illegal use of this scaring technique has been noted around some roosts: Police action prevented further scaring	Pers. obs.

NAME OF RESPONDENT AND YOUR AFFILIATION	**Jean-yves Paquet, AVES**							
COUNTRY	**Belgium**							
REGION / PROVINCE / etc. (if applicable)	**Wallon Region**							
Period which is concerned [year(s)]	**2001-2002**							
C. Feeding Sites								
C1. Small Rivers (Width < 100 m)								
Cormorant Damage Control Activities								
1. Resource Management	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Habitat management								
Improve habitat quality for fishes	regularly	unknown				diverse	not primarily used to mitigate Cormorant impact	
2. Bird-proof barriers (overhead barriers and peripheral fencing/netting)	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Wire, lines or string in parallel patterns (please give spacing)	regularly	months	3	3	3	Amblève & Loue (salmonid rivers)	Winter only: restricted to flyfishing section of river	V. Frank, Fishery Administration, pers. com.
3. Wildlife Management								
3.2 Lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Shooting adults and immatures								
to reduce bird numbers at specific sites	rarely	not efficient	4	5	2	diverse	illegal culling observed in some places but is very limited (see note 1)	

(1) Illegal culling techniques include the placement of dead (or live?) fish with a triple-hook.

At least one Cormorant has been found killed by this technique.

NAME OF RESPONDENT AND YOUR AFFILIATION	**JY Paquet, AVES**							
COUNTRY	**Belgium**							
REGION / PROVINCE / etc. (if applicable)	**Wallon Region**							
Period which is concerned [year(s)]	**2001-2002**							
C. Feeding Sites								
C2. Large Rivers (Width > 100 m)								
Cormorant Damage Control Activities								
1. Resource Management	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Habitat management								
Improve habitat quality for fishes	not for Cormorant mitigation							
3.2 Lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Shooting adults and immatures								
to reduce bird numbers at specific sites	rarely	not efficient	4	5	2	diverse	illegal culling occur has been observed in some places but is very	

NAME OF RESPONDENT AND YOUR AFFILIATION	JY PAQUET, AVES		Inne Vught, Instituut voor Bosbouw en Wildbeheer					
COUNTRY	**BELGIUM**		**Belgium**					
REGION / PROVINCE / etc. (if applicable)	**WALLON REGION**		**Flemish Region**					
Period which is concerned [year(s)]	**2001-2002**		**2001-2002**					
C. Feeding Sites								
C5. Aquaculture								
Cormorant Damage Control Activities								
1. Resource Management	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Fish management								
Altering fish stocking regimes. Please give details.	unknown ?							
2. Bird-proof barriers (overhead barriers and peripheral fencing/netting)	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Physical exclosures with narrow meshed systems (mesh sizes < 20 cm) using wire, lines or string in parallel or grid patterns	unknown						aquaculturists have tried (individually) different systems but currently no synthesis available	P. Gérard, pers. com.
Wire, lines or string in parallel patterns (please give spacing)	yes	months/years	2	2	2	State fisheries of Mirwart	spacing of 25 cm; cost of 0.8 euro/m2 for the wire, 0.25 euro/m2 for the full installation (see note 1).	D. Rouvroy, pers. com.
Wire, lines or string in parallel patterns (please give spacing)	yes	years	4	3	2	Lozen and Rijkevorsel	spacing of 30 cm, effective on small intensive fish ponds	Inne Vught, pers. com.
Polyethylene rope with foam floats	unknown							
Coloured streamers to increase visibility of wires and strings	unknown							
Submersed fish refuges (please specify)	rarely, submersed cage	unknown	2/4	1	?	Virelles pond (not currently in use)		
3. Wildlife Management								
3.1 Non-lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Gas bangers / cannons (propane gas exploders)	unknown ?							
Pyrotechnics / Fireworks (shell crackers, screamers, whistling projectiles, exploding projectiles, bird bangers, flash/detonation cartridges)	unknown ?							
Live ammunition	unknown ?							
3.2 Lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Shooting adults and immatures								
to reduce bird numbers at specific sites	rarely	unknown	4	5	2	illegal culling probably occurs rarely on some fish-farms		

(1) Long-term efficiency and quite cost effective on small intensive pond, up to 1 ha.

4.4 Stakeholders consulted

In the Wallonia region, the following stakeholders, representing the Government, fisheries associations and inter-University groups assisted with this overview of Cormorant conflicts. Data was also gathered from fisheries literature. The main problem is that there are many complaints about Cormorants but little available 'data'.

(1) Centre de Recherché de la Nature des Forêts et du Bois, Ministère de la Region Wallone, Avenue Maréchal Juin, 23, 5030 Gembloux, Belgium.
(2) Service de la Pêche, Région Wallonne, 100, Avenue Gouverneur Bovesse, 5100 Jambes, Belgium.
(3) Representative of the Fisheries Associations from the Hainaut Province in Belgium, Rue de la Mairie 69, 59164 Marpent, France.
(4) Groupe d'Intérêt pour les Poisons, la Pêche et l'Aquaculture, Avenue du Maréchal Juin, 23, 5030 Gembloux, Belgium.

In Flanders, the following governmental agencies gave information on Cormorant conflicts:

(5) Scientific Attaché - Fisheries Biologist, Institute for Forestry and Game Management, Duboislaan 14, B-1560 Groenendaal – Hoeilaart, Belgium.
(6) Flemish Institute for Nature Conservancy, Instituut voor Natuurbehoud Kliniekstraat 25, 1070 Brussels, Belgium.
(7) Institute for Forestry and Game Management, Institute for Forestry & Game Management , Gaverstraat 4, 9500 Geraardsbergen, Belgium.

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5. Bulgaria

5.1 National overview
By Ivailo Nikolov

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5.1.1 Great Cormorant

The Great Cormorant *(P.c. sinensis)* breeding population in Bulgaria was very dynamic during the last century. Literature sources show this species as a very common breeder along the Danube River and the Black Sea coast, especially south of the town of Bourgas (Lorenz-Liburnau 1893, Lintia 1909, Striburni 1930, Harrison 1933, Pateff 1950). However, large areas of natural wetlands were drained throughout the middle of the 20th century influenced by a fear of spreading infections and as a result of the need to expand areas under cultivation. This reduced the total area of natural wetlands in Bulgaria from 200,000 ha to 11,000 ha and contributed to the decline in breeding Great Cormorant numbers (Kolchev & Jordanov 1981).[1] As a result, the Great Cormorant was included in the Red Data Book of Bulgaria (1985) as a species “threatened to extinction”.

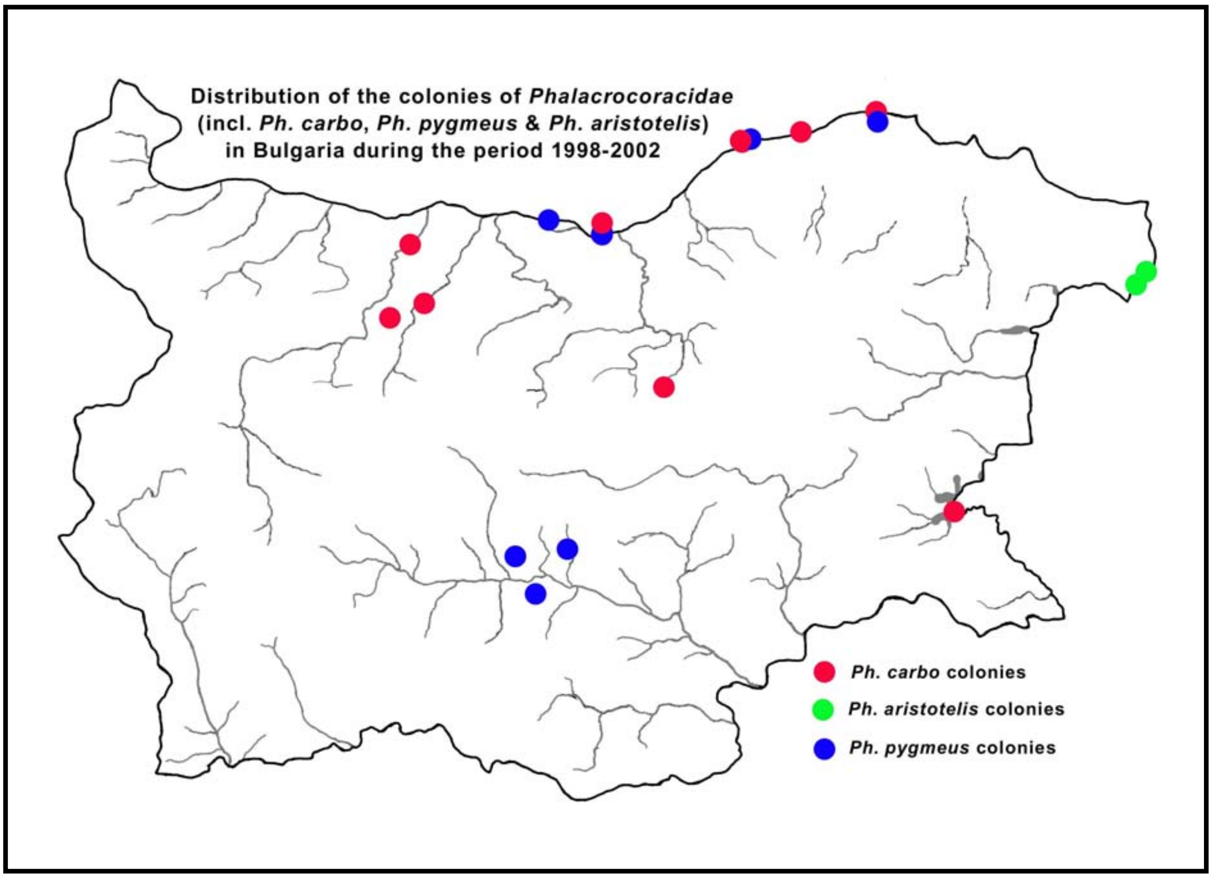
Until the end of the 1970s few colonies existed, mostly on islands along the Danube (up to 387 pairs on the island of Vardim) while only one colony, sometimes exceeding 50 pairs, was registered along the Black Sea coast in Mandra Lake (Prostov 1964, Paspaleva & Mitschev 1968, Georgiev, 1976, Michev 1985, Simeonov *et al.* 1990, Ivanov *et al.* 1997). Great Cormorant numbers began to grow again between the end of the 1970s and the beginning of the 1980s. For example, during 1978 there was only one colony reported with 70 breeding pairs (Ivanov *et al*. 1997) but in 1979 there were three with ca. 339 pairs (Simeonov *et al*. 1990, Michev 1985). In 2001, seven colonies were recorded with 1,206 pairs (N. Kamburova P. Shurulinkov, K. Popov, S. Dalakchieva, R. Tsonev pers. comm.). There is now evidence that Great Cormorant numbers are beginning to stabilize along the Danube and the Black Sea Coast.

However, the situation inland is changing. Until the middle of the 1990s, inland areas were the only ones unoccupied by Great Cormorants, excluding two isolated cases. During the last decade of the 20th century Great Cormorants have also started to move into these areas. Given the relatively good environmental conditions (there are lots of lakes, marshes, fish farms and rivers close to colonies), a few small colonies appeared (numbering up to 49 pairs) but there is no doubt their number will continue to increase.

For the period 2000-2004 the rough estimation of the breeding populations of Great Cormorant in Bulgaria shows a number of 1,700 – 1,900 pairs (data summarised on the basis of known localities and taking into account the possible existence of a few more colonies on the islands along the Danube bordering Romania.

[1] Until the beginning of the 1950s detailed information on the number of these colonies and data for any inland localities was incomplete.

The expansion of the Great Cormorant as a breeding bird in Bulgaria during the last 25 years seems to indicate that it is no longer "threatened to extinction" and thus its conservation status may need to be re-considered.



5.1.2 Pygmy Cormorant

Current legislation for the Pygmy Cormorant *(P. pygmeus)* defines it as a species with very high conservation status. This cormorant species was given legal protection and has also been included in the Red Data Book of Bulgaria (1985) as a species "threatened to extinction".[2] The Pygmy Cormorant breeding population in Bulgaria for the period 2000-2003 numbered roughly 450 – 600 pairs, nesting primarily along the Danube. There were a few small colonies (with a total of ca. 40 pairs) along Maritsa River and in the Eastern Rhodopes (Nikolov *et al*. 2000, Ivanov & Muraveev 2002) but proof of their recent existence is not available.

The wintering population across the country is as follows (according to Nikolov *et al*. 2000):

(i) Mid-January (between 1995-2000) - 7,000 to 11,000 birds

(ii) Mid-December (between 1998-2000) – 16,000 to17,500 birds

(iii) Most spend the cold months in Southern Bulgaria (the Thrace plain), primarily along the rivers Maritsa, Toundzha and the Black Sea coast.

[2] The number of wintering Pygmy Cormorants has increased during the last two decades as a result of a shift of the wintering territory to the Balkan Peninsula.

The greater part of fish farming activities in Bulgaria occurs in the Thrace plain, especially the production of young fish (one-year-old fingerlings) produced for restocking. This restocking material is usually conserved in special ponds to be used for stocking the fish farms, other ponds, artificial reservoirs and lakes throughout the whole country. The Pygmy Cormorant is subject to lots of negative human action like shooting, scaring and destruction of breeding colonies and roosts etc. Some estimates suggest that 15-20% of the wintering population of Pygmy Cormorants is shot every year in Bulgaria (Nikolov *et al*. 2000). This is because the species is one of the main migratory fish-eating birds wintering in Bulgaria, feeding at fish farms and aquaculture facilities causing substantial damage to production. Major problems have occurred because the Great Cormorant was a hunted species for some time until 2002, but the fishermen and hunters do not always have the knowledge or experience to differentiate between them and the Pygmy Cormorant. Nikolov *et al*. (2002) believe that losses, caused by direct shooting, do not exceed 1,400 Pygmy Cormorants throughout Bulgaria.

Lines with coloured streamers in parallel patterns are rarely used as Cormorant deterrents in Bulgaria (Freshwater Fish. Res. Inst. Plovdiv. Photograph Ivailo Nikolov).

5.1.3 Shag

Boev (1951) first reported the appearance of the Shag *(P. aristotelis desmarestii)* in Bulgaria. Most of the breeding grounds are located on cliffs along the Northern Black Sea Coast. According to Boev (1985), 25 – 30 pairs used to breed there but in 2002, the breeding population was estimated to be 150-200 pairs (Ivailo Nikolov pers. unpubl. data). During the winter, some of the birds move southwards to the Southern Black Sea Coast. Small numbers of birds from Ukrainian colonies are also likely to be present along the Southern Black Sea Coast during the non-breeding season and the winter months. The Shag is also included in the Red Data Book of Bulgaria (1985) as a species “threatened to extinction”. However, due to the current low numbers, this species does not cause any significant damage to the fisheries and marine aquaculture.

5.1.4 The Conflict

The economic damage from the loss of fish is high every year. Unfortunately, there are no precise guidelines or criteria applied to assess the scale of alleged damage to fish stocks and fisheries. Several non-lethal methods have been developed to protect fish production from fish-eating birds but the exact level of damage and the numbers of Cormorants (Great and Pygmy) feeding in the fishponds is unknown. Such information would allow the best strategy, methods and technical devices for solving the conflict between fish farming and Cormorants to be chosen in order to conserve both birds and fish.

Carbide cannon: Designed as a repellent against Cormorants, usually attracting birds to promising feeding ponds with its noise. (FFRI Plovdiv. Photograph Ivailo Nikolov).

5.1.5 Case Studies

Danube River

Data collected so far show that over the last 50 years Great Cormorant populations in Bulgaria have progressed along the Danube River. Located on islands (some of them protected areas), colonies are difficult to access. However, the presence of breeding birds can, in certain cases, depend on the water level of the island’s wetlands, which, in turn, depends on the water level of the Danube (the latter at present is controlled by man). Fluctuations in water levels also contribute to an absence of breeding cormorants for various periods (Ivanov *et al*. 1997). Almost all of the nests are in trees located in flooded forests, in separate or mixed colonies with Night Heron (*Nycticorax nycticorax*), Little Egret (*Egretta garzetta*), Grey Heron (*Ardea cinerea*), Spoonbill (*Platalea leucorodia*) and Glossy Ibis (*Plegadis falcinellus*) (Michev 1985). Eight islands are already known to hold Cormorant colonies but sometimes populations spread onto other islands. The biggest colonies ever registered along the Danube River were found on the islands of Vardim (387 pairs in the beginning of the 1960s (Paspaleva & Mitschev 1968) and Devnia (400 pairs in 2001 (Kamburova pers. comm.). The remaining colonies usually consist of between 30 and 200 pairs (Paspaleva & Mitschev 1968, Ivanov 1985, Lalev 1988, Simeonov *et al*. 1990, Boev 1990, Ivanov *et al*. 1997, Kostadinova 1997). Along the river and within adjacent fish ponds, conflicts occur between fisheries and cormorants over reduced catch, reduced value of the catch, loss of stocked fish and loss of earnings.

Black Sea Coast

Only two localities of breeding Great Cormorants are known along the Black Sea coast, both situated in lakes close to the town of Bourgas. The colony in Bourgas Lake during the middle of the 1980s numbered ca. 40 pairs while at the beginning of the 1990s it reached ca. 150 breeding pairs. The other colony is located in Mandra Lake. The nests are built on high-voltage power line posts, which cross the lake. As the maintenance team repeatedly destroys the nests, Cormorant numbers have varied greatly over the years. In 1985, 39 pairs were documented with 150 pairs in 1992 (Ivanov *et al*. 1997). Recent data show that this number has already doubled. In 2001 around 312 pairs were breeding there (K. Popov & S. Dalakchieva pers. comm.). Conflicts between Cormorants and fisheries arise because of frustrations over diminishing catches, reduced value of the catch and removal of fish from nets.

Inland

Apart from the Danube River and the Black Sea coast, information on inland Great Cormorant colonies is mostly lacking. There was evidence of inland breeding in the marsh of Straldzha, west of the town of Karnobat (Ioakimov 1909). Breeding status, number of pairs and any additional details were not mentioned. In 1967 a pair of Great Cormorants was found nesting on willow (*Salix sp*.) in the deposit basin of Kremikovtsi, situated in the northeastern suburbs of the city of Sofia (Simeonov & Sofroniev 1967).

Until 1996 no data were available for inland localities but since then four colonies have been established in Northern Bulgaria. Located in dam-lakes or little basins close to riverbeds, two of them (dam-lake Gorni Dabnik and dam-lake Iovkovtsi) comprise only Great Cormorants (R. Tsonev & P. Shurulinkov, pers. comm., Spasov 2002) while the rest (the ones situated in old riverbeds along the Rivers Iskar and Vit) also contain Night Heron and Little Egret. However, these colonies are few in number and still quite unstable with Cormorants numbering between 4 and 43 breeding pairs. The colony in dam-lake Gorni Dabnik was located in trees that were flooded. When the water level lowered at the end of 2000, the trees holding the 43 nests were felled for firewood. Such practices also reduced another colony (located along the Vit River close to Bivolare village) from 38 pairs in 1998 to 5 pairs during the period 1999-2002 (R. Tsonev & P. Shurulinkov, pers. comm.). Small breeding numbers mean that there is relatively little conflict between fisheries and Cormorants inland during the breeding season (until mid-July). After the breeding season, however, Cormorants spread into the big reservoirs where fishermen then note reduced catches.

5.1.6 Gaps to be filled

The economic damage from the loss of fish is high every year. Unfortunately there are no precise guidelines or criteria in Bulgaria to assess the scale of alleged damage to fish stocks and fisheries. Several non-lethal methods have been developed to protect fish production from fish-eating birds but a more precise understanding is needed of the extent of damage and the numbers of Cormorants (Great and Pygmy) feeding in the fishponds. This would allow the best strategy, methods and technical devices for managing the conflict between fisheries and cormorants to be chosen in order to conserve both the birds and fish.

5.2 Cormorant conflicts with fisheries

Care must be taken when interpreting information provided in this section. Please refer to section 2.2.3 (*Methodological limitations and difficulties*).

5.2.1 Conflict site descriptions

One Cormorant conflict was reported from Bulgaria: on one lake (Lake Ovcharitsa: 630ha, 100-500m altitude, eutrophic, artificial). This lake was used by all four stakeholder groups: recreational and commercial fishermen, aquaculturists and nature conservationists.

5.2.2 Birds and fish

In Bulgaria, cormorants reported to be involved in conflicts were *P.c. sinensis* and *P. pygmeus*. Maximum reported Cormorant density at the lake was 16 birds ha^{-1}. Six fish species were recorded in conflict with Cormorants in the single Bulgarian lake case study reported: Silver Carp, Bighead Carp, Carp, Goldfish, Wels and Catfish (see Appendix 2 for scientific names).

5.2.3 Seasonality

Cormorant conflicts in Bulgaria where reported to occur in winter (i.e. Oct-Apr).

Month of conflict												
COUNTRY	J	F	M	A	M	J	J	A	S	O	N	D
Bulgaria	■	■	■	■						■	■	■

5.2.4 Finance

Financial information on the ‘costs’ of Cormorant predation was reported for the Bulgarian lake conflict case. 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. It was requested that the values provided be categorised as either ‘actual’ or ‘estimated’. The information provided for Bulgaria was actual. Based on this case, turnover was 150,000 euro and loss was 80,000 euro (53% of turnover).

5.2.5 Conflict issues: magnitude of conflict

Cormorant conflicts in this case were reported by one person for all 3 fisheries stakeholder groups and by a nature conservation NGO representing the 4th stakeholder group. Conflict issues were scored exactly the same for all 3 fisheries stakeholders and so these have been combined and compared with those values given by nature conservationists (Table 5.1). Fisheries stakeholders identified 17 conflict issues relating to fisheries, fish stocks and environment. In contrast, nature conservationists identified 9 issues relating to both fish stocks and environment.

Conflict issue	Not claimed/not applicable	No impact	Minor effect	Major effect
(1) FISHERIES				
Reduced catch				3
Loss of stocked fish				3
Reduced value of catch (damage)				3
Reduced catchability (stress/behaviour)			3	
Loss of earnings from the fishery				3
Reduced capital values of fisheries			3	
Increased recurrent costs			3	
(2) FISH STOCKS				
Reduced stock - lowered production			3	
Effects on popn. dynamics/community structure				3
Vectors of diseases/parasites			(1)	
Loss of juvenile fish - lowered recruitment			(1)	3
Loss of spawners			(1)	3
Loss of aquaculture stock			(1)	3
(3) ENVIRONMENTAL				
Eutrophication			3 (1)	
Scaring/shooting disturbance			3 (1)	
Landscape alteration			3 (1)	
Drowning in fishing gear			3 (1)	
Damage to vegetation/landscape			3 (1)	

Table 5.1 Cormorant conflict issues as recorded by recreational angling, commercial fisheries and aquaculture stakeholders (and nature conservation stakeholders – in brackets) for the Bulgarian lake case study. Each figure is the number of times a particular issue was cited by stakeholders.

5.2.6 Conflict issues: status of information used by stakeholders

Overall, stakeholders provided 94 records of the status of the information they used to inform themselves about Cormorant conflict issues in Bulgaria. The highest proportion of records (75%) was for ‘popular’ articles, followed by ‘grey literature’ (25%) and no records for ‘scientific literature’. Overall, there were differences in the use of popular, grey and scientific literature sources between the 3 fisheries stakeholder groups and the nature conservationists providing information (Table 5.2).

	Stakeholder group			
Status of information	**Recreational**	**Commercial**	**Aquaculture**	**Nature conservation**
Popular	71%	71%	71%	100%
Grey literature	29%	29%	29%	-
Scientific literature	-	-	-	-
Total no. records (= 100%)	**28**	**28**	**28**	**10**

Table 5.2 Categorisation of the status of information used by stakeholders to inform themselves about Cormorant conflict issues. The 3 fisheries stakeholder groups used popular and grey literature sources differently to nature conservationists ($X^2 = 3.837$, df = 1, P = 0.05).

5.3 Potential Cormorant management tools

Information (summarised in the following tables) was provided on (1) general actions taken against Cormorants in Bulgaria, (2) management plans/legal regulations, (3) actions at breeding sites, (4) at roosts, (5) at small rivers, (6) at large rivers, (7) at small stillwaters, (8) at very large waterbodies, (9) at aquaculture sites.

NAME OF RESPONDENT AND YOUR AFFILIATION	Ivailo Nikolov, Sofia University Nikolay Kissiov, National Association of Fishery and Aquaculture in Bulgaria-NAFishA-BG & Society for Protection and Feeding of Water-connected Birds in Bulgaria.
COUNTRY	Bulgaria
REGION / PROVINCE / etc. (if applicable)	
Period which is concerned [year(s)]	1998-2002

General information on actions against Cormorants in Bulgaria (annual numbers)

	Total numbers		Regional numbers						
	National numbers	Count/Estimate?	Dam lake Gorni Dabnik (northern Bulgaria)	Bivolare (northern Bulgaria)	Bourgas lakes (incl. southern Black Sea coast)	Maritsa river (incl. dam lake Ovcharitsa)	Struma river	Toundzha river	Danube river
Number of breeding colonies destroyed or disturbed	2		+	+	+				+
Number of nests destroyed	81		+	+	+				+
Number of nestlings killed	no		+	+	+				+
Number of adults killed in the non-breeding season	1000+		+		+				+
Number of breeding adults killed	yes				+				+
Number of night roosts destroyed or disturbed	5				+	+	+	+	

Management plans / legal regulations (Bulgaria 1998-2002)		
	Total country	**Dam lake Gorni Dabnik**
Are there any management plans in effect? Please list all national or regional plans and give details	**no**	No
Are there any regulations in effect that allow Cormorant culling? Please list all national or regional regulations and give details	**yes**	see below
Are there any coordinated culling programmes in your country?	**no**	No
Is it mandatory to obtain single permits for Cormorant killing?	**no**	Yes; only the hunters have this right during the period allowed: 15 August - 31 January.
Has a general permit for Cormorant killing been issued?	**yes**	No
Is there any financial compensation for fish losses?	**no**	Just an attempt; practice with this - missing.
Is there any financial aid for the construction of Cormorant exclosures or for scaring programmes, etc.?	**no**	No

Remarks (on General information & on Management plans /legal regulations):

(1) There is no data published about the colonies destroyed in Bulgaria. There is some information about inland colonies e.g. the dam lake Gorni Dabnik, the colony near the village of Bivolare and the ones in Bourgas lakes. The colonies, placed on the islands along the Danube river are permanently disturbed by the fishermen but not enough to terminate them. Some of the biggest colonies there moved to some little islands close to the bigger islands where they were formerly. These little islands are just on the border between Romania and Bulgaria and the fishermen are not allowed to go there. So currently there is no need for urgent protection of most of the Danube river colonies.

(2) As a legal object of hunting, Cormorants in Bulgaria can be shot during the non-breeding period between 15 August and 31 January. During this period (and outside it when shooting is illegal) lots of Cormorants are killed annually. The exact number (even an approximation) is not known. Most birds are shot close to fish-ponds, lakes and dam lakes with high fish production, or close to big rivers inland (by the sport fishermen).

(3) A few years ago there was an attempt for financial compensation to all those fishermen who had high economical losses to Pygmy Cormorants. As a part of the project for Pygmy Cormorant conservation in Bulgaria this compensation was divided between the fish-ponds along the Maritsa river, where the birds used to spend the winter in quite great numbers. It was impossible to determine which part of the losses was caused by Pygmy Cormorants and which by Great Cormorants. For the fishermen and the insurance companies there was no difference - the losses were due to either. However some fishermen falsified (increased) their losses, the insurance companies realized this and stoped compensation payments for all fish-ponds.

(4) Some of the night roosts in Bulgaria (especially those inland along the rivers Struma, Maritsa and Toundzha) are mixed roosts - with Great and Pygmy Cormorants. They are an object of disturbance during winter period, when the humans' intolerance against cormorants is much bigger. Unfortunately like the other cases we do not have concrete information about this persecution.

(5) Currently we do not know how many of the fishermen are prepared to use and apply protective constructions against fish-eating birds. There are some experimental net-covered basins in some of the fish-ponds (e.g. fish-ponds "Plovdiv"). Their use is not proved enough, because the constructions are not well done. That is why most of the fishermen are not disposed well to such methods. Most of these constructions (excluding the noise-producing tools and some other cheap methods for scaring cormorants) are built as a result of the projects for Pygmy Cormorant protection in the fish-ponds along the Maritsa river. Unfortunately this is the reason why these net-covered basins are just an advertisement for these projects but nothing more. Financial support for such methods is currently missing in Bulgaria. Despite this, where they do occur (and are not part of a 'conservation' project) they are self-initiatives by fishermenwho are well informed about these protective measures and know their advantage.

Geographic coordinates of the places mentioned above:
Inland: Bivolare (N 43/29; E 24/34); dam lake Gorni Dabnik (N 43/22; E 24/19); fish-ponds "Plovdiv" (N 42/10; E 24/50); dam lake Ovcharitsa (N 42/15; E 26/11); fish-ponds Blagoevgrad (N 42/01; E 23/04);
Black Sea coast: Bourgas lakes: Vaia lake (N 42/30; E 27/25) + complex Mandra - Poda (N 45/25; E 27/23)
Along Danube river: about 10 islands with colonies

NAME OF RESPONDENT AND YOUR AFFILIATION	**Ivailo Nikolov, Sofia University**							
	Nikolay Kissiov, National Association of Fishery and Aquaculture in Bulgaria-NAFishA-BG & Society for Protection and Feeding of Water-connected Birds in Bulgaria.							
COUNTRY	**Bulgaria**							
REGION / PROVINCE / etc. (if applicable)								
Period which is concerned [year(s)]	**1990-2001**							
A. Breeding Sites								
Cormorant Damage Control Activities								
2. Existing colonies: Hinder cormorants from breeding	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Removal of trees	rarely	not known/years	4\1	5\1	4\3	Danube river, Bivolare, dam lake Gorni Dabnik		
Scaring by human presence	rarely	not efficient	4	2	3	Danube river		
3. Existing colonies: Reduce breeding success								**References**
Removal of nests	rarely	not known/years	4\3	3\2	3\2	Danube river, Bourgas lakes		See (1)
Egg destruction/removal	rarely	months	4\2	3	2	Danube river, Bourgas lakes		

(1) Ivanov, B., T. Michev, D. Nankinov, V. Pomakov, L. Profirov. (1997) Breeding and wintering status of the Cormorant *Phalacrocorax carbo* in Bulgaria - Ekologia Polska, vol.45, 1,63-68.

NAME OF RESPONDENT AND YOUR AFFILIATION	**Ivailo Nikolov, Sofia University** **Nikolay Kissiov, National Association of Fishery and Aquaculture in Bulgaria-NAFishA-BG & Society for Protection and Feeding of Water-connected Birds in Bulgaria.**
COUNTRY	**Bulgaria**
REGION / PROVINCE / etc. (if applicable)	
Period which is concerned [year(s)]	**1990-2001**
B. Roosting Sites	

Cormorant Damage Control Activities

2. Existing roost sites: Hinder cormorants from roosting	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Removal of trees	rarely	days	4\2	5\2	4\2	dam lake Ovcharitsa; along Maritsa and Struma rivers;		
Shooting some birds to reinforce scaring	rarely	days	4	4	3\2	dam lake Ovcharitsa; along Maritsa and Struma rivers;		

NAME OF RESPONDENT AND YOUR AFFILIATION	**Ivailo Nikolov, Sofia University** **Nikolay Kissiov, National Association of Fishery and Aquaculture in Bulgaria-NAFishA-BG & Society for Protection and Feeding of Water-connected Birds in Bulgaria.**
COUNTRY	**Bulgaria**
REGION / PROVINCE / etc. (if applicable)	
Period which is concerned [year(s)]	**1990-2001**
C. Feeding Sites	
C1. Small Rivers (Width < 100 m)	

Cormorant Damage Control Activities

3.2 Lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Shooting adults and immatures								
to reinforce non-lethal harassment	rarely	days	3	3	4	Along Maritsa and Struma rivers, dam lake Ovcharitsa		
to reduce bird numbers at specific sites	regularly	days	3	3	4\3	Along Maritsa and Struma rivers, dam lake Ovcharitsa		

NAME OF RESPONDENT AND YOUR AFFILIATION	**Ivailo Nikolov, Sofia University** **Nikolay Kissiov, National Association of Fishery and Aquaculture in Bulgaria-NAFishA-BG & Society for Protection and Feeding of Water-connected Birds in Bulgaria.**							
COUNTRY	**Bulgaria**							
REGION / PROVINCE / etc. (if applicable)								
Period which is concerned [year(s)]	**1990-2001**							
<u>C. Feeding Sites</u>								
C2. Large Rivers (Width > 100 m)								
Cormorant Damage Control Activities								
3.2 Lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Shooting adults and immatures								
to reinforce non-lethal harassment	rarely	days	3	3	4	Danube river		
to reduce bird numbers at specific sites	rarely	days	3	3	4\2	Danube river		

NAME OF RESPONDENT AND YOUR AFFILIATION	**Ivailo Nikolov, Sofia University** **Nikolay Kissiov, National Association of Fishery and Aquaculture in Bulgaria-NAFishA-BG & Society for Protection and Feeding of Water-connected Birds in Bulgaria.**							
COUNTRY	**Bulgaria**							
REGION / PROVINCE / etc. (if applicable)								
Period which is concerned [year(s)]								
<u>C. Feeding Sites</u>								
C3. Small Still Waters (< 100 ha); not aquaculture								
Cormorant Damage Control Activities								
3.2 Lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Shooting adults and immatures								
to reinforce non-lethal harassment	rarely	days	3	3	4	Small water bodies in Southern Bulgaria		
to reduce bird numbers at specific sites	rarely	days	3	3	4\2	As above		

NAME OF RESPONDENT AND YOUR AFFILIATION	**Ivailo Nikolov, Sofia University** **Nikolay Kissiov, National Association of Fishery and Aquaculture in Bulgaria-NAFishA-BG & Society for Protection and Feeding of Water-connected Birds in Bulgaria.**							
COUNTRY	**Bulgaria**							
REGION / PROVINCE / etc. (if applicable)								
Period which is concerned [year(s)]	**1990-2001**							
C. Feeding Sites								
C4. Very Large Waterbodies (Still Waters and Coastal Waters)								
Cormorant Damage Control Activities								
1. Resource Management	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Fish management								
Altering fish stocking regimes. Please give details.	rarely	years	2	3	2\1	see (1)		
3. Wildlife Management								
3.1 Non-lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Human harassment								
Human patrol on foot or in vehicles	rarely	not efficient	4\5	5	4	dam lake Ovcharitsa		
Audio frightening techniques								
Pyrotechnics / Fireworks (shell crackers, screamers, whistling projectiles, exploding projectiles, bird bangers, flash/detonation cartridges)	regularly	not efficient	5\4	5	3\2	dam lake Ovcharitsa		
3.2 Lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Shooting adults and immatures								
to reinforce non-lethal harassment	rarely	days	3\4	3	4	dam lake Ovcharitsa		
to reduce bird numbers at specific sites	rarely	days	4\5	3	4\2	dam lake Ovcharitsa		

(1) Some water bodies used also for extensive commercial fishing (e.g. dam lake Ovcharitsa), dependent on the presence of the last cormorants remaining (during spring mostly)

NAME OF RESPONDENT AND YOUR AFFILIATION	**Ivailo Nikolov, Sofia University** **Nikolay Kissiov, National Association of Fishery and Aquaculture in Bulgaria-NAFishA-BG & Society for Protection and Feeding of Water-connected Birds in Bulgaria.**						
COUNTRY	**Bulgaria**						
REGION / PROVINCE / etc. (if applicable)							
Period which is concerned [year(s)]	**1996 - 2002**						
C. Feeding Sites							
C5. Aquaculture -	**Pond farms and Artificial lake-dams/reservoirs**						
Cormorant Damage Control Activities							
1. Resource Management	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**
Fish management							
Altering fish stocking regimes. Please give details.							
(a) timing	regularly	months	2	2	4	Southern part of Bulgaria	
(b) frequency	regularly	months	3	2	4	As above	
(c) density	regularly	months	3	2	4	As above	
(d) stocked fish sizes	regularly	months	2	2	4	As above	
(e) etc.							
Use/management of feeding ponds to attract Cormorants (i.e. to distract them away from production ponds)	rarely	months	2	2	2	As above	
2. Bird-proof barriers (overhead barriers and peripheral fencing/netting)	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**
Wire, lines or string in parallel patterns (3-4m)	rarely	months	2	2	2	As above	
Coloured streamers to increase visibility of wires and strings	rarely	months	2	2	2	As above	
3. Wildlife Management							
3.1 Non-lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**
Human harassment							
Human patrol on foot or in vehicles	regularly	days	4	4	4	As above	Sometimes human patrols also shoot birds
Audio frightening techniques							
Gas bangers / cannons (propane gas exploders)	rarely	days	4	3	3	As above	See (1)
3.2 Lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**
Shooting adults and immatures							
to reinforce non-lethal harassment	regularly	days	4	4	2	whole country	See (2)
to reduce bird numbers at specific sites	regularly	days	4	4	2	whole country	See (2)

(1) The models in use are not very effective. Other models could be more effective. In some cases the cormorants can be attracted by the noise of the cannons to the fishponds.
(2) Cormorant is a legal hunting object between 15 August-January 15.

5.4 Stakeholders consulted

(1) NOMICOM (Managing dam-lake Ovcharitsa; cage fish-farming, restocking and commercial fishery in this dam-lake), Noncho Vodenicharov, G. Dimitrov Str. No 2, Radnevo, Bulgaria.
(2) Green Balkans (NGO), Tsar Ivan Shishman Str., No 76, 6000 Stara Zagora, Bulgaria.
(3) Union of Hunters and Fishermen in Bulgaria, Vitosha Blvd., No 31-33, 1000 Sofia, Bulgaria.

5.5 Bibliography

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(15) Lorenz-Liburnau, L. (1893) "Ornithologische Bruchstücke aus dem Gebiete der unteren Donau." Orn. Jahrbuch. 4: 12-23.
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6. Czech Republic

6.1 National overview

By Renata Martincova & Petr Musil

Background

The conflicts between Cormorants and fisheries originated in the 1980s as a result of a growing European population and the establishment of a Czech breeding population. The increasing occurrence of Cormorants not only in the breeding season but also during migration and wintering in the 1990s has caused escalating conflicts between fisheries managers and nature conservationists in the Czech Republic. Nowadays, the conflict is present in three types of water bodies:

(a) Fishpond areas, in which the breeding colonies are situated and where Cormorants are present nearly all year round.

(b) Fishpond areas where conflicts are concentrated especially during migration.

(c) Rivers used by Cormorants in the non-breeding season (more intensive during the winter season).

The main conflicts seem to occur in breeding areas (Figure 6.1) where Cormorants are present for most of the year. The current breeding population size of the Great Cormorant in the Czech Republic is estimated to be 200 – 250 pairs distributed across three or four colonies. All of them are located on islands in fishpond areas (Martincova & Musil 2003).

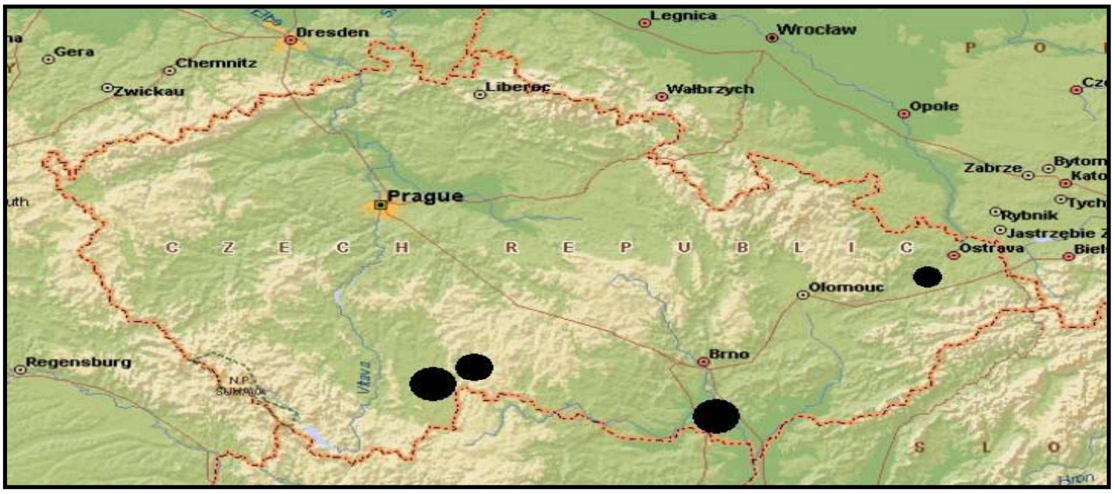


Figure 6.1 Distribution of breeding Great Cormorant colonies in the Czech Republic (2002-04).

6.1.1 The Cormorant in the Czech Republic

Up until 1980, only irregular breeding attempts by Great Cormorants were recorded in the Czech Republic. At the beginning of the 1980s, however, two important colonies were established: a colony on the water basin Nove Mlyny, South Moravia in 1982 and a colony on the Zenich and Novy Vdovec fishponds in the Trebon region, South Bohemia in 1983. The size of these colonies has increased rapidly in subsequent years (Musil & Janda 1997). The Moravian colony reached a peak number of 612 pairs by 1991 but then colony size declined dramatically. Due to the destruction of trees used for breeding, a new colony, the only current breeding colony in this region, was established nearby at the Krive Jezero Nature Reserve. In South Bohemia, the number of breeding pairs increased to 140 in 1988 but since 1989 the colony size has fluctuated between 62 and 106 pairs. However, since 2000, part of this colony has shifted from Zenich to the Krvavy fishpond in the Jindrichuv Hradec region, 23 km NE. There had been two known breeding colonies (both have ca. 50-100 pairs (see Martincova & Musil [2003]) in South Bohemia until 2004, when the cormorants left the colony on the fishpond Krvavy and occupied only the colony on the Zenich fishpond (162 pairs). The removal of the colony is supposed to be due to disturbance in the early breeding period.

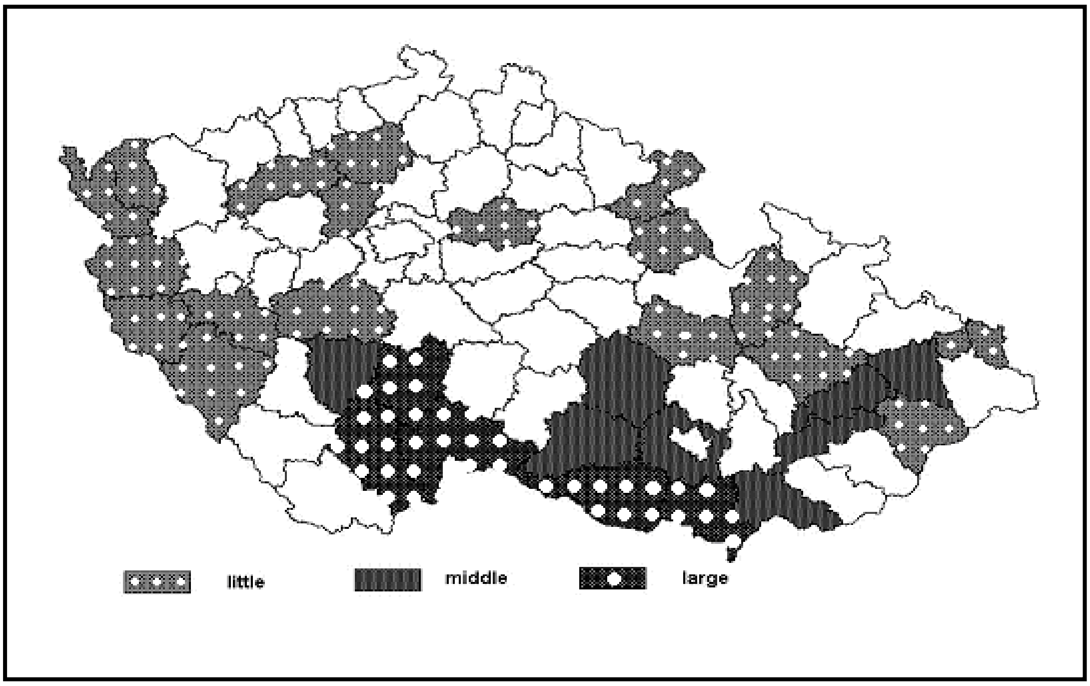
Roost site at the Nové Mlýny water reservoir, South Moravia (Photograph J. Chytil).

Breeding localities as well as other fishpond areas and reservoirs are the most important areas during the migration period. The estimated number of migrating Cormorants is approximately ten times higher than in the breeding and post-breeding seasons. Furthermore, although the spring migration is shorter, it seems to be much stronger than the autumn migration. The population size during migration is estimated to be 12,000-14,000 birds compared to the wintering population of about 8,000-12,000 birds. The size of the wintering population can be estimated more accurately than the number of migrating Cormorants and totals around 4,000 – 6,000 birds. In 2003 and 2004, when a more accurate winter census was carried out, the number of wintering Cormorants was estimated at 7,000 – 8,000 birds. The most important wintering localities are the Vltava, Labe, Ohre, Sazava and Berounka rivers in Central Bohemia (including Prague), South Moravia (Nove Mlyny water reservoir, upper part of the Morava and the Dyje rivers), the Becva and Morava Rivers (Central Moravia), Odra, Olza and Opava rivers (North Moravia), Berounka river in Plzen town (West Bohemia) and Vltava and Otava rivers (South Bohemia) (Martincova *et al*. 2003, Musil & Musilova 2004).

6.1.2 The Fishpond Area of Trebon

The fishponds

The Trebon Biosphere Reserve represents one of the largest and oldest fishpond districts of the Czech Republic. It consists of 600 fishponds, which are surrounded by agriculture and forest landscapes (Musil *et al*. 1995). The altitude of the area is about 410-500 m a.s.l.



The extent of Cormorant conflicts in the non-breeding season for each district: Blank areas = no request for regulation, Little = request for regulation but no permission issued, Middle = request for regulation, permission issued but no birds shot, Large = request for regulation, permission issued, shooting successful (Martincova & Musil 2003).

The Great Cormorants in this area

The breeding population of the Great Cormorant in the area of Trebonsko did not reach the same high numbers as the South Moravia population until the end of the 1980s. Great Cormorants *(P. c. sinensis)* has been breeding in this area since 1983. However, even though the main colony has been located on an island at the Zenich fishpond (or on the nearby Novy Vdovec fishpond in 1985), there have been mostly unsuccessful efforts to set up new colonies in this area (Janda & Machacek 1990). While the colony at Zenich reached its maximum size in 1989 (140 breeding pairs), numbers stabilised in the 1990s (between 62 and 106 breeding pairs) although breeding success has been still high (1997-2004: 3.37-3.60 fledglings per nest). However, due to the development of new breeding localities nearby, the number of breeding pairs at Zenich has declined since 2000 (Martincova & Musil 2003). Currently, only 60 nests have been recorded at this site. The Cormorant colony, located on two islands of Zenich fishpond in the 1980s and 1990s, was formed mainly by pines *(Pinus sylvestris)* and birches *(Betula sp)*. Nonetheless, the felling of damaged trees resulted in the occupation of a new island at the end of the 1990s on which only pine trees have been used for breeding. As the Cormorants left the nearby fishpond Krvavy and moved back to Zenich colony in 2004, the size of this colony reached its highest number (162 pairs).

The fish

Fish production was the main purpose for creating fishponds in the Middle Ages and they still have this function. Due to intensive human exploitation, fish stock abundance, density and biomass are much higher than in the first half of the century. Species composition depends on artificial breeding. The most common fish in fishponds is Carp (see Appendix 2 for scientific names), which has a high economical value and thus represents 92% of production. The remaining 8% of production is taken up by Tench, Pike, Pikeperch, Grass Carp, Silver Carp, Perch, Powan, Northern Whitefish, and Roach.

Great Cormorant breeding colonies at (Left) Novy Vdovec fishpond in South Bohemia (Photograph P. Musil) and (Right) the Zenich fishpond in South Bohemia (Photograph J. Sevcik).

The fishermen

The most important fish producer, Rybarstvi Trebon, attends to 7,440 ha of fishponds. The second important producer is the company Rybarstvi Kardasova Recice (see section 6.1.3). However, there are many other small fishpond owners in this area. According to data given by fishermen the total yield of the Rybarstva Trebon joint-stock company is 2,700-2,900 tons/year, equivalent to 362.9 kg/ha/year.

The diet of Great Cormorant nestlings

The diet composition of the Great Cormorant was studied using fledgling regurgitations during the breeding seasons 1997-1999 (Martincova 1999). Carp, which is the most common species in this area, represented 78.9% of the food composition. Tench was second important food item found (15.2% of the food), followed by Perch and Roach.

The impact and the conflict

The year-round presence of Cormorants means that their impact on fish stocks is probably high. Conflicts between the fishermen and fish-eating birds/mammals have been prevalent for some time in this region although the establishment of the Cormorant colony has tended to overshadow tensions between fishermen and Otter (*Lutra lutra*) or herons. The main problems seem to revolve around fishpond management, particularly when the ponds are stocked with fish of the same age. Cormorants prefer ponds that contain fish between 10-20 cm in size (see Musil *et al*. 1995), and so fishermen have blamed them for large recruitment losses.

Other relevant projects in the area

Regular monitoring of breeding waterbird populations has been carried out in this study area since 1981. Fish-waterfowl relationships are investigated by various projects, e.g. Grant Agency of the Czech Academy of Sciences entitled *"Ecology of selected waterfowl species in conditions of intensively managed fishponds"*. Numbers of Cormorants as well as other water birds are counted in the framework of the project *"Monitoring water birds in the Czech Republic"* (supported by Agency for Nature and Landscape Conservation).

Gaps to be filled

- Habitat differences between the feeding areas of breeding and non-breeding Cormorant populations.
- Area of foraging home range of breeding and non-breeding birds.
- Studies of factors affecting population dynamics in this area
- Assessment of economical impact of migrating Cormorants on fish production.

6.1.3 The Fishpond Area of Jindrichuv Hradec

The fishpond

This fishpond area is closely connected with the fishpond region in Trebonsko and represents the boundary of south Bohemia´s fishpond district. The fishponds are located at an altitude of 410-600 m a.s.l.

The Great Cormorants in this area

Early attempts at establishing a colony were recorded at the end of the 1980s but there were only a small number of breeding pairs and breeding was irregular. The Great Cormorants tried to breed unsuccessfully on the Kaclezsky fishpond in 1988 and 1989. In 1997 they began to breed at the nearby Krvavy fishpond (in the district of Jindrichuv Hradec) but this site did not gain importance until 2000 when part of breeding colony at Zenich´s fishpond moved there (Martincova & Musil 2003). Even though the colony suffered heavy disturbance at the end of the 1990s, 40 pairs bred in 2000 and 59 pairs in 2002 and 37 pairs in 2003. In 2004 the colony was abandoned and Cormorants moved back to the nearby fishpond Zenich (23 km SW). As with other colonies in the Czech Republic, this colony is located on an island, 23 km from Zenich fishpond. Although the majority of breeding pairs prefer pines some have built their nests on birches.

The fish

As in the Trebon area, the fishponds are stocked with economically valuable species. The most important and widely bred species is Carp followed by Tench and Grass Carp. Species with less importance include Pike, Perch, Pikeperch, Powan and Northern Whitefish. Occasionally, non-commercial fish such as Roach, Rudd and Ruffe can be found as well. According to unpublished data given by the company Rybarstvi Kardasova Recice, the total yield of Carp is 850 tonnes/year. Tench and Grass Carp both yield 20 tonnes/year while the production of Pike is estimated to be 10 tonnes/year, Pikeperch 2.5 tonnes/year and Whitefish 5 tonnes/year. The means fish production is approximately 303.3 kg/ha/year.

The fishermen

The biggest fish company, Rybarstvi Kardasova Recice Ltd., uses 448 fishponds (2,992 ha), which are located in the Jindrichuv Hradec district or belong to the Trebon Biosphere reserve. There are also many other smaller processors in this region.

The diet of Great Cormorants

The diet composition of Great Cormorants was gathered from studies of pellets collected in the colony in 2000 (during May, June and July – unpublished data). In total, eight fish species were found in the pellets. According to the ratio of stocked species, Carp was found to be the most abundant species (48%) followed by Perch (12%), Roach (13%) and Tench (9%). Grass Carp, Whitefish, Rudd and Ruffe were found as minor food items.

The impact and the conflicts

Problems encountered in this area are almost identical to the conflicts that occur in the Trebon region. However, profits of local fish companies depend more on their own production of young fish for further stocking than in case of the company in the Trebon region.

Other relevant projects in the area

Regular monitoring of breeding water bird populations have been carried out in the study area since 1981. Fish-waterfowl relationships are investigated by various projects, e.g. Grant Agency of the Czech Academy of Sciences entitled "*Ecology of selected waterfowl species in conditions of intensively managed fishponds*".

Gaps to be filled

(a) Habitat differences between the feeding areas of breeding and non-breeding Cormorant populations.
(b) Area of foraging home range of breeding and non-breeding birds.
(c) Studies on population dynamics in this area, particularly in the non-breeding season and the impact of migrating Cormorants on fish production.

6.2 Cormorant conflicts with fisheries

Care must be taken when interpreting information provided in this section. Please refer to section 2.2.3 (*Methodological limitations and difficulties*).

6.2.1 Conflict site descriptions

Five Cormorant conflicts were reported from the Czech republic: on 2 rivers (Vltava, Dyje) and three aquaculture ponds (in Trebon, and those managed by Rybarstvi Kardasova Recice in S. Bohemia and also ponds in S. Movaria) (Table 6.1).

6.2.2 Birds and fish

In the Czech Republic, Cormorants reported to be involved in conflicts were *P.c. sinensis*. Reported Cormorant density on 3 aquaculture ponds averaged 0.17 birds ha^{-1} (range = 0.12 – 0.25 birds ha^{-1}). Carp and Tench were recorded in conflict with Cormorants in all 3 Czech aquaculture pond case studies reported. Rainbow Trout were recorded in both conflict cases on rivers and Brown Trout, Grayling, Chub, Nase, Pike, Pikeperch and Carp were each reported on one river.

6.2.3 Seasonality

Cormorant conflicts in the Czech Republic were reported to occur throughout the year.

Habitat	Feature	Category			
	Reach	**Upper**	**Middle**	**Lower**	**Whole river**
Rivers	N = 2 cases		1	1	
	Width (m)	**< 10m**	**10-50m**	**50-100m**	**100+m**
Rivers	N = 2 cases		1	1	
	Altitude (m)	**< 100m**	**100-500m**	**500+m**	
Rivers	N = 1 case		1		
Aq. ponds	N = 3 cases		2	1	
	Trophic status	**Oligotrophic**	**Mesotrophic**	**Eutrophic**	
Rivers	N = 2 cases		1	1	
Aq. ponds	N = 3 cases			3	
	Anthropogenic Influence	**Natural**	**Semi-natural**	**Artificial**	
Rivers	N = 2 cases		2		
Aq. ponds	N = 3 cases		3		

Table 6.1 The number of Cormorant conflict cases reported from the Czech Republic in relation to habitat and habitat features.

6.2.4 Finance

Financial information on the ‘costs’ of Cormorant predation was reported for 2 aquaculture pond conflict 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. It was requested that the values provided be categorised as either ‘actual’ or ‘estimated’. The information provided for Czech cases was estimated. Based on the 2 cases, average turnover was 3,394,500 euro and average loss was 90,800 euro (2.7% of turnover).

6.2.5 Conflict issues: magnitude of conflict

Cormorant conflicts with aquaculturists and nature conservationist stakeholders on aquaculture ponds were the most frequently reported (n = 3 cases) in the Czech Republic. Here aquaculturists recorded 15 conflict issues and nature conservationists reported 25. The most commonly cited major conflicts by both stakeholder groups were effects on fish population dynamics/community structure, vectors of diseases/parasites, and damage to landscape/vegetation (Table 6.2)

6.2.6 Conflict issues: status of information used by stakeholders

Overall, stakeholders provided 157 records of the status of the information they used to inform themselves about Cormorant conflict issues in the Czech Republic. The highest proportion of records (69%) was for ‘popular’ articles, followed by ‘grey literature’ (23%) and ‘scientific literature’ (8%). Overall, there were differences in the use of popular, grey and scientific literature sources between the 3 stakeholder groups providing information (Table 6.3).

Status of information	Stakeholder group			
	Recreational	**Commercial**	**Aquaculture**	**Nature conservation**
Popular	62.5%	-	46.3%	100.0%
Grey literature	37.5%	-	35.8%	-
Scientific literature	-	-	17.9%	-
Total no. records (= 100%)	**32**	**None**	**67**	**58**

Table 6.3 Categorisation of the status of information used by stakeholders to inform themselves about Cormorant conflict issues. Nature conservationists used less grey literature and more popular literature than expected, aquaculturist stakeholders used more scientific literature than expected ($X^2 = 50.442$, df = 4, $P < 0.001$).

6.3 Potential Cormorant management tools

Information (summarised in the following tables) was provided on (1) general actions taken against Cormorants in the Czech Republic, (2) management plans/legal regulations, (3) actions at breeding sites, and (4) at aquaculture sites.

6.4 Stakeholders consulted

(1) Biosphere Reserve Třeboň:
Aquaculture: Rybarstvi Trebon, Rybarska 801, Trebon, CZ – 379 85.
Nature conservation: CHKO Trebonsko, Valy 121, Trebon, CZ –739 01.
(2) Fishpond managed by Rybářství Kardašova Řečice:
Aquaculture: Mostky 46, Kaplice, CZ – 382 41.
(3) River Dyje in Podyji National Park:
Nature Conservation: Jihomoravske muzeum ve Znojme, Premyslovcu 6, Znojmo, CZ – 669 45.
(4) Southern Moravia:
Nature Conservation: Správa CHKO Pálava, Namesti 32, Mikulov, CZ – 692 01.
Aquaculture: Rybarstvi Pohorelice, Videnska 717, Pohorelice, CZ – 691 23.

6.5 Bibliography

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(3) Martincová R. (1999) Skladba potravy a frekvence krmení mláďat kormorána velkého *(Phalacrocorax carbo sinensis)* na Třeboňsku. *Sylvia 35: 11-17*.
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(7) Musil P., Janda J., De Nie H. (1995) Changes in abundance and selction of foraging habitat in Cormorants *Phalacrocorax carbo* in south Bohemia (Czech Republic). *Ardea 83: 247-254.*
(8) Musilová Z. & Musil P. (2004) Mezinárodní scítání vodních ptáku v Ceské republice v roce 2004. [The International Waterbirds Census in the Czech Republic in January 2004.] Bulletin CSO News 59: 33-37.

Conflict issue	Not claimed/not applicable	No impact	Minor effect	Major effect
(1) FISHERIES				
Reduced catch			3 (2)	
Loss of stocked fish			3 (2)	
Reduced value of catch (damage)		(2)	3	
Removal of fish from nets		(2)		
Damage to fishing gear		(2)		
Reduced catchability (stress/behaviour)			3 (2)	
Loss of earnings from the fishery		(1)	1 (1)	
Reduced capital values of fisheries		(2)		
Reduced fishing tackle sales		(2)		
Increased recurrent costs			3 (2)	
Loss of employment		(2)		
(2) FISH STOCKS				
Reduced stock - lowered production			3 (2)	
Effects on popn. dynamics/community structure		(2)	3 (1)	
Threats to endangered fishes			(2)	
Vectors of diseases/parasites		(1)	3 (2)	
Loss of juvenile fish - lowered recruitment		(1)	2 (1)	1
Loss of spawners		(1)	3 (1)	
Loss of aquaculture stock		(1)	3 (1)	
(3) ENVIRONMENTAL				
Eutrophication		(2)		
Interactions with other birds		1 (2)	2	
Scaring/shooting disturbance		(1)	1 (2)	
Lead contamination (birds/environment)		(1)	(1)	
Landscape alteration		(2)		
Drowning in fishing gear		(2)		
Damage to vegetation/landscape		(2)	3 (1)	

Table 6.2 Cormorant conflict issues as recorded by aquaculturists (and nature conservation stakeholders in brackets) for Czech aquaculture ponds (n = 3 cases). Each figure is the number of times a particular issue was cited by stakeholders.

NAME OF RESPONDENT AND YOUR AFFILIATION	Renata Martincova, Charles University, Prague
COUNTRY	Czech Republic
REGION / PROVINCE / etc. (if applicable)	
Period which is concerned [year(s)]	1990-2002

General information on actions against Cormorants in Czech Republic (annual numbers)

	Total numbers		Regional numbers			
	National numbers	Count/Estimate?	Southern Bohemia (Trebonsko)	Southern Bohemia (Jindrichohradecko)	Southern Moravia (Breclavsko)	Southern Moravia (Znojemsko)
Number of breeding colonies destroyed or disturbed	2		1(1990)+1			
Number of nests destroyed	ca.30		15-30			
Number of nestlings killed	0		0			
Number of adults killed in the non-breeding season	1,600-2,800	Count	1,100	300	300-500	400-500
Number of breeding adults killed	0					
Number of night roosts destroyed or disturbed	yes					

Management plans / legal regulations (Czech Republic 1990-2000)				
	Total country	**Trebonsko**	**Jindrichohradecko**	**Nove Mlyny**
Are there any management plans in effect? Please list all national or regional plans and give details	**no**	no	no	no
Are there any regulations in effect that allow Cormorant culling? Please list all national or regional regulations and give details	**yes**	yes	yes	yes
Are there any coordinated culling programmes in your country?	**no**	no	no	no
Is it mandatory to obtain single permits for Cormorant killing?	**yes**	yes	yes	yes
Has a general permit for Cormorant killing been issued?	**no**	yes	yes	yes
Is there any financial compensation for fish losses?	**yes**	yes	yes	yes
Is there any financial aid for the construction of Cormorant exclosures or for scaring programmes, etc.?	**no**	no	no	no

Remarks (on General information & on Management plans/legal regulations):

In Czech legislation in accordance with the Nature Conservation and Landscape Protection Act No.114/1992 C. L. the Great Cormorant is protected as a specially protected animal species in the category of an endangered species. Shooting, disturbance etc. is allowed only with exception permitted by competent authorities (i.e. environmental office of District Civil Authority or Administration of the Protected Landscape Area or Administration of the National Park). In the areas of high occurrence of conflicts with fishery managers, i.e. on the breeding localities (South Bohemia and South Moravia), the unlimited shooting of cormorants is permitted only during non-breeding season (i.e. from the middle of July to the end of March), with exception of specially protected areas. In districts with low numbers of cormorants and with irregular occurrence in time of spring or autumn migration, only specified numbers of cormorants may be shot. In particular districts, the number of shot cormorants is registered by nature protection authorities.

Because of concerns among fishery organisations about the depredations of fish stock by cormorants (growing since 1980s) there has been a considerable pressure to lift protection of cormorants and legalise shooting. But finally a new law, which permitted compensation of damages, was approved on April 2000. Since this year, in accordance with this law, fishery managers could ask for compensation only for such damage caused by the breeding population. However, this law was modified in November 2001 and fisheries may now seek compensation for damage caused by cormorants throughout the year. However, the goverment has provided a much smaller amount of money for compensations than is actually needed.

NAME OF RESPONDENT AND YOUR AFFILIATION	**Renata Martincova, Charles University, Prague**							
COUNTRY	**Czech Republic**							
REGION / PROVINCE / etc. (if applicable)								
Period which is concerned [year(s)]	**1990-2002**							
A. Breeding Sites								
Cormorant Damage Control Activities								
1. Avoid foundation of new colonies	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Scaring by human presence	rarely	months (if repeated)	3	3	5	Trebonsko (southern Bohemia)-49.02/14.49		
Removal of nests	rarely	years	3	3	5	Trebonsko (southern Bohemia)-49.02/14.49	As there has been a tendency to maintain only one colony in Trebon area, a new small colony on fishpond Stare jezero, which had about 10-15 nests in 1986-1989, was eliminated by cutting down nesting trees in 1990. Similarly another attempt to estabilish a new colony on fishpond Kanov was stopped by nest removal and frequent disturbance in the early breeding period.	
Egg destruction/removal	rarely	not known	3	2	5	Trebonsko (southern Bohemia)-49.02/14.49		
3. Existing colonies: Reduce breeding success	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Egg destruction/removal	rarely	not known	3	3	5	water reservoir Nove Mlyny(southern Moravia) 48.53/16.39, Jindrichohradecko(southern Bohemia) - 49.07/15.07	Partial substitution of artificial eggs or egs removing; the reduction to 1 egg per nest (southern Moravia - in early 1990s; short-term efficiency) or to 3 eggs/nestlings per nest (Jindrichohradecko - in 2002; efficiency recently unknown)	

NAME OF RESPONDENT AND YOUR AFFILIATION **Renata Martincova, Charles University, Prague**
COUNTRY **Czech Republic**
REGION / PROVINCE / etc. (if applicable)
Period which is concerned [year(s)] **1990-2002**
C. Feeding Sites
C5. Aquaculture

Cormorant Damage Control Activities								
Fish management	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Altering fish stocking regimes. Please give details.								
(d) stocked fish sizes	regularly	not efficient	3	4	3	Trebonsko (southern Bohemia)-49.02/14.49	Fishery has tended to locate most susceptible size of Carp (<25-30cm) out of the direct vicinity of the colony (>5-10km). However, the flying range of Cormorants is too large, so	
3. Wildlife Management								
3.1 Non-lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Visual frightening techniques								
Simple human effigies or scarecrows	regularly	days	2	4	5	Trebonsko (southern Bohemia)-49.02/14.49, Jindrichohradecko(southern Bohemia) - 49.07/15.07	Although the efficiency is very short-term (no more than a week) this technique is quite widespread	
3.2 Lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Shooting adults and immatures								
to reinforce non-lethal harassment	regularly	days	3	3	4	Fishpond areas used during migration periods	Specified number of cormorants allowed to be shot (permission needed) to scare them in particular	
to reduce bird numbers at specific sites	regularly	months	4	3	2	Breeding areas (Trebonsko-49.02/14.49, Nove Mlyny-48.53/16.39, Jindrichohradecko-49.07/15.07), western Bohemia, central Moravia.	Unlimited number of cormorants allowed to be shot in breeding areas in non-breeding period (middle of July - end of April). Intensive shooting in Trebon area is likely conditioned by payment to fishery managers of 300 crowns (i. e. about 9.6 euro) for every dead bird.	
to reduce regional population levels	regularly	not known	4	3	2	as above.	As above	

7. Denmark

7.1 National overview

By Christian Dieperink, Thomas Bregnballe & Michael Andersen

7.1.1 Background

Breeding Great Cormorants were exposed to extensive harassment in Denmark in the second half of the 19th century. These actions were taken because the species was seen as a competitor to fisheries and breeding cormorants extensively damaged trees. The last breeding colony was abandoned in 1876, and no new breeding colonies were founded in the following 60 years. However, the Great Cormorant began breeding again in 1938 and several colonies were founded in the 1940s and 1950s. Nevertheless, up until 1971 the breeding population remained small (maximum 902 pairs) due to human interaction in the colonies. The Vorsø colony was founded in 1944 and was the only colony where Cormorants were protected, except for licensed shooting of up to 300 young annually. When shooting of young at Vorsø was stopped after 1970 by the proprietor of the island, the breeding population began to increase and new breeding colonies were founded although the rate of increase was hampered by partly illegal and partly legal shooting and felling of nesting trees during the 1970s. These actions were primarily aimed at reducing colony sizes to protect trees against breeding Cormorants.

Ground nesting Cormorants, Olsens Pold, West Denmark (Photograph C. Dieperink).

7.1.2 The Conflict

Protection of Great Cormorants during the breeding season increased during the 1980s and the breeding population expanded dramatically from 2,037 occupied nests in 1980 to 33,560 nests in 1992, i.e. an annual rate of increase of 16-36%. The intensity of conflicts with fisheries, especially pound net fisheries, increased markedly during these years. The growth of the breeding population levelled off during the early 1990s and the breeding population stabilised, with breeding numbers ranging from 36,400 to 42,500 nests during 1993-2004. The current size of the breeding population is believed to be limited by availability of fish around existing colonies and limited access to new un-colonised areas (access is limited by a national management practice preventing new breeding colonies). The extent of conflict between Cormorants and commercial and recreational fisheries has intensified throughout the 1990s.

(Left) Ground nesting Great Cormorant and (Right) regurgitation from Grey Heron containing fish tags (Photographs C. Dieperink).

The shallow waters in Denmark are used by Great Cormorants coming from several European countries during the post-breeding season, the migration period and to a lesser extent during winter. The majority of visiting birds originate from Sweden, North Germany and Norway. The number of birds visiting Denmark is unknown, but is believed to have continued to increase during the 1990s due to the continued growth of breeding numbers in Sweden.

The policy for management of the conflicts and of the Great Cormorant population is formulated in a national management plan for the Great Cormorant. The current plan is supposed to be revised in 2007.

7.1.3 Case study: Covering of nets in the pound net fishery

Several attempts to protect fish caught in coastal pound nets have been undertaken in cooperation between industry, management, and science in Denmark. The results of most of these experiments have been inconclusive and ‘the solution’ to Cormorant predation in pound nets has not yet been found. One reason for the inconclusive results is believed to be the large variability in catches as well as the relatively small-scale designs. A larger-scale experiment was therefore carried out in Middelfart in Denmark in 1997. The fishing gear was designed by fishermen who complained that deterrents investigated previously were too ‘academic’ and would not work under commercial conditions. Three pound nets (55 m, 45 m, and 35 m in circumference) were covered with a special net. The covers were designed to float on the water rather than being extended over the gear. The catch in situations with and without cover was compared.

It was concluded, and agreed by fishermen, that the covers did have some effect on the amount of fish eaten or damaged by Cormorants. There was a statistically significant lower proportion of damaged fish when covers were used, both for Cod and Garfish (see Appendix 2 for scientific names). For Garfish however, the total catch was significantly reduced when covers were on – presumably due to the 'scaring effect' of the shadow of the net. For Cod, some improvement in catch levels was observed when covers were used. The improvements in catch size and quality were compared to the cost in terms of material and extra work. The improvement in catch value was relative (i.e. measured in %), whereas the costs were somewhat fixed, and it was shown that the increase in catch value was only large enough to pay for the added expenses in the largest of the pound nets.

(Left) coastal pound net fishery at Middlefart and (Right) the day's catch of Herring and Garfish, some damaged by Cormorants (Photographs Dave Carss).

The results indicated that a substantial proportion of the fish had been damaged by Cormorants when they were guided towards the gear, i.e. before they entered the fish-holding part of the pound net. It was also noticed that Cormorants adapted to the gear modifications during the period. A larger cover, extending over the opening of the gear may further improve the catch quality, but will certainly also increase the workload. The pound net fishery is carried out from small boats and so the dimensions of the gear are an important issue. The fishermen who took part in the experiment do not use the cover, as they find it too troublesome, in particular when there are strong winds.

7.1.4 Distribution of Great Cormorant colonies in Denmark in 2003

The locations of Danish Great Cormorant colonies (2003) are shown in Figure 7.1 below.

7.1.5 Stakeholders

7.1.5.1 Commercial fishermen (fishing with gill nets, pound nets, fyke nets)

Areas of conflict include coastal and estuarine regions (within depths of less than 15 m) as well as a few larger lakes with semi-commercial fisheries. Conflicts occur mainly during the fishing and breeding season which falls between March and October. Wintering Cormorants cause problems in the pound net fishery between

October-December as the catch (primarily silver Eel and Cod) for many of these enterprises during this period contributes up to 80-90% of the total annual value of the fishery.

Cormorants affect fish catches through predation and scaring fish out of the pound nets. They also inflict wounds on the fish, reducing the value of the catch. Commercial fishermen feel some antipathy towards ornithologists and groups in favour of Cormorants as they feel that their livelihood is threatened. Fishermen find it difficult to enter into dialogue with scientists and conservationists although the problems associated with Cormorants damaging their fishing gear is considered to be severe. There have several instances where illegal killing of Cormorant nestlings by releasing mink and foxes have been carried out in ground breeding colonies.

Fish species of concern (commercial): Eel, Eelpout, Flounder, Plaice, Herring, Cod, Garfish, Perch, Smelt, Brown Trout, Atlantic Salmon, and whitefish.

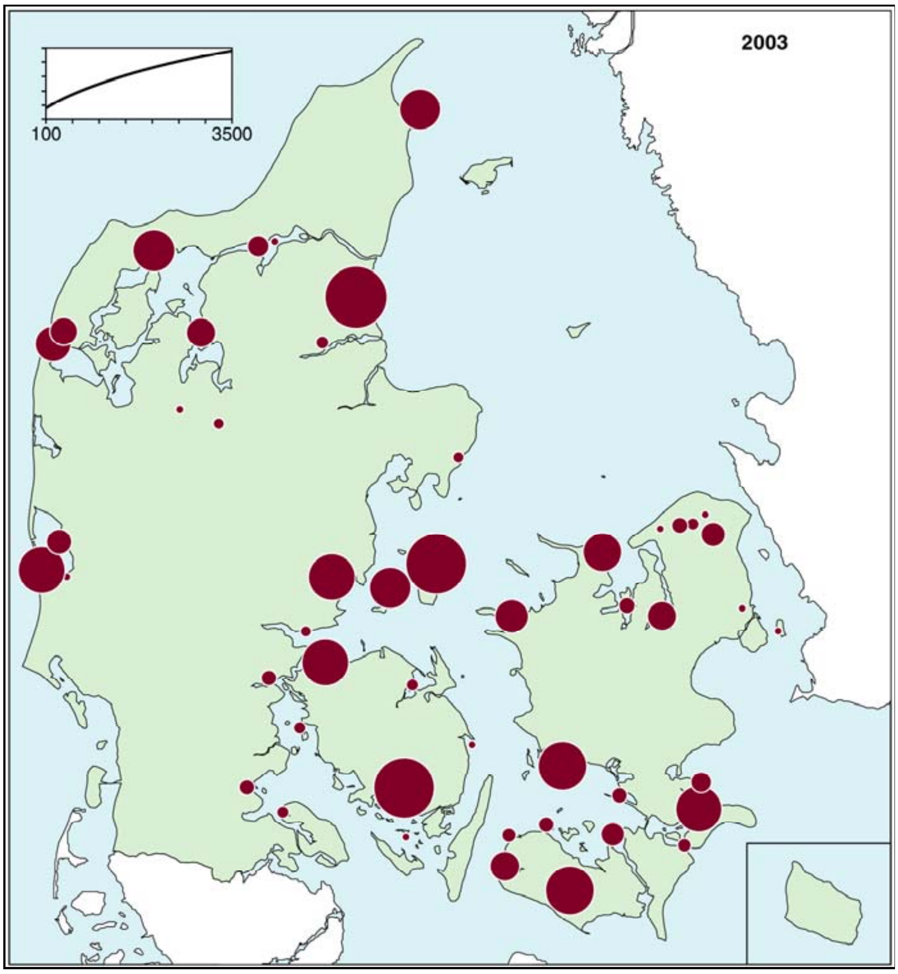

Figure 7.1 The locations and sizes of Great Cormorant colonies in Denmark in 2003. The size of the circles refers to the scale in the top left corner.

Financial losses: The extent of financial losses in commercial fisheries due to

Cormorants varies with locality, season, and type of gear. An estimation of total losses has never been attempted. Cormorants are believed to cause severe financial losses for many commercial coastal fishermen using pound nets and fyke nets.

7.1.5.2 Recreational fishermen (rod and line fishing, recreational fyke-netting and gill-netting)

Areas of conflict can be found in freshwater localities such as rivers and lakes (mostly anglers) and in coastal and estuarine regions (mostly recreational fishermen using commercial gear). Conflicts occur during the breeding season, the post-breeding season and early in the autumn migration (March to September). Recreational fishermen are divided on issues dealing with Cormorants. Generally, many are concerned that money and effort invested in increasing fish stocks (Eel, Trout, Salmon, Pike, Whitefish) is wasted because of Cormorant predation on stocked fish. However, fishermen who use commercial gear (fyke nets, gill nets) tend to share the opinion of commercial fishermen, whereas anglers often do not view Cormorants as a major competitor, except during stocking of salmonid smolts and the natural migration of smolts to the sea.

Fish species of concern (recreational): Eel, Brown/Sea Trout, Salmon, whitefish, Pike, Flounder, Plaice, Perch.

7.1.5.3 Ornithologists

The views of BirdLife Denmark on Cormorants and the Cormorant-fishery conflict are as follows. The initial expansion of the breeding population of Cormorants in Denmark was welcomed. Although, the colonisation of some sites by breeding Cormorants has lead to deteriorating breeding conditions for other bird species, this is not viewed as a problem of concern. Attempts to reduce the extent of conflict between fisheries and Cormorants should be dealt with primarily by taking actions on the specific sites where the conflict occurs, e.g. at the pound net where fish are being predated or at the site of the river where fish are being stocked. However, scaring of Cormorants (e.g. in certain fjords) to reduce numbers will be acceptable if commercial fisheries in these areas face severe problems because of Cormorants. BirdLife Denmark does not believe that actions taken in breeding colonies to reduce breeding numbers will have any significant influence on the extent of problems experienced by fisheries (commercial and angling) in Denmark.

7.1.5.4 Nature Conservationists

Nature conservationists act in favour of a pristine environment where wildlife in general is protected against human interference. They recognise that there is a conflict between fisheries and Cormorants.

7.1.5.5 Hunters

Hunters, like anglers, are divided on issues dealing with Cormorants. Some hunters are in favour of introducing a hunting season on the species whereas others are not. The Danish Hunters Association has about 94,000 members out of the 170,000 hunters in Denmark. The Danish Hunters Association does not advocate the reintroduction of an open season on Cormorants. It is their opinion that a species like the Great Cormorant should not have an open season because only a minority of hunters would hunt it for its food value. The Danish Hunters Association is supporting the current management policy of the Ministry of Environment including the prevention of new colonies and oiling of eggs in some of the existing ground nesting colonies.

7.1.5.6 Natural Resource Managers

The main natural resource managers in this context are based in local forest districts under the National Forest and Nature Agency. The national cormorant management plan defines the possibilities and limitations for actions than can be taken. The extent of actions taken locally varies depends partly on the apparent intensity of the conflict between Cormorants and fisheries (including anglers). Some forest districts use the possibilities given in the management plan to oil eggs in breeding colonies whereas other forest districts are more moderate in oiling eggs. In general the local forest districts have a positive attitude towards angling clubs asking for permission to shoot Cormorants during the days following stocking of fish in rivers. There is concern about Cormorant predation on the last natural stock of Atlantic Salmon in the River Skjern, where it is estimated that Cormorants in some years eat more than half of the smolt run in the estuary.

***Fish species of concern**:* Local populations of Atlantic Salmon, Eelpout and Cod.

7.2 Cormorant conflicts with fisheries

Care must be taken when interpreting information provided in this section. Please refer to section 2.2.3 (*Methodological limitations and difficulties*).

7.2.1 Conflict site descriptions

Five Cormorant conflicts were reported from Denmark: all on coasts, Issefjord Sejrø Bay, Nissum Fjord, Vorsø Island, Ringkøbing Fjord, and Bay of Aalbaek (information provided for 4 cases reported that all were eutrophic and natural waters).

7.2.2 Birds and fish

In Denmark, Cormorants reported to be involved in conflicts were *P.c. sinensis* with occasional *P.c. carbo.* Reported average Cormorant density (n = 4 cases) was 1.11 birds ha^{-1} (range = 0.005 – 2.67 birds ha^{-1}). Thirteen species of fish were recorded in conflict with Cormorants in 4 Danish coastal case studies reported. Brown Trout was reported in 3 cases, Cod, Flounder, Eel and Plaice in 2, and Dab, Eelpout, Herring, Garfish, Mackerel, Atlantic Salmon, whitefish and Sole each in 1 case.

7.2.3 Seasonality

Cormorant conflicts in Denmark were reported to occur throughout the year.

7.2.4 Finance

Financial information on the ‘costs’ of Cormorant predation was reported for 3 coastal conflict 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. It was requested that the values provided be categorised as either ‘actual’ or ‘estimated’. The information provided for Danish cases was estimated. Based on the 3 cases, average turnover was 1,966,667 euro and average loss was 833,333 euro (42% of turnover).

7.2.5 Conflict issues: magnitude of conflict

Cormorant conflicts with recreational and commercial fisheries stakeholders on coasts were the most frequently reported (n = 5 and 3 cases, respectively) in Denmark. Nature conservationist stakeholders reported 1 conflict case on the coast. Recreational fisheries stakeholders on coasts identified 19 conflict issues, commercial fisheries identified 16, and nature conservationists identified 2 issues. Recreational and commercial fisheries stakeholders cited mostly fisheries and fish stock issues with a few environmental ones. The few issues cited by nature conservationists were all environmental (Table 7.1).

7.2.6 Conflict issues: status of information used by stakeholders

Overall, stakeholders provided 90 records of the status of the information they used to inform themselves about Cormorant conflict issues in Denmark. The highest proportion of records (73%) was for 'popular' articles, followed by 'scientific literature' (26%) and 'grey literature' (1%). Overall, there were no statistical differences in the use of popular, grey and scientific literature sources between the 3 stakeholder groups providing information (Table 7.2).

	Stakeholder group			
Status of information	**Recreational**	**Commercial**	**Aquaculture**	**Nature conservation**
Popular	68.6%	78.4%	-	100.0%
Grey literature	2.0%	-	-	-
Scientific literature	29.4%	21.6%	-	-
Total no. records (= 100%)	**51**	**37**	**None**	**2**

Table 7.2 Categorisation of the status of information used by stakeholders to inform themselves about Cormorant conflict issues.

7.3 Potential Cormorant management tools

Information (summarised in the following tables) was provided on (1) general actions taken against Cormorants in Denmark, (2) management plans/legal regulations, (3) actions at roosts, (4) at small rivers, (5) at small still waters, (6) at very large water bodies, and (7) at aquaculture sites.

7.4 Stakeholders consulted

These included:

(1) Danmarks Fiskeriforening (Danish Fishermen's Association).
(2) Dansk Amstørfiskerforening (Union of Danish Amateur Fishermen).
(3) Dansk Fritidsfiskerforening (Union of Danish Leisure Time Fishermen).
(4) FFD- Association of Freshwater Fisheries in Denmark.
(5) Danmarks Naturfredningsforening (The Danish Society for Nature Conservation).
(6) Dansk Ornitologisk Forening (Bird Life Denmark).
(7) Danmarks Jægerforbund (Danish Hunters Society).
(8) Skov & Naturstyrelsen (The National Forest and Nature Agency).
(9) Skovdyrkerforeningen (Forestry Society).
(10) Danmarks Sportsfiskerforbund (Danish Angling Club Alliance), Worsåesgade 1DK 7100 Vejle
(11) Danish Anglers Association (DSF).
(12) Ferskvandsfiskeriforeningen for Danmark (The Society for Inland Fisheries), Vejlsøvej 39, DK 8600 Silkeborg.

(13) Fiskeridirektoratet (Directorate of Fishing, The Ministry of Food, Agriculture and Fisheries), Postboks 2196, DK-1007 København K.
(14) Amtsrådsforeningen (The Society of County Counsel).
(15) Foreningen Kyst, Land og Fjord (The Society for Coast, Earth and Sea, Claus Meiner, Bøgevej 3, 6880 Tarm.

Conflict issue	Not claimed/not applicable	No impact	Minor effect	Major effect
(1) FISHERIES				
Reduced catch			(1)	3 (4)
Loss of stocked fish			(1)	(3)
Reduced value of catch (damage)			(3)	2 (2)
Removal of fish from nets			1 (1)	2 (2)
Damage to fishing gear			1 (1)	
Reduced catchability (stress/behaviour)			1 (1)	
Loss of earnings from the fishery			(1)	3 (1)
Reduced capital values of fisheries			(2)	3
Reduced fishing tackle sales			(1)	(1)
Increased recurrent costs			1 (2)	1
Loss of employment				3
(2) FISH STOCKS				
Reduced stock - lowered production				2 (3)
Effects on popn. dynamics/community structure			(1)	1 (1)
Threats to endangered fishes			(2)	(1)
Vectors of diseases/parasites			(1)	
Loss of juvenile fish - lowered recruitment			(1)	2 (3)
Loss of spawners		(1)	(1)	2
Loss of aquaculture stock				(1)
(3) ENVIRONMENTAL				
Interactions with other birds			1 (1)	[1]
Scaring/shooting disturbance		1 (1)		1
Drowning in fishing gear			1	
Damage to vegetation/landscape			[1]	

Table 7.1 Cormorant conflict issues as recorded by recreational angling stakeholders (n = 5 cases), commercial fishermen (n = 3 cases, in round brackets) and nature conservationists [n = 1 case, in square brackets] for Danish coasts (N= 5 cases). Each figure is the number of times a particular issue was cited by stakeholders.

NAME OF RESPONDENT AND YOUR AFFILIATION	**Thomas Bregnballe, National Environmental Research Institute, Dept. of Coastal Zone Ecology, Kalø, 8410 Rønde**	
COUNTRY	**DENMARK**	
REGION / PROVINCE / etc. (if applicable)	**DENMARK**	
Period which is concerned [year(s)]	**1994-2002**	
General information on actions against Cormorants in Denmark (annual numbers)		
	Total numbers	
	National numbers	**Count/Estimate?**
Number of breeding colonies destroyed or disturbed	**0**	
Number of nests destroyed	**0**	
Number of nestlings killed	**100**	
Number of adults killed in the non-breeding season	**0**	
Number of breeding adults killed	**2,040 - 4,500**	
Number of night roosts destroyed or disturbed	**15**	

Management plans / legal regulations (Denmark 1994-2002)	
	Total country
Are there any management plans in effect? Please list all national or regional plans and give details	yes
Are there any regulations in effect that allow Cormorant culling? Please list all national or regional regulations and give details	no
Are there any coordinated culling programmes in your country?	no
Is it mandatory to obtain single permits for Cormorant killing?	no
Has a general permit for Cormorant killing been issued?	no
Is there any financial compensation for fish losses?	no
Is there any financial aid for the construction of Cormorant exclosures or for scaring programmes, etc.?	no

Remarks (on General information & on Management plans /legal regulations):

(1) A new management plan was launched in 2002. The original plan was launched in 1993 (I think, but see reference) and this was modified in early spring of 1994. All known regulations are listed in a Danish report. There is a semi-coordinated culling programme.

(2) If you are a fisherman (professional or amateur), it is not mandatory to obtain single permits before shooting cormorants within 1000 m from standing fishing gear.
(3) A general permit has been given for 2002-2004 in two fjords in western Jutland. But each hunter/fisherman must get a personal license. There was an upper limit for the total number of cormorants allowed to be shot per fjord per season (600 in one and 1500 in the other).

NAME OF RESPONDENT AND YOUR AFFILIATION	**Thomas Bregnballe, National Environmental Research Institute, Dept. of Coastal Zone Ecology, Kalø, 8410 Rønde**
COUNTRY	**DENMARK**
REGION / PROVINCE / etc. (if applicable)	**DENMARK**
Period which is concerned [year(s)]	**1994-2002**

B. Roosting Sites

Cormorant Damage Control Activities

1. Avoid foundation of new roost sites	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Scaring by use of live ammunition	rarely	days/weeks	2	2	2	At at least two roosts		
Shooting some birds to reinforce scaring	rarely	days/weeks	2	2	2	As above		
Gas bangers / cannons (propane gas exploders)	rarely	days/weeks	2	3	2	As above	Only effective if used in combination with shooting at birds	
Pyrotechnics / Fireworks	rarely	days/weeks	2	2	4	As above	As above	
Other audio frightening techniques	rarely	days/weeks	2	3	4	As above	As above	
Simple scarecrows	rarely	days/weeks	2	2	4	As above	As above	
Animated scarecrows	rarely	days/weeks	2	2	4	As above	As above	
Intense light	rarely	days/weeks	2	2	4	As above	As above	
Scaring by human presence	rarely	days/weeks	2	2	4	As above	As above	
Combination of audio and visual techniques	rarely	days/weeks	2	2	4	As above		
2. Existing roost sites: Hinder cormorants from roosting	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Removal of trees	rarely	years	3	4	2	As above		
Scaring by use of live ammunition	rarely	days				As above		
Shooting some birds to reinforce scaring	rarely	days/weeks	2	2	4	As above	As above	
Gas bangers / cannons (propane gas exploders)	rarely	days/weeks	2	2	4	As above	As above	
Pyrotechnics / Fireworks	rarely	days/weeks	2	2	4	As above	As above	
Other audio frightening techniques	rarely	days/weeks	2	2	4	As above	As above	
Simple scarecrows	rarely	days/weeks	2	2	4	As above	As above	
Animated scarecrows	rarely	days/weeks	2	2	4	As above	As above	
Intense light	rarely	days/weeks	2	2	4	As above	As above	
Scaring by human presence	rarely	days/weeks	2	2	4	As above	As above	
Other visual frightening techniques	rarely	days/weeks	2	2	4	At at leasrt one roost	As above	
Combination of audio and visual techniques	rarely	days/weeks	2	2	4	At at least one roost	As above	

NAME OF RESPONDENT AND YOUR AFFILIATION	**Thomas Bregnballe, National Environmental Research Institute, Dept. of Coastal Zone Ecology, Kalø, 8410 Rønde**							
COUNTRY	**DENMARK**							
REGION / PROVINCE / etc. (if applicable)	**DENMARK**							
Period which is concerned [year(s)]	**1994-2002**							
C. Feeding Sites								
C1. Small Rivers (Width < 100 m)								
Cormorant Damage Control Activities								
1. Resource Management	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Habitat management								
Improve habitat quality for fishes	rarely	unknown	unknown	unknown	unknown	at least at a few sites	not done to avoid cormorant predation	
Fish management								
Altering fish stocking regimes. Please give details.	rarely	unknown	unknown	unknown	unknown	at least at one site	could be used much more than is the case	
(a) timing	rarely	unknown	unknown	unknown	unknown	at least at one site		
(b) frequency	rarely	unknown	unknown	unknown	unknown	at least at one site		
(c) density	rarely	unknown	unknown	unknown	unknown	at least at one site		
3. Wildlife Management								
3.1 Non-lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Human harassment								
Human patrol on foot or in vehicles	rarely	days	4	2	2	only knwon from one site	only done during the days after smolt were stocked in	
Others (please specify)								
Audio frightening techniques								
Live ammunition	rarely							
3.2 Lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Shooting adults and immatures								
to reinforce non-lethal harassment	rarely	days	4	2	2	only known from one site	only done during the days after smolt were stocked in the river	
to reduce bird numbers at specific sites	rarely	days	4	2	2	only known from one site	only done during the days after smolt were stocked in the river	

NAME OF RESPONDENT AND YOUR AFFILIATION	**Thomas Bregnballe, National Environmental Research Institute, Dept. of Coastal Zone Ecology, Kalø, 8410 Rønde**							
COUNTRY	**DENMARK**							
REGION / PROVINCE / etc. (if applicable)	**DENMARK**							
Period which is concerned [year(s)]	**1994-2002**							
	NB: includes 'put and take' fisheries							
C. Feeding Sites								
C3. Small Still Waters (< 100 ha); not aquaculture								
Cormorant Damage Control Activities								
3. Wildlife Management								
3.1 Non-lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Audio frightening techniques								
Gas bangers / cannons (propane gas exploders)	rarely	days	2	4	2	at one site		
Live ammunition	regularly	days/weeks	2	3	2	at one or a few sites		
3.2 Lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Shooting adults and immatures								
to reinforce non-lethal harassment	rarely	days/weeks	2	3	2	at one or a few sites		
to reduce bird numbers at specific sites	rarely	days/weeks	2	3	2	at one or a few sites		

NAME OF RESPONDENT AND YOUR AFFILIATION	**Thomas Bregnballe, National Environmental Research Institute, Dept. of Coastal Zone Ecology, Kalø, 8410 Rønde**
COUNTRY	**DENMARK**
REGION / PROVINCE / etc. (if applicable)	**NB: the table does not provide opportunities for denoting the use of modified net design when fishing with standing fishing gear on large water bodies, eg. Pound net fisheries, fishing with fykes.**
Period which is concerned [year(s)]	**1994-2002**
<u>C. Feeding Sites</u>	
C4. Very Large Waterbodies (> 100 ha; Still Waters and Coastal Waters)	

Cormorant Damage Control Activities								
1. Resource Management	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
3. Wildlife Management								
3.1 Non-lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Human harassment								
Gas bangers / cannons (propane gas exploders)	rarely	days	3	4	3	Tried in a few years at a few pound nets		
Live ammunition	regularly	not efficient/days	1	1	3	Done regularly by some pound net fishermen		
3.2 Lethal techniques	**Technique is**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where**	**Remarks, Details, &**	**References**
Shooting adults and immatures								
to reinforce non-lethal harassment	regularly	not efficient/days	1	1	3	As above		
to reduce bird numbers at specific sites	rarely	unknown	3	4	2	Licensed in two fjords 2002-2004		
to reduce regional population levels	rarely	unknown	4	4	1	As above		

NAME OF RESPONDENT AND YOUR AFFILIATION	**Thomas Bregnballe, National Environmental Research Institute, Dept. of Coastal Zone Ecology, Kalø, 8410 Rønde**
COUNTRY	**DENMARK**
REGION / PROVINCE / etc. (if applicable)	**DENMARK**
Period which is concerned [year(s)]	**1994-2002**
Comments:	**Put and take fisheries not included. In such places, some shooting takes place. No information on use of other measures at put and take ponds/lakes.**
C. Feeding Sites	**Only freshwater aquaculture included.**
C5. Aquaculture	

Cormorant Damage Control Activities								
1. Resource Management	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Facility construction								
Design / construction (of an aquaculture facility)	regularly	years	3	1	1	All land based aquacultures	Refers only to the fact that all aquaculture sites are designed to allow use of wires	Personal information
2. Bird-proof barriers (overhead barriers and peripheral fencing/netting)	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Physical exclosures with narrow meshed systems (mesh sizes < 20 cm) using wire, lines or string in parallel or grid patterns	always used	years	3	1	1	At all Danish feshwater aquaculture sites: by law		
Wire, lines or string in parallel patterns (please give spacing)	always used	years	3	1	1	As above.		
3. Wildlife Management								
3.1 Non-lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Human harassment								
Human patrol on foot or in vehicles	rarely	days	3	2	2	A few trout farms		
Audio frightening techniques								
Gas bangers / cannons (propane gas exploders)	rarely	days	2	3	3	In some years at a few trout farms		
Live ammunition	rarely	days	2	2	4	As above.		
Visual frightening techniques								
Simple human effigies or scarecrows	rarely	unknown	2	1	4	As above.		
3.2 Lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Shooting adults and immatures								
to reinforce non-lethal harassment	rarely	unknown	4	2	3	As above.		
to reduce bird numbers at specific sites	unknown	unknown						

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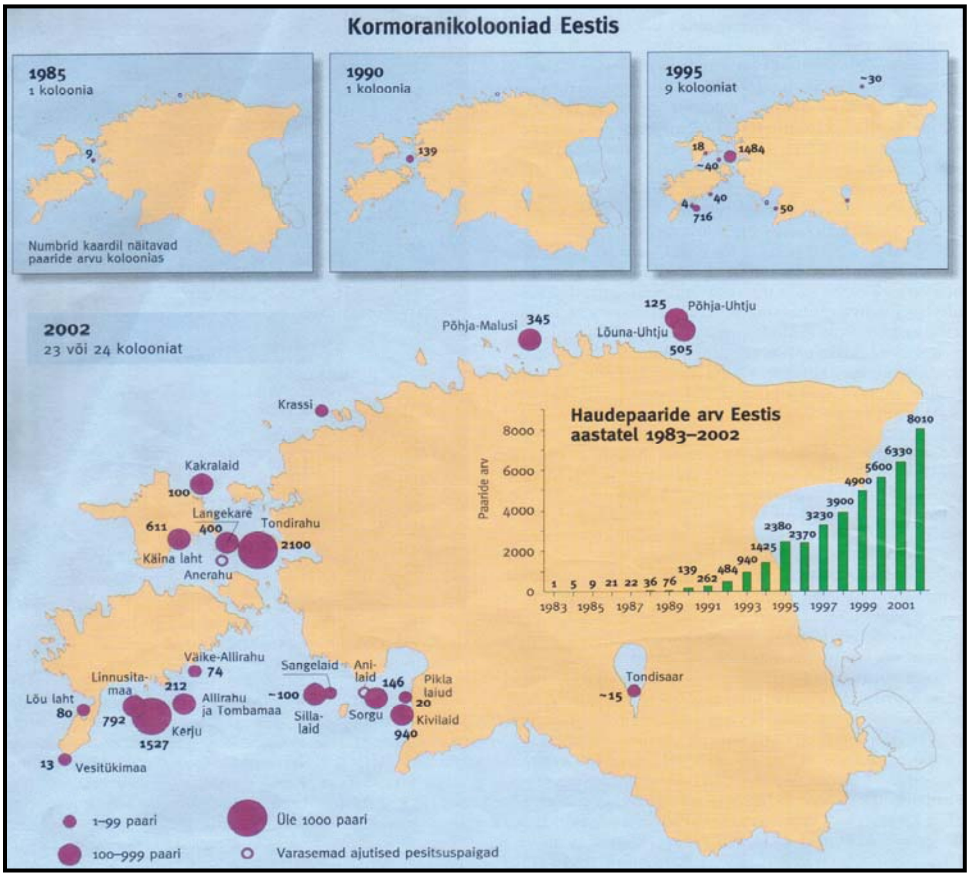
8. Estonia

8.1 National overview

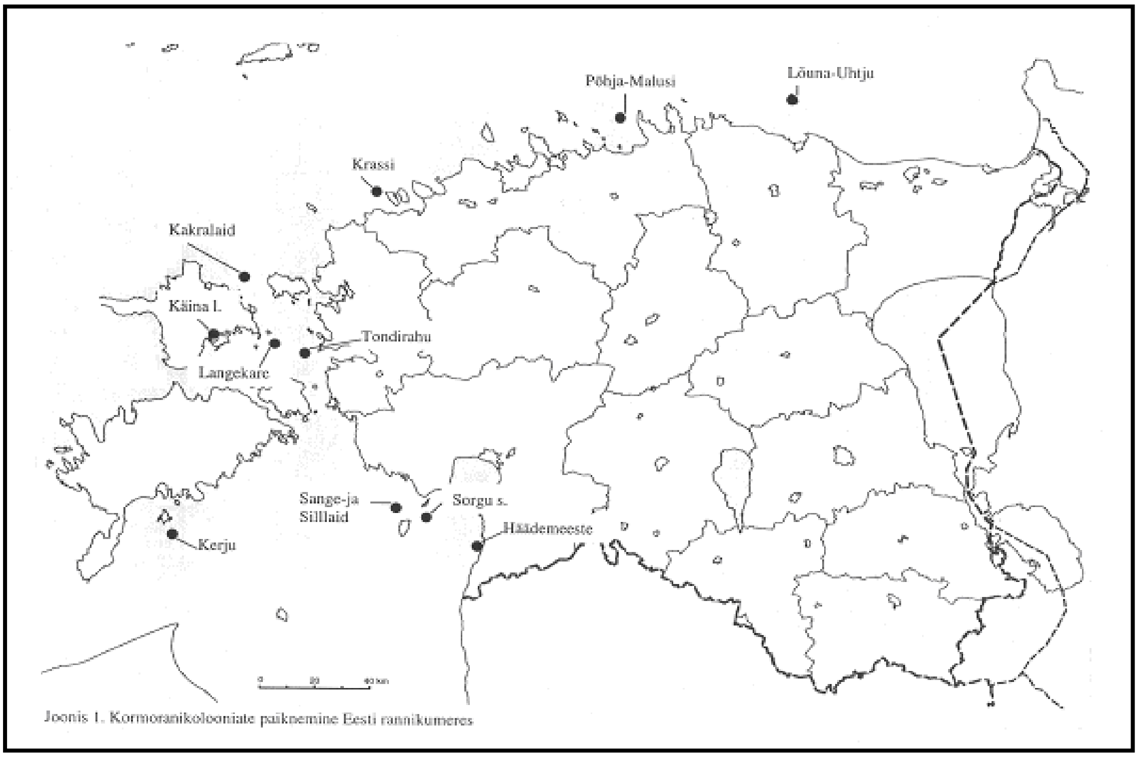
By Redik Eschbaum & Vilju Lilleleht

Background

In recent years, the numbers of Great Cormorants (*P. c. sinesis*) in Estonian coastal waters have increased rapidly (Lilleleht 1995, Lõhmus *et al.* 1998). Cormorants have been documented in Estonia since the 1960s but the first colony was established in 1984 in the region of Väinameri located on the west Estonian archipelago (Lilleleht 1995). The conflict is generally confined to coastal areas because all colonies are situated on small islets in the sea, with the exception of one colony in Lake Võrtsjärv (16 pairs in 1999 although there were no birds in 2002). The coastal areas of Estonia can be divided as follows: Gulf of Finland, Gulf of Riga and Väinameri (West Estonian Archipelago Sea) having Cormorant populations (in 1999) of 323, 920 and 3,500 breeding pairs. Despite being the smallest territory, Väinameri has the largest number of Cormorants probably due to the fact that it is very shallow and thus very suitable for the birds. Large numbers of Cormorants can be found in Estonia between April and September: the total being around five times the breeding numbers which in 2002 there were 8,010 breeding pairs and in 2004 9,397 pairs.



Location and size of Cormorant colonies in Estonia 1985-2002 (Lilleleht 2004).



Locations of Great Cormorant colonies in Estonia.

8.1.1 Case Study: Väinameri (Moonsund)

Väinameri is a shallow (average depth 5m) archipelago area, which includes more than 300 islands and islets (Sepp 1970) many of which have been designated as protected areas (Eschbaum *et al*. 2003). Salinity is low, 5-6% on average (maximum 8%) while water transparency varies between 0.3 and 10m depending on season and hydro-meteorological conditions (Mardiste 1970). Ice begins to form in the shallow bays in the second half of November although generally the whole of Väinameri is covered in ice between January and early April (Eschbaum *et al*. 2003).

Damged and lost vegetation in Cormorant colony on islet Tondirahu (Photograph Markus Vetemaa).

8.1.2. The Fish

The sheltered and shallower parts of Väinameri, particularly Matsalu Bay, are amongst the most important fish spawning and nursing areas along the Estonian Coast. Around 60 fish species have been found in the region, 40% of which are freshwater species (Saat & Eschbaum 2002). However, the abundance and availability of fish species in Väinameri generally vary seasonally. For example, several species are almost absent during the summer but abundant in other seasons including winter spawners (e.g. Burbot and Sculpins, see Appendix 2 for scientific names), Marine species spawning in coastal areas (Baltic Herring, Smelt, Garfish), Dace and some other cyprinids forage predominantly in the deeper waters of Väinameri during the summer months (Eschbaum *et al*. 2003).

8.1.3. The Fishermen

Väinameri is home to intensive commercial fishing which has increased markedly since 1990. The pound-net fishery for Baltic Herring constitutes a major part of the total catch (Eschbaum *et al*. 2003). Traditionally Perch was the second most important species but stocks collapsed (mainly due to over fishing) and the proportion of cyprinds such as Roach, Silver Bream and Ide has increased (Saat & Eschbaum 2002).

In 1998 there were 2,692 breeding pairs of Cormorants the Väinameri region; 2,522 on the neighbouring islets of Tondirahu and Sipelgarahu, 150 in Käina Bay and 20 on Kakralaid islet (see map). In 1999 the number increased to 3,500 with 2,943 breeding pairs on Tondirahu and Sipelgarahu, 355 in Käina Bay, 43 on Kakralaid and 132 in a new colony on Langekare islet (Eschbaum *et al*. 2003). The potential and actual conflict between Cormorants and fisheries in this region is the most significant in Estonia as fishermen believe that Cormorants are largely responsible for the dramatic decline in catches since the early 1990s. Indeed, a mail survey (unpublished) carried out in 2000 highlighted that 47% of commercial fishermen of Hiiumaa island (bordering the Väinameri from NW) considered Cormorants and seals to be the main driving force behind the decline of most important commercial fish stocks, such as Perch. Around half of the 180 commercial fishermen answered this mail survey, which probably indicates that this perception is shared by the bulk of fishermen.

8.1.4 Cormorant predation in Estonia

In Estonia, especially in Väinameri area, the biggest problem is the total amount of fish consumed by Cormorants. Bite marks and stealing fish from nets and traps are also a significant concern. All common fish species can also be found in diet of Cormorants although food composition varies seasonally (Eschbaum *et al*. 2003). Prior to and early in breeding season, the main proportion of Cormorant diet consists of fish species that enter the shallow coastal areas for spawning and species more easily caught by social (group) fishing (*ibid*). Seasonal differences in diet are probably related to water transparency. For example, turbidity in Väinameri is highest during spring. In 1998, Cormorants consumed approximately 460 tonnes of fish while the total commercial catch of fish from the Väinameri in the same year was 1,292 tonnes, including 1,071.5 tonnes of Baltic Herring (*ibid*). However, the most important fish in the Cormorant diet was Eelpout/Viviparous Blenny, a relatively slow-swimming, bottom-living species, which is not commercially exploited in Estonia. Abundant Roach, Burbot, Pikeperch and Perch formed the main part of commercial species consumed. The most critical period, from the point of view of the fisheries, is spring when the diet of the birds consists of mainly commercially important species. During the summer, Cormorants predominantly eat Viviparous Blenny.

Cormorant colony on the island Põhja-Uhtju (Photograph Markus Vetemaa).

In view of the present state of commercially important fish stocks, it can be concluded that Cormorants do compete with fishermen in Väinameri (Eschbaum *et al*. 2003). Nevertheless, it should be noted that during the early 1990s, when Cormorant numbers were low, commercial fishing efforts had increased substantially leading to overexploitation of the valuable fish species. Fishing effort has decreased during the last 5-7 years but stocks have only slightly improved. Predation by Cormorants is most probably one reason for the restrained recovery of the fish stocks.

8.1.5 Gaps to be filled

There have been efforts to calculate the amount of fish consumed by Cormorants for every fish species. However, this work has been hindered by several uncertainties such as the number of non-breeding birds etc. Calculated amounts of eaten fish were multiplied with the average ‘first buyers’ prices of different species. Of course, it is understood that the monetary value achieved through such calculations does not reflect the exact economic losses of fisheries because before the fish can be sold it has to be caught (fish in the sea have no price and fishing always includes fishing costs). The monetary value of fish eaten by Cormorants in 1998 (2.1 million Estonian crowns, EEK, based on average first buyer’s prices; 15.6 EEK = 1 euro) was approximately 50% of the value of the commercial catch (4.2 million EEK). However, when Herring is excluded, the value of coastal fish eaten by Cormorants (2.0 million EEK) exceeded the value of fish captured by fishermen (1.6 million EEK) (Eschbaum *et al*. 2003). Nowadays the number of Cormorants is about 60% higher and the value of fish eaten by Cormorants surpasses the official aggregate revenue of fisheries in that particular area. The catches in Väinameri have not improved despite additional fishing restrictions and a decrease in fishing effort.

Dead Cormorant found on islet Tondirahu and used to study parasites (Photograph Markus Vetemaa).

Another topic of interest is the comparative numbers of individual fish consumed by the birds and caught by the fishermen. For many fish species, Cormorants mainly eat specimens under the minimum legal size and so the impact of the birds on fish stocks could be more significant than is suggested by calculations based solely on the weight of fish. For example, in several cases (including some commercially important species) estimated predation by Cormorants exceeded fishing mortality. Pikeperch is a valuable species in the region but the stock is in poor condition. Commercial catches in 1998 amounted to approximately 4,000 individuals while Cormorants were estimated to have consumed over 100,000 juveniles (Eschbaum *et al*. 2003).

8.2 Cormorant conflicts with fisheries

Care must be taken when interpreting information provided in this section. Please refer to section 2.2.3 (*Methodological limitations and difficulties*).

8.2.1 Conflict site descriptions

Three Cormorant conflicts were reported from Estonia: all on coasts, the west-Estonian Archipelago Sea, and the Gulfs of Finland and Riga. However, the number of reported conflicts does not reflect the full extent of the conflict: the Estonian coastline is about 4,000 km long and conflicts here are very numerous.

8.2.2 Birds and fish

In Estonia, Cormorants reported to be involved in conflicts were *P.c. sinensis*. Reported Cormorant density for one case study was 0.1 birds ha^{-1} Thirteen fish species were recorded in conflict with Cormorants in the three Estonian coastal case studies reported. Perch and Herring were recorded in 3 cases, Burbot, Pikeperch, Roach, Eelpout in 2, and Zährte, Eel, Pike, Atlantic Salmon, Brown Trout, Bull-rout and Four-horn Sculpin each in 1 case.

8.2.3 Seasonality

Cormorant conflicts in Estonia were reported to occur in summer/autumn (i.e. Mar-Nov): grey boxes indicate months where few conflict cases were reported.

Month of conflict												
COUNTRY	J	F	M	A	M	J	J	A	S	O	N	D
Estonia												

8.2.4 Finance

Financial information on the 'costs' of Cormorant predation was reported for all 3 coastal conflict 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. It was requested that the values provided be categorised as either 'actual' or 'estimated'. The information provided for Estonian cases was actual (turnover) and estimated (loss). Based on the 3 cases, average turnover was 1,119,333 euro and average loss was 28,967 euro (less than 1% of turnover).

8.2.5 Conflict issues: magnitude of conflict

Cormorant conflicts with commercial fisheries stakeholders and nature conservationists on coasts were reported (n = 3 cases) in Estonia. Commercial fisheries stakeholders reported 21 conflict issues and nature conservationists reported 13 issues. Seven issues were cited as having major effects (Table 8.1).

8.2.6 Conflict issues: status of information used by stakeholders

Overall, stakeholders provided 442 records of the status of the information they used to inform themselves about Cormorant conflict issues in Estonia. The highest proportion of records (75%) was for 'grey literature', followed by 'popular' articles (20%) and 'scientific literature' (5%). Overall, there were differences in the use of popular, grey and scientific literature sources between the 2 stakeholder groups providing information (Table 8.2).

Status of information	**Stakeholder group**			
	Recreational	**Commercial**	**Aquaculture**	**Nature conservation**
Popular	-	14.3%	-	100.0%
Grey literature	-	80.6%	-	-
Scientific literature	-	5.1%	-	-
Total no. records (= 100%)	**None**	**413**	**None**	**29**

Table 8.2 Categorisation of the status of information used by stakeholders to inform themselves about Cormorant conflict issues. Nature conservationists used more popular literature and less grey literature than expected (X^2 = 124.851, df = 2, $P < 0.001$).

Conflict issue	Not claimed/not applicable	No impact	Minor effect	Major effect
(1) FISHERIES				
Reduced catch				3
Loss of stocked fish		(3)		
Reduced value of catch (damage)			1	2
Removal of fish from nets			1	2
Damage to fishing gear			1	2
Reduced catchability (stress/behaviour)			3	
Loss of earnings from the fishery		(1)		3
Reduced capital values of fisheries		(1)	3	
Reduced fishing tackle sales		(1)	1	2
Increased recurrent costs		1	2	
Loss of employment			2 (1)	1
(2) FISH STOCKS				
Reduced stock - lowered production		(1)		3
Effects on popn. dynamics/community structure			(3)	3
Threats to endangered fishes				1
Vectors of diseases/parasites			1	
Loss of juvenile fish - lowered recruitment			(3)	3
Loss of spawners				3
Loss of aquaculture stock				
(3) ENVIRONMENTAL				
Eutrophication			3 (3)	
Interactions with other birds			3	
Scaring/shooting disturbance		3		(3)
Lead contamination (birds/environment)		3		
Landscape alteration		(3)		
Drowning in fishing gear		(3)	3	
Damage to vegetation/landscape		(1)		(2)

Table 8.1 Cormorant conflict issues as recorded by commercial fisheries (and nature conservationist) stakeholders for Estonian coasts (n = 3 cases). Each figure is the number of times a particular issue was cited by stakeholders.

8.3 Potential Cormorant management tools

Information (summarised in the following tables) was provided on (1) general actions taken against Cormorants in Estonia, (2) management plans/legal regulations, and (3) actions at breeding sites.

NAME OF RESPONDENT AND YOUR AFFILIATION	**Redik Eschbaum (University of Tartu, Estonian Marine Institute) & Vilju Lilleleht (Estonian Agricultural University, Institute of Zoology and Botany)**
COUNTRY	**ESTONIA**
REGION / PROVINCE / etc. (if applicable)	
Period which is concerned [year(s)]	**1997-2001**

General information on actions against Cormorants in Estonia (annual numbers)

	Total numbers		Regional numbers			
	National numbers	**Count/Estimate?**	**VÄINAMERI**	**Gulf of Finland**	**Gulf of Riga**	**Lake Võrtsjärv**
Number of breeding colonies destroyed or disturbed	11	E	3	0	7	1
Number of nests destroyed	1220	E	200	0	1000	20
Number of nestlings killed	~250	E	0	0	250	0
Number of adults killed in the non-breeding season	102	C	?	0	62	0
Number of breeding adults killed	0	E	14	26	0	0
Number of night roosts destroyed or disturbed	0	E	0	0	0	0

Management plans / legal regulations (Estonia 1997-2001)	
	Total country
Are there any management plans in effect? Please list all national or regional plans and give details	no (but see 1)
Are there any regulations in effect that allow Cormorant culling? Please list all national or regional regulations and give details	See (2)
Are there any coordinated culling programmes in your country?	no
Is it mandatory to obtain single permits for Cormorant killing?	yes, except during hunting season (see 3)
Has a general permit for Cormorant killing been issued?	no
Is there any financial compensation for fish losses?	no
Is there any financial aid for the construction of Cormorant exclosures or for scaring programmes, etc.?	no
Remarks (on General information & on Management plans /legal regulations):	

(1) A National Management Plan will probably be accepted in 2002.

(2) Minister of Environment can give single permits to shoot birds outside the hunting season or for destroying nests if there is evidence of cormorant damage.

(3) Cormorant is in the list of hunted seabirds (hunt is allowed from 20.08.-31.10.).

NAME OF RESPONDENT AND YOUR AFFILIATION	**Redik Eschbaum (University of Tartu, Estonian Marine Institute) & Vilju Lilleleht (Estonian Agricultural University, Institute of Zoology and Botany)**							
COUNTRY	**ESTONIA**							
REGION / PROVINCE / etc. (if applicable)								
Period which is concerned [year(s)]	**1997-2001**							
A. Breeding Sites								
Cormorant Damage Control Activities								
1. Avoid foundation of new colonies	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Removal of nests	rarely	not known	4	5	4	Gulf of Riga	Illegal actions by fishermen	
Egg destruction/removal	regularly	months/years	2	5	4	Gulf of Riga, Lake Võrtsjärv and single colonies in Väinameri	As above	
Killing of young	unknown							
3. Existing colonies: Reduce breeding success	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Removal of nests	rarely	not known	4	5	4	Gulf of Riga	As above	
Egg destruction/removal	regularly	months/years	2	5	4	Gulf of Riga, Lake Võrtsjärv and single colonies in Väinameri	As above	
Killing of young	rarely	not known	5	5	3	Gulf of Riga	As above	

8.4 Stakeholders consulted

Cormorants mainly forage in coastal areas rather than on fishponds or around fish cages so aquaculture-related stakeholders were only briefly consulted. In the Gulf of Finland the main target for recreational fishermen is Brown Trout but there are not many Cormorants here. In other areas, ice fishing for Perch is very important amongst recreational fishermen but during the winter there are no Cormorants and so they are not blamed for the small catches. Angling is not so popular in coastal areas. The organisational structure of anglers in Estonia is considered to be weak but while there is no unitary organisation of recreational fishermen in Estonia, there are several smaller ones. There is the Estonian Fishermen's Association and also local associations or organisations for specific fisherman (e.g. trawlermen) but the smaller organisations are mostly also under the umbrella of the Estonian Fishermen's Association. Nevertheless, the majority of anglers that were contacted felt that they were unable to contribute, as they do not have much experience of the problem. There is, however, some concern. In 2001, 102 birds were shot during the water bird hunting season. During the last years the Cormorants are more often met on mainland (far from coast) and shot at fishfarms. As this action is illegal, there are no official data. This concern over persecution meant that the nature conservation representative was suspicious of the aims of REDCAFE and initially refused to take part: most probably thinking that the project might lead to further persecution of Cormorants.

Ministry:

(1) Department of Fish Resources, Ministry of the Environment, Kalavarude Osakond, Marja 4d, 10617 Tallinn.

Conservation:

(2) Matsulu Looduskaitseala (Matsalu Nature Reserve), Penijõe, Lihula vald 90305, Lääne Maakond.

Commercial Fishermen:

(3) Eesti Kalurite Lit (Estonian Fishermen's Association), Gonsiori 29, 10147 Tallinn.
(4) Representative of Hiiumaa Fishermen's Association.
(5) Representative of Islands Fishermen's Association.

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(10) Ratas, U., E. Mägi, et al. (1999) Linnustiku mõju väikesaarte mullastikule ja taimestikule (Impact of birds on the vegetation and soil of Estonians small islands, in Estonian.) - Loodusevaatlusi 1997 - 1999. Lihula.**:** 3-19.
(11) Ratas, U., E. Mägi, et al. (2000) Impact of birds on the development of the landscape of Estonians small islands - Estonia: 124-139., Estonian Academy Publishers.
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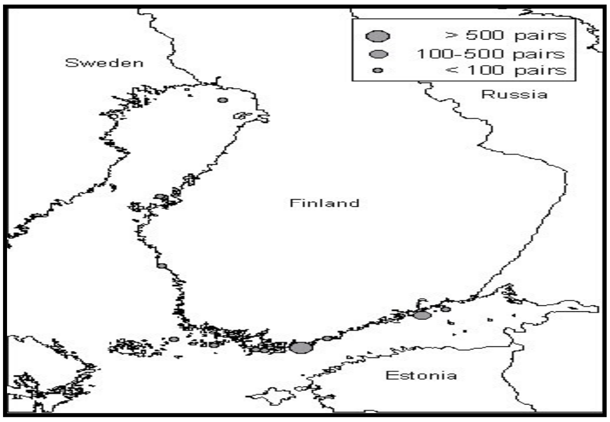
9. Finland

9.1 National overview

By Timo Asanti

9.1.1 Background

At present, Great Cormorant predation is not considered to be a problem in Finland. However, there are a few landowners and fishermen who are of the opinion that the birds can cause problems. There are no freshwater fishponds in Finland but a coastal archipelago fish farming industry that uses cages (‘net pens’) small enough to be covered with nets. The Finnish Environment Institute has been monitoring the Great Cormorants in Finland since 1996 when the first breeding occurred at the Tammisaari archipelago in the Gulf of Finland. Water quality around the breeding sites/marine areas is excellent. All Great Cormorant colonies mentioned are located in coastal regions (outer archipelago), far out from the mainland. About 80% of Great Cormorants breed in the Gulf of Finland while the rest are located in the Gulf of Bothnia and Åland archipelago. Most birds are ground breeders and so far in Finland there are only four colonies in trees. Today birds breed at 21 different colonies and the number of pairs is 2,931. In 2002 during the autumn migration about 16,600 birds were counted moving westwards from the Russian side along the Gulf of Finland. There are two colonies (about 3,000-4,000 breeding pairs) situated on the Russian side very close to the Finnish border. The range of feeding areas can be up to 15-20 km from colonies so birds are also recorded in the inner archipelago. Moreover, during the spring and autumn migrations birds are recorded inland on lakes and bigger rivers.



(Left) distribution of Great Cormorant colonies in Finland and (Right) adult bird on its nest in Tammisaari (Southwest Finland).

9.1.2 The Conflict

The effect of Great Cormorant guano production on the landscape and flora is evident and is for some people a visual intrusion. Studies of the effects of colonisation by Cormorants on vegetation were carried out in 1998 and 2002 on two nearly treeless islets. Threatened plant species do not occur on the breeding islets currently used by Cormorants. Juniper and shrubs, which favour more acid soil, have suffered most of the nitrogen load. Arborescent species have overall regressed markedly also because of physical damage due to collection of twigs for nest-building. Gathering points of Cormorants are often bare and even certain lichens, which favour nitrogen, cannot survive there. Recovery of the vegetation is fast if the number of Cormorants declines. As in colonies of gulls, some vascular plant species regress while others benefit from the surplus nitrogen. The total number of plant species has remained almost the same in colonies for a period of four years.

The latest studies show that the numbers of colonially breeding species (Common Eider *Somateria mollissima*, Herring Gull *Larus argentatus*, Razorbill *Alca torda*, Guillemot *Uria aalge* and Black Guillemot *Cepphus grylle*) have not decreased in the largest colonies of Great Cormorants in 1997-2004 compared to the situation before the establishment of Cormorants. A small colony of Razorbill has started breeding in a Cormorant colony, an islet that has been abandoned by Razorbills for ca. 40 years. Monitoring of Cormorant diet during the breeding season started in 1998 and has continued since in a few colonies in SW Finland. Samples (1,100 specimens of 13 species) include only a few economically valuable fish species: Baltic Herring (see Appendix 2 for scientific names) comprising 7% and Pikeperch 2% of the total number. Perch is the only dominant species (24%) that is used commonly by man.

Some damage to fishing gear occurs but this is not a major problem because the birds merely take fish from nets. However, pellet analysis studies indicate that most of the consumed fish has minimal economical value. For example, the food composition at the Tammisaari colonies in 2004 (n = 234 fish) included Eelpout (45%), Perch (27%), Roach (17%), Baltic Herring (6%), Ruffe (2%) and others (3%). The state of Finland does not pay any compensation for damage caused by Great Cormorants. Although the bird is a protected species, in accordance with the Finnish Nature Act, birds are known to be disturbed. In 2001 up to 1,100 eggs were stolen from one colony while in 2004 illegal persecution was reported in three colonies.

Most of the Great Cormorants in Finland are ground breeders.

At least 36% of all Cormorant colonies have suffered from persecution in 1996-2004. The first case occurred in 1998 and since 2001 incidents have been documented annually. Persecution has taken place in all coastal areas. By 2003, two colonies out of nine had been abandoned because of persecution. Most incidents have occurred at small colonies and early in the breeding season, typically when first breeding has taken place on a certain islet. Reports of an offence have been carried out in each case by environmental authorities.

There are many potential areas where Great Cormorants could breed in Finland, particularly around inland lakes, river estuaries and large reservoirs, which could further exacerbate existing conflicts. For example, Salmi & Muje (2001) point out that fishing has always been important to the nutrition and economy of the rural areas in Finland. Fishing is also considered to be one of the most popular leisure-time activities in Finland (Salmi & Auvinen 1998). However, fisheries management of inland waters in Finland, which is traditionally based on private ownership of fishing waters and governed by local-level decision making, has recently developed into a complicated multilevel management system, producing new kinds of conflicts between "user groups and management levels" (Salmi & Muje 2001). Cormorant populations are currently being monitored while discussions have been set up between government environmental agencies (such as the Finnish Environment Institute) and other organisations like the Hunters Association, BirdLife Finland, Ministry of Agriculture and Forestry, Fisheries Institute, Zoological Museum, Universities etc, to devise a national management plan for the Great Cormorant.

Adult Cormorants on their breeding island in Tammisaari.

9.2 Cormorant conflicts with fisheries

Care must be taken when interpreting information provided in this section. Please refer to section 2.2.3 (*Methodological limitations and difficulties*).

9.2.1 Conflict site descriptions

Nine Cormorant conflicts were reported from Finland: all on coasts (Bolax gaddarna, Båtgrundet, Haverören, Iso Haahkaluoto, Lankoslahden luoto, Sköldharun-Lerharun, Tvåkobbarna, Ådgrundet, and Äggharuna).

9.2.2 Birds and fish

In Finland, Cormorants reported to be involved in conflicts were *P.c. sinensis*. No fish species were recorded in conflict with Cormorants from Finland although diet is know to comprise Eelpout, Roach, Perch, Silver Bream, Baltic Herring, Pikeperch and Ruffe (data from Tammisaari colonies, see also above).

9.2.3 Seasonality

Cormorant conflicts in Finland were reported to occur early in the breeding season (i.e. April-July): grey boxes indicate months where fewer conflict cases were reported.

Month of conflict												
COUNTRY	J	F	M	A	M	J	J	A	S	O	N	D
Finland												

9.2.4 Finance

Financial information on the ‘costs’ of Cormorant predation was not provided for Finnish cases. In Finland there is no financial compensation system for damage caused by Cormorants.

9.2.5 Conflict issues: magnitude of conflict

There are no published reports of Cormorant conflicts with fisheries stakeholders in Finland. Thus nature conservationist stakeholders reported all 9 conflict cases, citing 7 conflict issues in the environmental category (Table 9.1)

9.2.6 Conflict issues: status of information used by stakeholders

Overall, stakeholders provided 42 records of the status of the information they used to inform themselves about Cormorant conflict issues in Finland. The highest proportion of records (57%) was for ‘popular’ articles, followed by ‘scientific literature’ (43%) with no reference to ‘grey literature’.

9.3 Potential Cormorant management tools

There is no management in Finland concerning Cormorants although a national plan is under development (see section 9.1.2). The Finnish Cormorant population is now (in 2004) at 2,931 pairs in 21 colonies, spread over most of the sea regions of Finland. The approximate annual increase of breeding pairs was 150 % in 1996–2002. The first tree-nesting colonies appeared in 2002. As yet, there have been no real conflicts concerning fisheries and Cormorants in Finland.

A few cases of illegal persecution have taken place: (a) in 1998 all 3 nests (with eggs and young) of a new colony were destroyed in the Archipelago Sea, (b) in 2001, 1,104 eggs were destroyed in the largest Finnish colony, in the Gulf of Finland. Breeding pairs (380) at the disturbed islet raised only 265 fledglings, (c) in 2002, 15 nests (with eggs) of 17 were destroyed in a new colony in the Gulf of Finland and all 52 nests (with eggs) were destroyed in a colony in the Archipelago Sea.

Conflict issue	Not claimed/not applicable	No impact	Minor effect	Major effect
(3) ENVIRONMENTAL				
Eutrophication		8		
Interactions with other birds		1	3	
Scaring/shooting disturbance		1	2	2
Lead contamination (birds/environment)		5		
Landscape alteration			2	
Drowning in fishing gear			1	
Damage to vegetation/landscape			5	

Table 9.1 Cormorant conflict issues as recorded by nature conservationist stakeholders for Finnish coasts (n = 9 cases). Each figure is the number of times a particular issue was cited by stakeholders.

The Ministry of the Environment in Finland nominated a national working group at the end of March 2004. The members of this working group represent stakeholders from different sectors of Finnish society. The reason behind this working group was the increase of the Cormorant (*P. c. sinensis*) population in Finland and the obvious damage for fisheries in the future and the outlook that the Cormorant situation will become a great problem. The main tasks of the working group are to:

(1) Devise a plan to manage the cormorant population in Finland.
(2) Address/solve the effects of Cormorants on fish stocks and the marine environment.
(3) Determine how and when to interfere in the development of the Cormorant population and the techniqus to be used.

9.4 Stakeholders consulted

(1) Finnish Environment Institute, Mechelininkatu 34 a, P.O.Box 140, 00251 Helsinki.
(2) Uudenmaan riistanhoitopiiri, Sompiontie 1, 00730 Helsinki, Finland.
(3) BirdLife Finland, Annankatu 29 A, 00100 Helsinki, Finland.
(4) Ministry of Agriculture and Forestry, Hallituskatu 3 A, Helsinki, Finland.

(5) Game and Fisheries Institute, Pukinmäenaukio 4, P.O.Box 6, 00721 Helsinki, Finland.
(6) Zoological Museum, P. Rautatienkatu 13, P.O.Box 17, Helsinki, Finland

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10. France

10.1 National overview

By Loïc Marion

Background

In less than two decades, the Great Cormorant has changed its North-Western European distribution from a coastal (i.e. *P. c. carbo* subspecies) to predominantly inland (i.e. *P. c. sinensis*) distribution, mainly due to the protection of the *sinensis* population by the European Community in 1979 (van Eerden *et al*. 1995). Such a European population expansion prompted an increase in the wintering population in France, which became the main European wintering country for the *sinensis* subspecies. This resulted in an overlap in the wintering range with the *carbo* population, originating from the local coastal colonies but also from the British Isles. This *sinensis* component probably led to the establishment of the ‘new’ inland breeding population in France from 1981 (Marion 1983, 1995) as is believed to have occurred in south-east England (Goostrey *et al*. 1998).

A change in the inland Cormorant population inevitably resulted in an increase in pressure from fish farmers and anglers, particularly in France, on European authorities to do something about the situation (Marion 1997b). Various reports concluded that Cormorants were not imposing severe economic damage on a large geographical scale (Lebreton & Gerdeaux 1996, Marion 1997a). However, shooting of Cormorants began in France in 1992, initially at a few sites but rapidly increasing from 4,500 birds shot in 1996-97 to 19,000 in 2001-02 and 25,000 in 2003-04. Thus France is the European country where shooting of Cormorants is most prolific. The total number of Cormorants shot in Europe in 1999 was estimated at around 29,000 (Heer 2000) at the time when the number authorised in France was 12,000 (Marion 2003a).

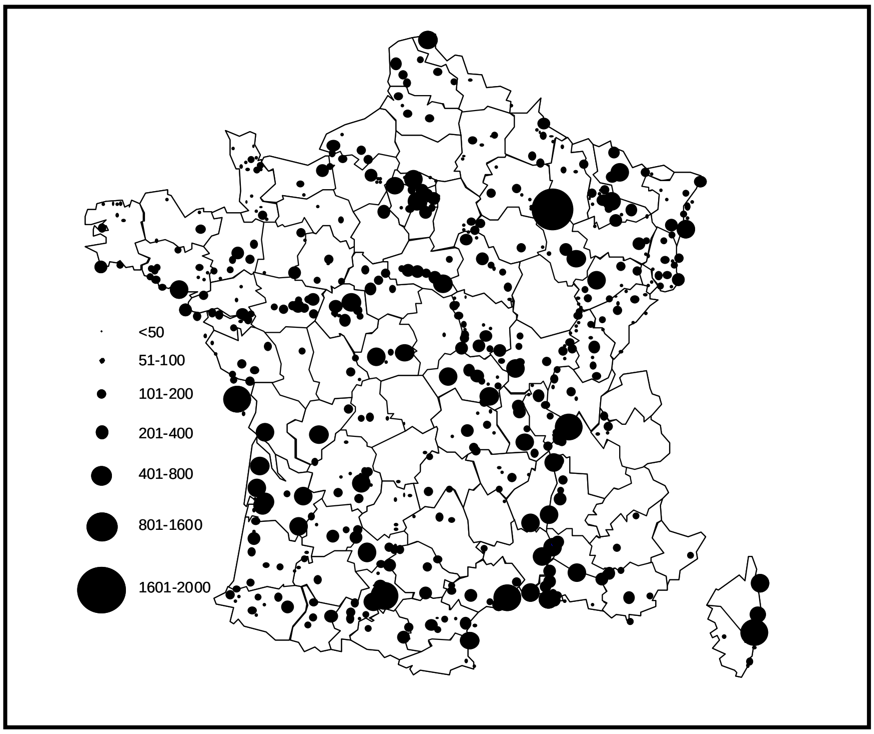
10.1.1 Breeding population

The French inland and coastal breeding populations differ greatly in their rate of population increase. During the last three decades, the oldest population along the Normandy coasts spread slowly towards the west in Brittany, but its size appears to have stabilized to about 1,900 breeding pairs in 19 colonies in 1998-1999 against an estimated 1,800 at the beginning of the 1990s (Debout 1998) and 1,740 in 1995 (Marion 1997a). However this coastal population increased up to 2,100 breeding pairs in 2003 due to expansion to the southern coast of Britanny (Marion 2004). During the same period, the inland breeding population, established in 1981 at the Lake of Grand-Lieu, spread east and secondarily south, with wintering birds from the Northeast European population and emigrants from Grand-Lieu contributing to the inland population growth. This inland population showed a strong increase of about 52% per year until 1995, followed by a lower mean annual rate of increase of about 8% until 1998, and 13% thereafter, and by 2003 reached 2,700 breeding pairs in 33 colonies (Marion 2004). The intermediate slowing up seems largely to be due to the stabilization of the main inland colony, Grand-Lieu, at about 500 pairs, after a decline of 26% since 1999. This colony had initially increased by 47% per year between 1981 and 1996 to reach 680 pairs (Marion 2003). The other four main inland colonies also levelled off, so the recent increase of population is only due to the appearance of new colonies, most of them being rather small (less than 50 pairs).

10.1.2 Wintering population

The wintering population has also showed signs of stabilising in recent years with an annual increase of 2% between 1992 (66,000 Cormorants) and 1997 (72,800) compared to 19% prior to this (Marion 1997a,c). However, the wintering population in 1997 was probably adversely affected by the cold weather because the population increased by 7% per year between this year and 1999 (83,000 Cormorants, Marion 1999). The increase was only 1% per year (until 2001) with 85,000 Cormorants (Marion 2001), and 2.4% until 2003 with 89,000 Cormorants (Marion 2003b).

The increase of wintering Cormorants over the past twenty years has shown several spatial changes. At the beginning of the 1980s, the coast of Brittany was the main wintering area. During the 1980s, however, Cormorants also used the Mediterranean coast, before they invaded the Rhone and the Loire valleys, and finally the Seine valley in 1992. At this time, most of the small rivers and large areas in the East and the centre of France were still unpopulated. Nevertheless, the national census of 1997 (Marion 1997c) showed that a large proportion of the wintering population was now beginning to occupy previously vacant areas, particularly in the Seine and Garonne valleys and in the East of France, largely contributing to the national population increase from 1992. The upper waters were also used for the first time



Distribution of winter night roosts of Great Cormorants in France in January 1999 (from Marion 1999).

because several of the downstream stretches were frozen. Curiously, in this year a strong decline in wintering Cormorants was observed on the coasts of Brittany and to a lesser extent along the Mediterranean coast, although these areas were unfrozen during the census.

By 1999, there was an almost complete distribution of wintering cormorants over France, masking any previous importance of large rivers apparent in 1992 (Marion 1995). Numbers in the Loire Valley decreased by 3% compared to 1997, the Rhône valley by 10% and the Seine and the Marne by 43%.

Conversely, several regions in the East of France and in Aquitaine now found the number of birds were increasing. By 2001, these changes were confirmed (Marion 2001), with an increase in the North-Eastern parts and in Massif Central, and a levelling off or decrease in the other parts of the country (Loire, Rhône and Garonne valleys, Alps, Corsica). The situation did not really change in 2003 (Marion 2003b).

10.1.3 Cormorant predation conflicts

While there is abundant data on Cormorant populations due to regular National surveys (every two years), there is very little information about fish stocks in France, and about “real” predation (Marion 1997b). At the national level, the wintering population of Cormorants probably predated about 5,300 tonnes of fish per winter, assuming a mean daily food intake of 340 g (Marion 1997a), which would represent only about 2% of the estimated national fish stock. According to Marion (2001), about 92% of the wintering population use natural feeding wetlands, most of them in large rivers, lakes or coasts, where they primarily feed on cyprinids without important commercial or sport-fishing value. The remaining Cormorants use the five main fishpond areas (Dombes, Brenne and Sologne, Forez, Lorraine and Vendée).

Wintering Cormorants are considered to be pests by fish farmers in the main fishpond areas around central France (e.g. Brenne).

Conflicts between Cormorants and fisheries started in the 1980s, particularly in the Dombes (in Ain) and the Brenne (in Indre). Within these areas the total estimated predation represents less than 4% of the national production (10,000 tonnes). However, this predation is not regularly distributed but focussed on a few attractive fishponds where predation can reach 20% to 80% according to fish farmers. Unfortunately, there are no official statistics on annual production and consequently on losses due to Cormorants. Some other causes of fish loss are frequently attributed to Cormorants due to a lack of knowledge. For example, the Brenne Fishermen's Union reported the following predation rates for eleven representative ponds in the Brenne (based on production loss compared to "normal" levels): 35%, 45%, 52%, 60%, 65%, 82% and four with a predation rate of 85%, equivalent to a loss of 600kg per pond in terms of fish stock (Marion, 1997a). However, Broyer (1996) highlights the fact that between 1990-1992, drought had some affect on fish production and so losses could not only be blamed on Cormorants. Predation is probably negligible in large rivers (Loire, Rhône, Garonne, Seine) and lakes that hold the largest concentration of wintering Cormorants. Predation is probably more problematic in some upper waters (Trout, Grayling, see Appendix 2 for scientific names) although very few have been documented. However, the number of wintering Cormorants in these waters is relatively low and problems appear to be mainly restricted to the Alp area where fish communities largely differ from the rest of France being mainly lowland rivers dominated by cyprinids.

Nevertheless, a large majority of anglers, primarily interested in salmonids (and then Pike and Eel) are convinced that the dramatic loss of quarry fish in rivers is due to Cormorant predation. Since 1992 increased political pressure from the angling lobby (representing around 2.5 million anglers) has encouraged a rise in shooting in the hope of maintaining (or reducing) the wintering Cormorant population to about 73,000 (as proposed by Lebreton & Gerdeaux [1996] for official policy). This National Management Plan has so far had little effect and the number of Departments authorised to shoot Cormorants has increased in recent years. Following repeated requests by anglers, shooting, which was first limited to fish farms has now been extended to peripheral open waters and in open waters not close to fish farms (Marion 1997b). In 2001, the shooting quota allocated to each Department for fish farms and peripheral open waters varied from between 20 to 2,600 birds (Dombes in Ain), five times more than the number of wintering Cormorants in that area and totalling 14,650 for the country as a whole. This reached 18,400 in 2003-04. The minimum number of Cormorants that could be shot without any proof of damage in other open waters (not affected by nearby fish farms) was 90 Cormorants per Department, but this was subsequently increased to 400 (in Ain) and to 500 (in Nièvre), the total for France reaching 4,300 birds in 2001 and 13,000 in 2003. The distribution of such quotas is more representative of the political pressure wielded by anglers and fish farmers than the effect of wintering Cormorants on fish losses. The main "conflict" Departments are: Ain and Saône et Loire (Dombes), Indre and Indre et Loire (Brenne), Loire (Forez), Loiret and Loir et Cher (Sologne), and Moselle (Lorraine).

In spite of this increase in the number of birds shot, there is no relationship between intensity of shooting and changes in the number of wintering Cormorants the following year (Marion 1999, 2001, 2003b) which is similar to findings in Bavaria (Keller, 2000). The distribution of Cormorants appears to be largely dependent on natural factors but, because conflicts essentially occur during winter, shooting of breeding birds is prohibited in France (Marion 2001, 2003a). However, from 2001 the authorities authorized the scaring of breeders using laser guns to prevent new settlements in the main fishpond areas. Such methods were used for two small colonies in Brenne but illegal destruction of colonies also occurred in the main fishpond areas (Marion, pers.comm.).

10.1.4 Case Studies (conflict areas)

Lac de Grand-Lieu : Fishermen are in conflict with the Cormorants. Predation on Pikeperch is considered to be serious by fishermen but dietary data do not confirm this opinion (<1% of diet). Most of the diet comprised cyprinids that have no commercial value at this site.

Reservoir Poutes : Minimal impact. The hydroelectric plant kills more Atlantic Salmon than do Cormorants.

Lake Geneva: Minimal impact.

Lake Bourget and Lake Annecy: Alpine lakes which are very large and deep (about 300 m) with relatively cold and clear waters. They are more representative of Switzerland and alpine habitats. Cormorant populations in these alpine lakes are relatively minor in France. At Lake Bourget, fishermen wish to kill Cormorants but bird watchers do not agree, whilst at Lake Annecy the low impact of Cormorants is acceptable.

10.2 Cormorant conflicts with fisheries

Care must be taken when interpreting information provided in this section. Please refer to section 2.2.3 (*Methodological limitations and difficulties*).

10.2.1 Conflict site descriptions

Six Cormorant conflicts were reported from France (though see comments on national coverage in section 2.2.3): on 5 lakes (Annecy, Bourget, Geneva, Reservoir Poutes and Lac de Grand-Lieu) (Table 10.1) and one coast (Chausey Islands). However these sites were only those for which any documented data were available. Most lake conflicts were reported from semi-natural, mesotrophic waters at altitudes of 100-500m.

Habitat	**Feature**	**Category**		
	Altitude (m)	**< 100m**	**100-500m**	**500+m**
Lakes	N = 4 cases		4	
	Trophic status	**Oligotrophic**	**Mesotrophic**	**Eutrophic**
Lakes	N = 5 cases	1	3	1
	Anthropogenic Influence	**Natural**	**Semi-natural**	**Artificial**
Lakes	N = 5 cases	1	3	1

Table 10.1 The number of Cormorant conflict cases reported from France in relation to habitat and habitat features.

10.2.2 Birds and fish

In France, Cormorants reported to be involved in conflicts were both *P.c. carbo* and *P.c. sinensis*. Reported Cormorant density on lakes (5 cases) averaged 0.60 birds ha^{-1} (range = 0.05 - 1.5 birds ha^{-1}), density in the coastal case was reported to be 0.01 birds ha^{-1}. Fourteen fish species were recorded in conflict with Cormorants in the 5 French lake case studies reported. Brown Trout, whitefish, Perch, and Pike were reported in 3 cases, juvenile Atlantic Salmon, Tench, Bream, Carp, Pikeperch, Black Bullhead Catfish, Roach, Rudd and Eel each in 1 case. Sole was reported in relation to the single coastal case study.

10.2.3 Seasonality

Cormorant conflicts in France were reported to occur in winter (i.e. Oct-Mar): grey boxes indicate months where fewer conflict cases were reported.

Month of conflict												
COUNTRY	J	F	M	A	M	J	J	A	S	O	N	D
France												

10.2.4 Finance

Financial information on the ‘costs’ of Cormorant predation was reported for only 1 conflict case. 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. It was requested that the values provided be categorised as either ‘actual’ or ‘estimated’. The information provided for 1 French lake case was estimated. Here, estimated turnover for the commercial fishery was 365,000 euro and estimated loss was 22,800 euro (6% of turnover). For the French coastal case, turnover for the commercial fishery was estimated at 600,000 euro and there was considered to be no financial loss to Cormorants here.

10.2.5 Conflict issues: magnitude of conflict

Cormorant conflicts with recreational and commercial fisheries and nature conservationist stakeholders on lakes were the most frequently reported (n = 5 cases) in France. Here, commercial fisheries stakeholders (n = 4) reported 8 conflict issues, nature conservationist stakeholders reported 4 issues, and recreational fisheries stakeholders reported 2 issues (Table 10.2)

10.2.6 Conflict issues: status of information used by stakeholders

Overall, stakeholders provided 31 records of the status of the information they used to inform themselves about Cormorant conflict issues in France. The highest proportion of records (68%) was for ‘popular’ articles, followed by ‘scientific literature’ (32%) and no records of ‘grey literature’. Overall, there was no significant difference in the use of popular, grey and scientific literature sources between the 3 stakeholder groups providing information (Table 10.3).

Status of information	Stakeholder group			
	Recreational	**Commercial**	**Aquaculture**	**Nature conservation**
Popular	37.5%	73.7%	-	100.0%
Grey literature	-	-	-	-
Scientific literature	62.5%	26.3%	-	-
Total no. records (= 100%)	**8**	**19**	**None**	**4**

Table 10.2 Categorisation of the status of information used by stakeholders to inform themselves about Cormorant conflict issues.

Conflict issue	Not claimed/not applicable	No impact	Minor effect	Major effect
(1) FISHERIES				
Reduced catch			3 (4)	
Loss of stocked fish			3 (4)	
Reduced value of catch (damage)			4	
Removal of fish from nets			3	
Damage to fishing gear			3	
(2) FISH STOCKS				
Reduced stock - lowered production			1 [1]	
Loss of juvenile fish - lowered recruitment			1 [1]	
Loss of spawners			1 [1]	
Loss of aquaculture stock				
(3) ENVIRONMENTAL				
Landscape alteration			[1]	

Table 10.3 Cormorant conflict issues as recorded by commercial (5 cases), recreational (4 cases, round brackets) and nature conservationist [1 case, square brackets] stakeholders for French lakes (N = 5 cases). Each figure is the number of times a particular issue was cited by stakeholders.

10.3 Potential Cormorant management tools

Information (summarised in the following tables) was provided on (1) general actions taken against Cormorants in France, and (2) management plans/legal regulations.

NAME OF RESPONDENT AND YOUR AFFILIATION	**Loic Marion, Universite de Rennes, 35042 Rennes Cedex, France.**
COUNTRY	**France**
REGION / PROVINCE / etc. (if applicable)	
Period which is concerned [year(s)]	**1999/00**
General information on actions against Cormorants in your country (please give annual numbers)	
	National numbers
Number of breeding colonies destroyed or disturbed	**0**
Number of nests destroyed	**0**
Number of nestlings killed	**0**
Number of adults killed in the non-breeding season	**20,000**
Number of breeding adults killed	**0**
Number of night roosts destroyed or disturbed	**yes**

NOTE: Information from Marion, L. (2003) Recent development of the breeding and wintering population of Great Cormorants (*Phalacrocorax carbo*) in France - Preliminary results of the effects of a management plan of the species. Vogelwelt 123, Suppl., 35-39.

Management plans / legal regulations (France 1999-2000)	
	Total country
Are there any management plans in effect? Please list all national or regional plans and give details	**yes, regional plans**
Are there any regulations in effect that allow Cormorant culling? Please list all national or regional regulations and give details	**yes, regionally**
Are there any coordinated culling programmes in your country?	**no**
Is it mandatory to obtain single permits for Cormorant killing?	**yes, regionally**
Has a general permit for Cormorant killing been issued?	**yes, regionally**
Is there any financial compensation for fish losses?	**no**
Is there any financial aid for the construction of Cormorant exclosures or for scaring programmes, etc.?	**yes, regionally**

Remarks (on General information & on Management plans /legal regulations):

It is illegal to do anything to Cormorants during the breeding season, except in Brenne and Sologne where scaring techniques can be employed.

10.4 Stakeholders consulted

(1) Union Nationale pour la Pêche en France. 17 rue Bergère, 75009 Paris, France.
(2) Union Nationale du Syndicat de l'Etang, Ain, France.
(3) Société des Pêcheurs du Lac de Grand-Lieu, Passay, Loire Atlantique, France.

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11. Germany

11.1 National overview

By Thomas M. Keller, Kareen Seiche & Harald Kleisinger

Background

Up until the middle of the 19th century the Great Cormorant *P. c. sinensis* bred intermittently in Germany (Bauer & Glutz von Blotzheim 1966). Despite human persecution, colony sizes of several hundred to some thousands were not uncommon. Nevertheless sustained persecution across Europe coupled with the effect of the First World War resulted in near-extinction of the Great Cormorant except for one or two remote coastal colonies. Extended persecution and disturbance decreased during the 1960s and there were signs of a recovery linked to a growth in population numbers in Denmark and The Netherlands (Bregnballe & Gregersen 1995, Lindell *et al.* 1995).

11.1.1 Great Cormorant breeding population

According to Menke (1997) habitat and species protection in Germany in the 1980s meant that the numbers of breeding pairs rose from 955 in 1980 to 2,280 in 1985 and to 14,800 in 1995. Located close to the North and Baltic seas, northern Germany provided particularly suitable breeding habitat (cf. Kieckbusch & Koop 1997). During the 1990s, the breeding population has doubled every 3-4 years with the annual rate of increase averaging 21% (Bregnballe *et al.* 2003). By the year 2001 the number of >20,000 nests in 100 breeding colonies was reached (Table 11.1). There are three types of occupied breeding habitat areas (Figure 11.1):

1. The largest and oldest colonies are located in the coastal areas of the North and Baltic Seas.
2. Several medium-sized colonies are located in the lake district of the northern lowland that is rich in freshwater lakes. Colonies are located 30-100 km from the coast and so available feeding sites include both marine and fresh water bodies.
3. Colonies are also situated in inland areas extending to the south of Bavaria, especially along large rivers and on pre-Alpine Lakes.

11.1.2 Great Cormorant distribution and numbers in winter (after Wahl **et al.** *2004).*

As part of the first pan-European Cormorant midwinter census Great Cormorants were counted at their night roosts in Germany in mid-January 2003. A total of 500 roosts were controlled (including 158 unoccupied roosts/waterbodies). In neighbouring countries close to the German border another 18 roosts were checked (two of which did not hold birds). Within Germany 33,568 Cormorants were recorded (Table 11.2).

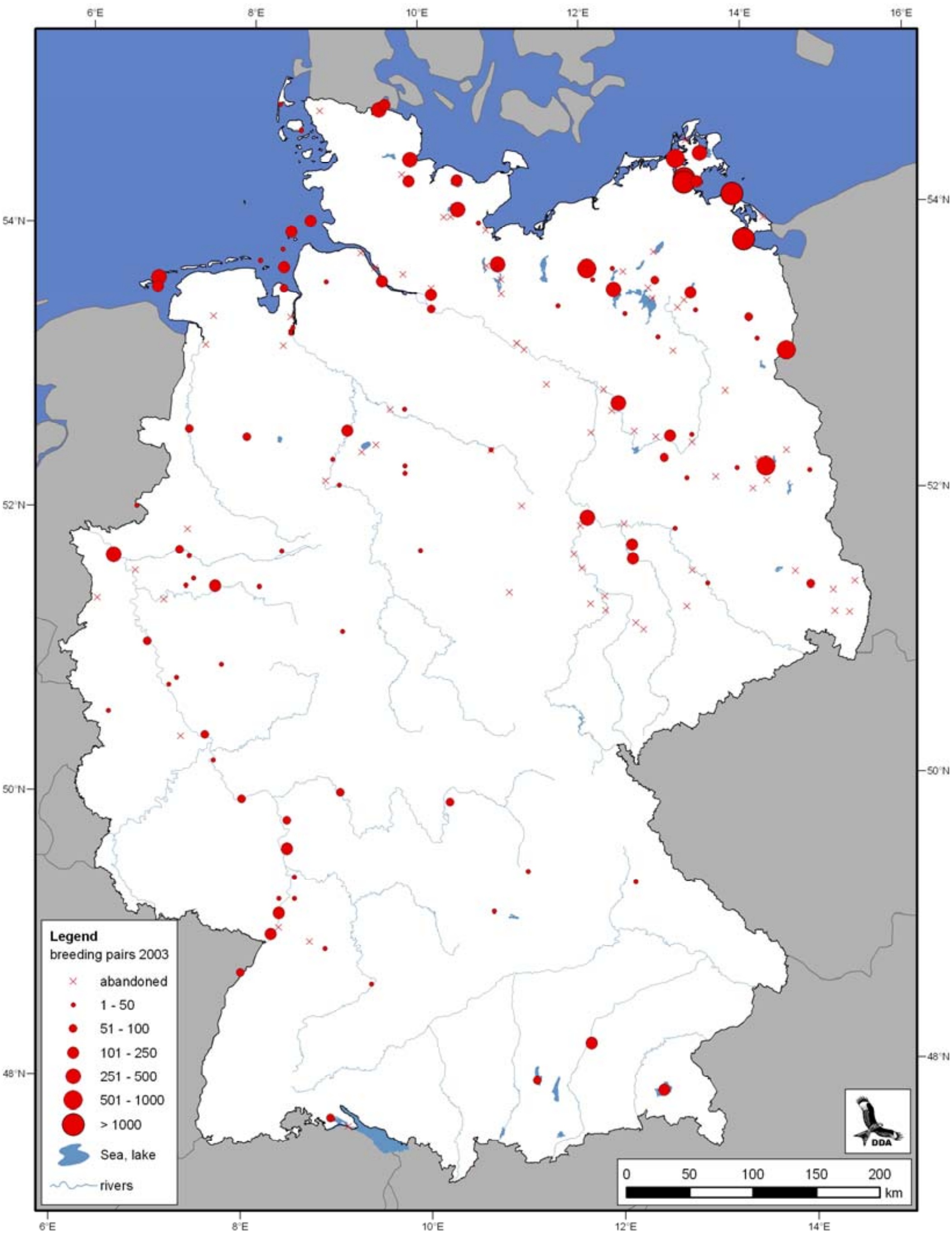

Figure 11.1 Distribution and size of the Great Cormorant breeding colonies in Germany in 2003 (map produced by J. Wahl (DDA); see Table 11.1 for data sources).

STATE	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Schleswig-Holstein	1,566	2,466	2,450	3,202	2,597	2,539	2,561	2,768	2,751	2,576	2,362	2,226
	6	7	7	8	7	10	10	12	11	9	10	12
Mecklenburg-Vorpommern	6,700	7,332	9,500	8,458	8,179	9,457	8,314	8,606	9,356	10,681	10,849	11,651
	13	14	15	14	16	16	15	19	15	17	19	17
Niedersachsen	414	428	647	758	740	967	1,023	1,147	1,250	1,261	1,144	1,194
	7	8	9	9	9	15	18	17	19	21	18	19
Hamburg	0	0	52	148	111	188	202	225	277	313	345	338
	0	0	2	2	2	3	3	3	2	2	2	2
Berlin	0	0	2	36	72	140	0	0	3	0	0	8
	0	0	1	1	1	2	0	0	1	0	0	1
Brandenburg	256	373	712	1,267	1,177	1,654	2,058	2,004	2,206	2,813	2,492	2,370
	3	5	9	8	10	13	9	10	11	13	11	12
Sachsen-Anhalt	32	52	257	261	270	230	325	446	585	621	733	693
	2	2	7	5	6	8	5	5	3	3	7	4
Nordrhein-Westfalen	33	110	211	230	270	432	457	429	687	648	671	771
	3	1	4	6	4	5	7	8	9	13	13	16
Sachsen	35	54	126	6	20	49	62	175	11	16	20	79
	2	4	3	2	3	2	2	3	2	3	1	1
Hessen	150	150	190	297	370	310	351	368	427	420	450	459
	1	1	1	2	2	2	3	4	4	4	6	5
Rheinland-Pfalz	4	35	64	68	99	128	111	101	125	150	162	225
	1	2	2	2	2	2	2	2	3	2	4	4
Baden-Württemberg	0	0	5	10	17	28	118	154	215	264	279	301
	0	0	1	1	1	2	4	4	4	6	8	8
Bayern	254	225	267	302	328	289	361	384	484	488	518	520
	5	5	4	4	5	6	6	7	7	7	7	7
∑ Breeding Pairs	**9,444**	**11,225**	**14,483**	**15,043**	**14,250**	**16,411**	**15,943**	**16,807**	**18,377**	**20,251**	**20,025**	**20,835**
∑ Breeding Sites	**43**	**49**	**65**	**64**	**68**	**86**	**84**	**94**	**91**	**100**	**106**	**108**

Table 11.1 Great Cormorant breeding numbers (top rows) and numbers of breeding colonies (bottom rows) in the 13 German states with breeding birds (1992 - 2003). (After data collected by W. Knief [Staatl. Vogelschutzwarte Schleswig-Holstein] from the German state bird conservation agencies [Staatl. Vogelschutzwarten oder Landesumweltämter] and from Zimmermann, 1993, 1994, 2004 and pers. comm. [Mecklenburg-Vorpommern], Buchheim & Bellebaum, 1993 and Buchheim pers. comm. [Nordrhein-Westfalen], Seiche & Wünsche, 1996 and Seiche pers. comm. [Sachsen], Boschert *et al.*, 2000 and Boschert pers. comm. [Baden-Württemberg], T. Keller pers. comm. [Byern].

Assuming around 10% of the individuals were missed during the census, the total German midwinter population was estimated at ca 38,000 birds in January 2003. Compared to counts in the western federal states in the mid 1990s, numbers have increased only slightly. However, the number of roosts rose by at least 25% in this region. Due to the low temperatures in the first half of January 2003, most water bodies in northern and eastern Germany were covered with ice. In these regions large roosts formed on the coast (Fig. 11.2). Almost half (47%) of the night roosts held up to 50 birds, and only about 13% more than 200 birds (46% of all individuals). Trees were almost exclusively used as night roosts. By far the most common roost sites were located on rivers and their back waters.

Federal State	Number of Birds	Number of Roosts[a]		Coordinator
		controlled	occupied	
Schleswig-Holstein (incl. Helgoland)	3,515	16	15	J. KIECKBUSCH, B. KOOP, K. GÜNTHER
Niedersachsen	1,456	39	25	D. WENDT
Bremen	182	3	2	D. WENDT
Mecklenburg-Vorpommern	39	17[b]	2	H. ZIMMERMANN
Hamburg	274	3	2	D. SCHLORF
Sachsen-Anhalt	1,570	15[c]	12	S. FISCHER, E. SCHWARZE
Brandenburg	91	16[d]	4	M. MÜLLER, M. MIETHKE, B. LITZKOW
Berlin	103	3	2	B. SCHONERT
Nordrhein-Westfalen	4,986	73	44	A. BUCHHEIM
Hessen	2,627	32	23	K. FIEDLER
Rheinland-Pfalz	2,969	32	30	T. DOLICH
Saarland	1,185	12	8	G. SÜßMILCH
Thüringen	1,590	14	14	J. WIESNER
Sachsen	1,310	33	21	K. SEICHE
Bayern	6,836	131	93	U. LANZ, T. KELLER
Baden-Württemberg	4,835	61	45	M. BOSCHERT, W. HELLWIG, U. MAHLER, G. MÜLLER, A. PUCHTA,
Total	**33,568**	**500**	**342**	
Abroad close to border	11,467	18	16	

[a] Important: in some cases it was not stated if zero-counts referred to a deserted roost or only to controlled water bodies..
[b] + two regions
[c] + one region
[d] + one region without Cormorants

Table 11.2 Great Cormorant numbers in 16 German states, Jan. 2003 (from Wahl *et al.* 2004).

11.1.3 Case Study: Great Cormorant Impacts in Bavaria (after Keller **et al.** *1997)*

Since the late 1980s the advancing occurrence of Great Cormorants in Bavaria, southern Germany, has caused substantial conflicts between fisheries managers and nature conservationists. As legislation has placed the birds under special protection, fishermen and fish farmers see their fish stocks and yields increasingly threatened. Since the winter of 1973/74 the number of migrating and wintering Cormorants has increased exponentially between September and March (Bezzel & Engler 1985). An exception is Upper Bavaria, where bird numbers have declined as a result of a significant drop in the numbers of visiting Cormorants at the three larger south Bavarian roosting sites at Ismaning reservoir, Ammersee and Chiemsee.

Typical water bodies in Bavaria include large pre-alpine lakes (e.g. Chiemsee, Ammersee), man-made lakes (e.g. Altmühlsee and gravel pit Ochsenanger), large rivers (e.g. Danube, Lech, and Lower Inn), small rivers (e.g. Alz and Maisach), and Carp (see Appendix 2 for scientific names) farms (e.g. Haundorfer Weiher). Of the

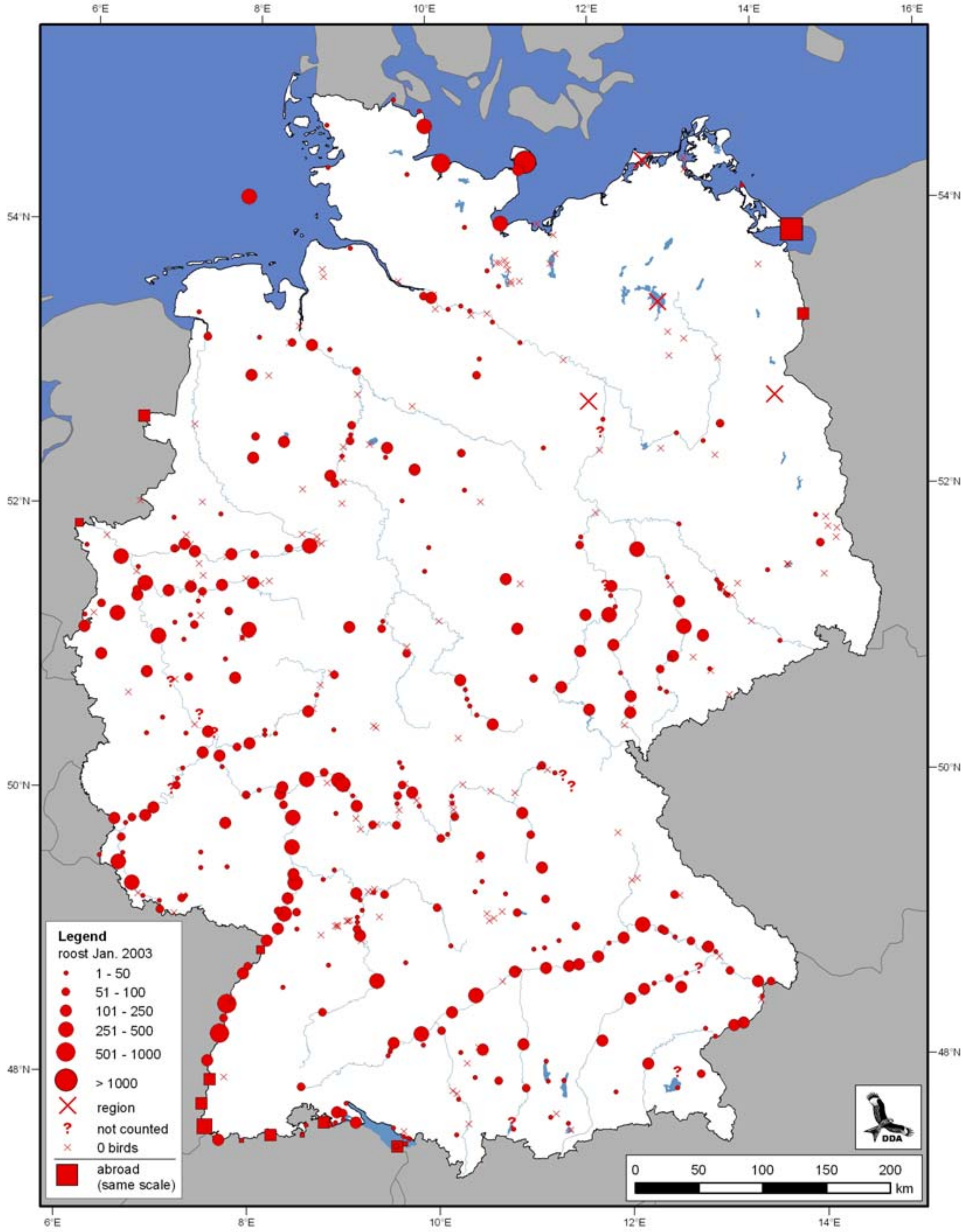

Figure 11.2 Distribution and numbers of Great Cormorants in Germany in January 2003, including nearby roosts in neighbouring countries (squares) and waterbodies (small crosses) and regions (large crosses) without Cormorants (after Wahl *et al.* 2004).

examples mentioned Ammersee, Altmühlsee and Chiemsee have adjacent Cormorant nesting colonies. The Carp ponds Haundorfer Weiher are situated within the foraging range of the Altmühlsee colony. The remainder are only temporarily visited by migrating or wintering Cormorants. Roosting sites have developed in the vicinity of some of these waters.

From 1991 to 1994 a three-year study on the impacts of wintering Cormorants on the fish stocks of a variety of water bodies was conducted in Bavaria, southern Germany. Cormorant pellets from a study carried out at seven roosts and waters were dominated by cyprinid remains, primarily those of Roach, Bream, Rudd and Chub. Remains of these species were most abundant in pellets from all areas, except Ammersee. Cormorants at Ammersee and Altmühlsee, as well as at the rivers Danube and Inn, fed commonly on Perch, and along the Danube on Ruffe. At the Alz, with its faster flow, Grayling and salmonids appeared to be important as Cormorant prey.

Yields of both commercial and recreational fisheries are subject to substantial between-year fluctuations. Various environmental factors are responsible for this including eutrophication, hydraulic engineering, shipping traffic and recreational uses. However, in relation to Cormorant impact the following assessments were made:

- ***Large pre-alpine lakes (Ammersee, Chiemsee):*** No detectable influence of Cormorants on fisheries production was observed. Yield decreases were not associated with the presence of Cormorants.
- ***Reservoirs and gravel pits (Altmühlsee and Ochsenanger gravel pit):*** Fish yield statistics did not reveal any effects of Cormorants. However some impact on staple prey fish (cyprinids and Perch) may be possible.
- ***Large rivers (Danube, Lower Inn, Lech):*** In the uncontrolled sections and fringing backwaters of the Danube, a large influence of Cormorants on fish yields could not be demonstrated. From a commercial fisheries point of view punctual measures could be called for in the future if Cormorants seasonally concentrate hunting in backwater areas that are important wintering grounds for fish. In controlled, impounded rivers (Lower Inn, Lech) predation problems may arise with Grayling within the flow section of the barrages.
- ***Small rivers (Alz Maisach):*** Because of the specific behaviour of Grayling, a significant influence of Cormorants on the already low stocks of this species can be assumed. This applies to a lesser extent also to Barbel.
- ***Fish farms:*** Carp ponds appear to be highly attractive to Cormorants and this may lead to substantial damage especially to the production of fish for stocking purposes.

According to the observations above, it was concluded that the establishment of new breeding colonies in the centres of the Bavarian Carp production areas should not be permitted. Under certain circumstances such control was also thought to be necessary in the vicinity of individual ponds and uncontrolled rivers with Brown Trout and Grayling populations. As no considerable effect of Cormorant predation on fish stocks and fisheries yields could be observed at the studied pre-alpine lakes (Ammersee, Chiemsee), artificial lakes (Altmühlsee, gravel pit Ochsenanger), and large rivers (Danube, Inn, Lech), it was suggested that there was no need for action to protect such fisheries at that time. But, at isolated smaller lakes and gravel pits, and at discrete important fish wintering sites in the backwater areas of rivers, considerable impacts on fish stocks seemed possible. In controlled impounded rivers predation problems also might have arisen with Grayling in the flowing sections of those rivers. Thus a need to use scaring techniques in special cases was seen. Due to the specific behaviour of Grayling, Cormorant predation was assumed to have a considerable impact on the already decreased populations of this species at the small rivers studied. Actions were endorsed to deter Cormorants from sections of free-flowing rivers suitable for the natural reproduction of Grayling. To avoid Cormorant damage at aquaculture facilities the constant use of a combination of primarily non-lethal deterrence measures was recommended under the consideration of legal regulations. If Cormorants got used to, or did not respond positively to, the actions taken, it was suggested that the selective shooting of individuals be considered.

11.1.4 Case study: Great Cormorant Population Control in Practice (after Keller & Lanz 2003)

The numbers of migrating and wintering Great Cormorants in Bavaria have remained stable since about the winter of 1993/94 with means ranging between approx. 6,300 to 7,400 birds (winter maxima between 7,700 and 9,500 birds). The Cormorant population had stabilised two to three winters before large scale shooting started in the winter of 1996/97. Since that winter, 2,547 to 6,258 Cormorants have been reported as being shot in Bavaria annually. The highest shooting pressure was in Oberbayern, Schwaben, and Mittelfranken with the numbers of shot birds often reaching, or even exceeding, the mean numbers of birds counted in almost all winters since 1996/97. Most of the birds were shot at large rivers (37.6%), followed by ponds (26.4%), small rivers (14.0%) and gravel pits (13.2%). Especially, in Oberbayern, Niederbayern, and Schwaben large proportions of Cormorants were shot at large rivers while in Mittelfranken and the Oberpfalz, the two most important regions for Carp production in Bavaria, most Cormorants were shot at ponds (67.3% and 74.3%, respectively).

Although the bird population has remained stable since about the winter 1993/94, the number of roosts has increased steadily. At the same time, the number of small roosts (1 - 49 birds) has increased whereas the numbers of large (100 - 199 birds) and very large roosts (≥200 birds) have declined significantly. The uncoordinated shooting of large numbers of Cormorants (up to 102% of the mean Cormorant winter population and up to 66% of the maximum number in 1996/97, respectively) has not reduced the overall numbers of migrating and wintering Cormorants, neither on a Bavarian (see Figure 11.3) nor on a regional scale. Consequently it is unlikely that the overall amount of fish consumed by Cormorants will have declined either. The most probable explanation for this lack of ‘success’ is a high turnover rate in the Cormorant winter populations. Shot birds are quickly replaced by other birds if the local resource is very attractive.

This finding is in good concordance with other regions in Europe with Cormorant shooting. The presence of ice, expressed as ice days, was a factor influencing the numbers of birds present in some Bavarian regions and also shooting was highest in colder winters. Thus climatic conditions and the local availability and density of food are thought to regulate the numbers and duration of stay of Cormorants in different migrating areas.

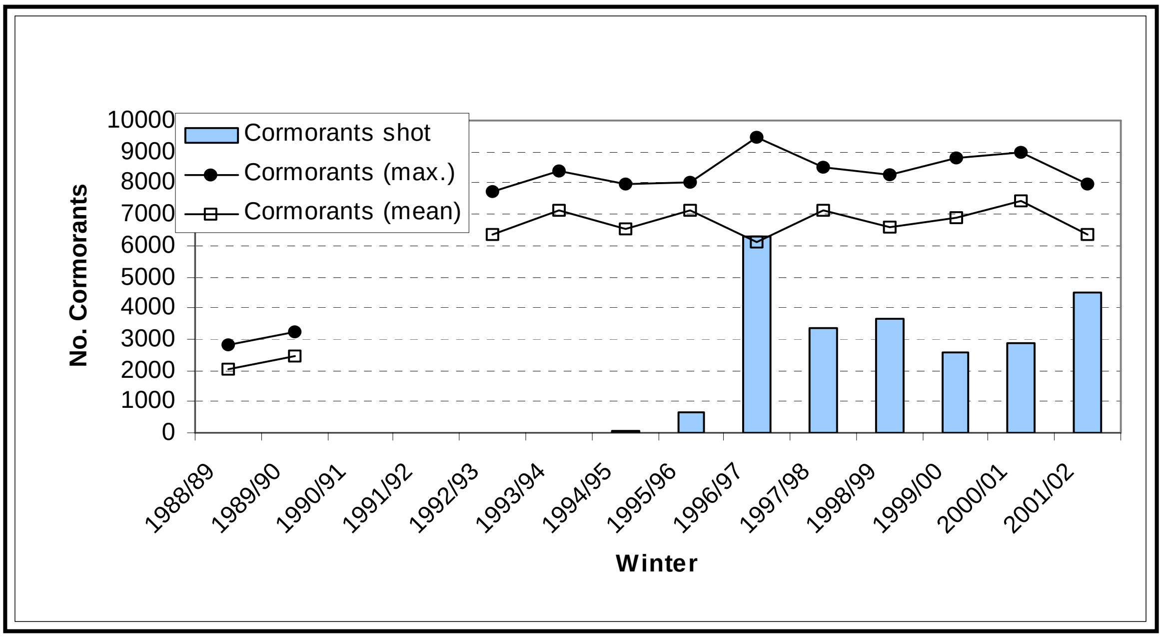

Figure 11.3 Mean and maximum Great Cormorant numbers (Oct-Mar) and numbers of birds shot in Bavaria, southern Germany (after Keller & Lanz 2003).

11.1.5 Saxony case study: financial compensation scheme

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

Financial help is also available to those farmers who farm their fish in an environmentally friendly way (e.g. according to nature protection regulations, low stocking levels, no supplementary feeding, and long-term rotation of ponds). The interactions between Cormorants and fish appear to be very complex and, as a result, are not fully understood. Nevertheless, many feel that there is enough information available upon which to base a financial compensation scheme. Although sound information is needed about Cormorant-fish interactions at ponds, the conflict cannot be solved solely on a scientific level. Thus a forum has been developed whereby biologists, fish farmers and regional politicians can discuss these problems and work together to find a satisfactory solution. Although the compensation scheme is acknowledged to be subjective, all feel that it is based on current best estimates of the situation – and it has gone some way to mitigate local concerns about fish losses to Cormorants (for details see Seiche [2003]).

11.2 Cormorant conflicts with fisheries

Care must be taken when interpreting information provided in this section. Please refer to section 2.2.3 (*Methodological limitations and difficulties*).

11.2.1 Conflict site descriptions

Twenty Cormorant conflicts were reported from Germany: 9 at lakes, 7 at rivers and four at aquaculture ponds (Table 11.3). Most conflicts were reported from the lower reaches of rivers and at widths of more than 100m and altitudes of 100-500m in the case of rivers and below 100m in lakes. Most of these rivers and lakes were semi-natural and of high nutrient status.

Habitat	**Feature**	**Category**			
	Reach	**Upper**	**Middle**	**Lower**	**Whole river**
Rivers	N = 7 cases		3	4	
	Width (m)	**< 10m**	**10-50m**	**50-100m**	**100+m**
Rivers	N = 7 cases	1		1	5
	Altitude (m)	**< 100m**	**100-500m**	**500+m**	
Rivers	N = 7 cases	2	4	1	
Stillwaters	N = 13 cases	8	3	2	
	Trophic status	**Oligotrophic**	**Mesotrophic**	**Eutrophic**	
Rivers	N = 7 cases		1	6	
Stillwaters	N = 13 cases		4	9	
	Anthropogenic Influence	**Natural**	**Semi-natural**	**Artificial**	
Rivers	N = 7 cases	1	6		
Stillwaters	N = 13 cases	5	6	2	

Table 11.3 The number of Cormorant conflict cases reported from Germany in relation to habitat and habitat features.

11.2.2 Birds and fish

In Germany, Great Cormorants reported to be involved in conflicts were *Ph. c. sinensis*. Reported Cormorant densities are given in Table 11.4

Habitat	**No. cases**	**Cormorant density (maximum no. ha^{-1})**			
		Mean	**SE**	**Minimum**	**Maximum**
Lakes	8	0.60	0.165	0.08	1.50
Aq ponds	4	0.69	0.306	0.13	1.55

Table 11.4 Great Cormorant density (mean, standard error [SE], minimum and maximum) for German cases in relation to 2 habitat types.

Twenty species of fish were recorded in conflict with Great Cormorants in the German case studies reported (Table 11.5).

Species	Frequency (% of cases)		
	Rivers (7 cases)	Lakes (9 cases)	Aquaculture ponds (4 cases)
Eel	57	89	
Roach	57	56	
Chub	57		
Pike	43	25	50
Bream	43	33	
Pikeperch	29	66	50
Perch	29	66	
Nase	29		
Grayling	29		
Barbel	29		
Ruffe	29	22	
Carp	14	11	100
Tench	14	11	75
Brown Trout	14		
Dace	14		
Rudd	14	33	
Powan	14	11	
Burbot	14	11	
Silver Bream	14	22	
Whitefish	14	22	

Table 11.5 Fish species reported to be involved in conflicts with Great Cormorants in 20 cases from Germany.

11.2.3 Seasonality

Great Cormorant conflicts in Germany were reported to occur throughout the year. Due to its size and situation in Central Europe, conflicts in Germany occur throughout the year. In summer most conflicts arise from breeding birds with the highest number of breeding sites and breeding pairs in northern Germany along the shores of the North Sea and the Baltic Sea. In contrast, in winter most conflicts are reported from inland waters where high numbers of migrating and wintering Cormorants are found.

11.2.4 Finance

Financial information on the ‘costs’ of Cormorant predation was reported for 7 conflict cases. Two sources of financial information were provided: (a) the annual financial turnover in the system and (b) the turnover loss thought to be due to Cormorants. It was requested that the values provided had to be categorised either as ‘actual’ or ‘estimated’. The majority (11/14 = 78%) of information provided for German cases was estimated. Based on 3 cases, average turnover for aquaculture pond fisheries was 2,201,000 euro and average loss was 728,732 euro (33% of turnover) and average turnover for 4 recreational and commercial lake fisheries was 194,497 euro and average loss was 756,000 euro (389% of turnover). This figure for loss was exceptional and suggests that the information provided was incomplete: for 2 of the lake fisheries, loss was *estimated* at 969% and 15,773% of turnover, respectively, based on the figures available for *actual* turnover.

11.2.5 Conflict issues: magnitude of conflict

Cormorant conflicts with recreational fisheries, commercial fisheries and nature conservationist stakeholders were reported both on lakes (n = 9 cases, Table 11.6) and rivers (n = 7 cases, Table 11.7) in Germany. Conflicts with aquaculturists and nature conservationists were also reported from aquaculture ponds (n = 4 cases). Here, the most commonly cited major conflicts for aquaculturists were reduced catches, loss of stocked fish, loss of earnings from the fishery and reduced stock through lowered production, whereas for nature conservationists the main issues were scaring/shooting disturbance.

11.2.6 Conflict issues: status of information used by stakeholders

Overall, stakeholders provided 416 records of the status of the information they used to inform themselves about Cormorant conflict issues in Germany. The highest proportion of records (42%) was for 'popular' articles, followed by 'grey literature' (32%) and 'scientific literature' (27%). Overall, there were differences in the use of popular, grey and scientific literature sources between the 4 stakeholder groups providing information (Table 11.8).

	Stakeholder group			
Status of information	**Recreational**	**Commercial**	**Aquaculture**	**Nature conservation**
Popular	38.9%	68.2%	65.4%	25.5%
Grey literature	29.2%	23.9%	30.8%	35.8%
Scientific literature	31.9%	7.9%	3.8%	38.7%
Total no. records (= 100%)	**72**	**88**	**52**	**204**

Table 11.8 Categorisation of the status of information used by stakeholders to inform themselves about Cormorant conflict issues. Commercial fisheries stakeholders used more popular literature and less scientific literature than expected, nature conservationist stakeholders used less popular literature and more scientific literature than expected ($X^2 = 71.196$, df = 6, $P < 0.001$).

11.3 Potential Cormorant management tools

Information (summarised in the following tables) was provided on (1) general actions taken against Cormorants in Germany, (2) management plans/legal regulations, (3) actions at breeding sites, (4) at roosts, (5) at small rivers, (6) at large rivers, (7) at small still waters, (8) at very large water bodies, and (9) at aquaculture sites.

Conflict issue	Not claimed/not applicable	No impact	Minor effect	Major effect
(1) FISHERIES				
Reduced catch		[6]	[2]	7(4)
Loss of stocked fish		[1]	[1]	3
Reduced value of catch (damage)		[2]	2	1
Removal of fish from nets		[2]	2	1
Damage to fishing gear		[2]	2	1
Reduced catchability (stress/behaviour)		[1]		2
Loss of earnings from the fishery		[2]	[1]	4
Reduced capital values of fisheries				1
Reduced fishing tackle sales				1
Increased recurrent costs				1
Loss of employment				2
(2) FISH STOCKS				
Reduced stock - lowered production		[3]	[4]	6 (2)
Effects on popn. dynamics/community structure		[2]	[4]	5 (2)
Threats to endangered fishes		[3]		2 (1)
Vectors of diseases/parasites		2 [2]	1 [1]	
Loss of juvenile fish - lowered recruitment		[1]	[2]	4 (2)
Loss of spawners		[1]	[2]	3 (2)
Loss of aquaculture stock		[1]	[1]	3 [1]
(3) ENVIRONMENTAL				
Eutrophication		[1]	1	
Interactions with other birds		[1]		2
Scaring/shooting disturbance		1		[2]
Lead contamination (birds/environment)			[2]	
Landscape alteration		[2]	1	
Drowning in fishing gear		1	[1]	
Damage to vegetation/landscape		[3]	1 [1]	

Table 11.6 Cormorant conflict issues as recorded by commercial fisheries stakeholders, recreational angling stakeholders (round brackets) and nature conservationist stakeholders [square brackets] for German lakes (n = 9 cases). Each figure is the number of times a particular issue was cited by stakeholders.

Conflict issue	Not claimed/not applicable	No impact	Minor effect	Major effect
(1) FISHERIES				
Reduced catch		(1) [1]	(1) [3]	1 (5) [1]
Loss of stocked fish		(2) [2]	[2]	1 (4) [1]
Reduced value of catch (damage)		1		(2)
Removal of fish from nets		[1]		
Damage to fishing gear		[1]		
Reduced catchability (stress/behaviour)		[1]		1 (1)
Loss of earnings from the fishery			[2]	1 (1)
Reduced capital values of fisheries			[2]	(1)
Reduced fishing tackle sales			[2]	
Increased recurrent costs				1
Loss of employment			[2]	
(2) FISH STOCKS				
Reduced stock - lowered production		(1) [1]	1 (2) [3]	(4) [1]
Effects on popn. dynamics/community structure		(1)	(1) [3]	1 (3) [1]
Threats to endangered fishes		[1]	[1]	(5)
Vectors of diseases/parasites				
Loss of juvenile fish - lowered recruitment			(1) [3]	1 (4) [1]
Loss of spawners			(1) [3]	(3) [1]
(3) ENVIRONMENTAL				
Scaring/shooting disturbance			[1]	[3]
Lead contamination (birds/environment)			[3]	

Table 11.7 Cormorant conflict issues as recorded by commercial fisheries stakeholders, recreational angling stakeholders (round brackets) and nature conservationist stakeholders [square brackets] for German rivers (n = 7 cases). Each figure is the number of times a particular issue was cited by stakeholders.

NAME OF RESPONDENT AND YOUR AFFILIATION	**Thomas M. Keller - TUM (with information from Hans Bardenhagen, Martin Boschert, Bernd Conrad, Thomas Dolich, Stefan Fischer, Wilhelm Irsch, Heiner Klinger, Ekkehard Kluge-Johannink, Wilfried Knief, Erich Mahler, Detlef Schlorf, Kareen Seiche, Peter Südbeck, Matthias Werner, Jochen Wiesner, Klaus Witt, Horst Zimmermann)**
COUNTRY	**Germany**
REGION / PROVINCE / etc. (if applicable)	
Period which is concerned [year(s)]	**Current situation (2001/02)**

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

	Total numbers		**Regional numbers**							
	National numbers	**Count/Estimate?**	**Baden-Württemberg**	**Bayern (Bavaria)**	**Berlin**	**Brandenburg**	**Bremen**	**Hamburg**	**Hessen (2000)**	**Mecklenburg-Vorpommern**
Number of breeding colonies destroyed or disturbed	**5**	Count	0	1	0	0	0	0	0	4
Number of nests destroyed	**107**	Count	0	87	0	0	0	0	0	20
Number of nestlings killed	**500**	Count	0	0	0	0	0	0	0	500
Number of adults killed in the non-breeding season	**5970**	Count	713	4500	0	227	0	0	80	450
Number of breeding adults killed	**63**	Count	0	63	0	0	0	0	0	0
Number of night roosts destroyed or disturbed	**yes, regionally (see Remarks)**	Est	yes	yes	0	0	0	0	0	0

	Regional numbers								
	Niedersachsen (bis 2001)	**Nordrhein-Westfalen**	**Rheinland-Pfalz**	**Saarland**	**Sachsen (Saxony)**	**Sachsen-Anhalt**	**Schleswig-Holstein (2001)**	**Thüringen**	**Remarks**
Number of breeding colonies destroyed or disturbed	0	0	0	0	3	0	1	0	
Number of nests destroyed	0	0	0	0	6	0	0	0	
Number of nestlings killed	0	0	0	0	0	0	0	0	
Number of adults killed in the non-breeding season	120	0	40	0	300	0	610	91	
Number of breeding adults killed	0	0	0	0	0	15	0	0	
Number of night roosts destroyed or disturbed	0	yes	0	0	yes	0	0	0	Roosts not especially protected; shooting happens, but no data available.

Management plans / legal regulations (Germany 2001-2002)	Total country	Baden-Württemberg	Bayern (Bavaria)	Berlin	Brandenburg	Bremen	Hamburg	Hessen	Mecklenburg-Vorpommern	Niedersachsen	Nordrhein-Westfalen	Rheinland-Pfalz	Saarland	Sachsen (Saxony)	Sachsen-Anhalt	Schleswig-Holstein	Thüringen
Are there any management plans in effect? Please list all national or regional plans and give details	**yes, regional plans**	**yes**	**yes**	**no**	**yes**	**no**	**no**	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**	**no**	**yes**	**yes**
Are there any regulations in effect that allow Cormorant culling? Please list all national or regional regulations and give details	**yes, regionally**	**yes**	**yes**	**no**	**yes**	**no**	**no**	**yes**	**yes**	**yes**	**yes**	**no**	**no**	**yes**	**yes**	**yes**	**yes**
Are there any coordinated culling programmes in your country?	**no**	**no**	**no**	**no**	**no**	**no**	**no**	**no**	**no**	**no**	**no**	**---**	**no**	**no**	**no**	**no**	**no**
Is it mandatory to obtain single permits for Cormorant killing? (no) = in some regions not and/or during some parts of the year not.	**yes, but regionally not**	**(no)**	**(no)**	**yes**	**(no)**	**---**	**---**	**yes**	**(no)**	**yes**	**yes**	**yes**	**---**	**yes**	**yes**	**yes**	**yes**
Has a general permit for Cormorant killing been issued?	**yes, regionally**	**no**	**yes**	**no**	**yes**	**no**	**no**	**no**	**yes**	**no**	**no**	**no**	**no**	**no**	**no**	**no**	**no**
Is there any financial compensation for fish losses?	**only in Sachsen**	**no**	**no**	**no**	**no**	**no**	**no**	**no**	**no**	**no**	**no**	**no**	**no**	**yes**	**no**	**no**	**no**
Is there any financial aid for the construction of Cormorant exclosures or for scaring programmes, etc.?	**only in Bayern and Hessen**	**no**	**yes**	**no**	**no**	**no**	**no**	**yes**	**no**	**no**	**no**	**no**	**no**	**no**	**no**	**no**	**no**

Remarks (on General information & on Management plans /legal regulations):	
Baden-Württemberg	Annual permits to shot Cormorants for certain lakes and rivers required.
Bayern	General permit to shot Cormorants at most water bodies; financial aid for the construction of Cormorant exclosures from agriculture programmes.
Berlin	No actions taken against Cormorants.
Brandenburg	General permit to shot Cormorants at fishponds and some lakes.
Bremen	No actions taken against Cormorants.
Hamburg	No actions taken against Cormorants.
Hessen	Most birds shot at one single fish farm (1999 + 2000: 100 birds).
Mecklenburg-Vorpommern	General permit to shot Cormorants at most water bodies; permits to reduce breeding success by 70 - 80% in 4 colonies; numbers of nestlings
Niedersachsen	Single permits required to shot Cormorants in all cases; shooting of immature birds (bright belly) can be allowed all year.
Nordrhein-Westfalen	Single permits required to shot Cormorants at selected sections of some small rivers (up to 70 Cormorants are allowed to be shot in winter
Rheinland-Pfalz	Shooting of birds only as an experiment in one area: "Westerwälder Seenplatte" & some fish ponds in that same area.
Saarland	No lethal actions taken against Cormorants.
Sachsen	All breeding attempts are prevented with the exception of the flooded large open cast minings.
Sachsen-Anhalt	Single permits (exceptional permissions from the nature protection law) required to shot Cormorants in all cases. 15 adults or immatures killed in
Schleswig-Holstein	Single permits to shot Cormorants can be obtained at fish ponds and small lakes (< 300 ha) from August 01 to March 31 (excluding all nature
Thüringen	Single permits required to shot Cormorants at fishponds or rivers, where obvious fish losses occur.

NAME OF RESPONDENT AND YOUR AFFILIATION Thomas M. Keller - TUM
COUNTRY Germany
REGION / PROVINCE / etc. (if applicable) ---
Period which is concerned [year(s)] Current situation (2001/02)
A. Breeding Sites

Cormorant Damage Control Activities								
1. Avoid foundation of new colonies	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Scaring by use of live ammunition	Regularly	Weeks	2	3	3	various regions		Ancdotal Information
Shooting some adults to reinforce scaring	Regularly	Weeks	3	1/4	2	various regions	Shooting mostly allowed until March 31	Ancdotal Information
Gas bangers / cannons (propane gas exploders)	Rarely	Days	2	3	4	Sachsen	Avoidance of new colonies near carp ponds in Saxony	Seiche (2002)
Laser light	Rarely	Days	3	1/5	1	Mecklenburg-Vorpommern, Brandenburg, Sachsen	Mostly experimantal use only! French DESMAN laser guns have been used at breeding sites; public discussion about laser safety; new American less powerful laser (Dissuader TM) may be more acceptable.	Internet (cf. www.komitee.de); Seiche (2002)
Scaring by human presence	Rarely	Days/Weeks	2	3	3	Mecklenburg-Vorpommern, Sachsen, others		Regueira Cortizo (1998); Seiche (2002)
Removal of trees at a roost to prevent colony establishme	Rarely	Years	2	1/5	4	Saxony, others		Seiche (2002)
2. Existing colonies: Hinder cormorants from breedin	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Removal of trees	Rarely	Years	2	1/5	4	Saxony	Used at small colonies near Carp ponds to avoid permanent settlement and increase.	Seiche (2002)
Shooting some adults to reinforce scaring	Rarely	3 Weeks	3	1/5	2	Bavaria	The shooting of 63 Cormorants in a nature reserve at Lake Chiemsee caused a major conflict with nature conservation NGOs. Success very low. The number of breeding pairs decreased by only 20% from 145 (in 2001) to 117 pairs (in 2002). The breeding success decreased by only 10% from 242 to 217 young.	Geiersberger (2002)
Gas bangers / cannons (propane gas exploders)	Regularly	Days	2	3	4	Ponds at Peitz in Brandenburg; Sachsen		Regueira Cortizo (1998); Seiche (2002)
Other audio frightening techniques	Rarely	Days	2	3	4	Ponds at Peitz in Brandenburg		Regueira Cortizo (1998)
Intense light	Rarely	Days	2	3	3	Brandenburg		Regueira Cortizo (1998)
Combination of audio and visual techniques	Rarely	Days	2	3	4	Unknown		Anecdotal information
3. Existing colonies: Reduce breeding success	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Egg destruction/removal	Regularly	Months	2/3	1/4	3	Mecklenburg-Vorpommern	Happens in one colony; eggs are replaced by artificial (plaster) eggs.	Horst Zimmermann (pers. comm.)
Killing of young	Regularly	Months	3	1/5	3	Mecklenburg-Vorpommern	Happens in three colonies; 500 - 1000 young killed annually; shooting needs to be repeated two times per breeding season.	Horst Zimmermann (pers. comm.)

References:

Geiersberger, I. (2002): Auswirkungen der Kormoranabschüsse am Nest auf den Brutbestand und Bruterfolg der Brutkolonie am Chiemsee. Gutachten im Auftrag der Regierung von Oberbayern, Murnau, Upubl. report, 27 pp.

Regueira Cortizo, F. (1998): Der Entwurf eines Managementkonzeptes für die brandenburgische Karpfenteichwirtschaft zur Lösung der Kormoranproblematik. Diplom-Thesis, Univ. Potsdam, Math.-Nat. Fak., 98 pp.
Seiche, K. (2002): The conflicts between Great Cormorants *Phalacrocorax carbo sinensis* and Carp fish farming: attempted resolution and strategy in Saxony, Germany. Vogelwelt 123, Suppl., 349-354.

Remarks:

As can be seen from the numbers in the General Informations sheet, there is not much action taken against breeding colonies in Germany. Only four colonies have regularly been addressed in Mecklenburg-Vorpommern, one in Schleswig-Holstein and three in Saxony. In Saxony the foundation of new colonies is almost entirely prevented. In Bavaria, there was the shooting of adults at one colony in 2002 which caused a major conflict between nature conservation and fisheries (see above).

NAME OF RESPONDENT AND YOUR AFFILIATION	**Thomas M. Keller - TUM**							
COUNTRY	**Germany**							
REGION / PROVINCE / etc. (if applicable)	**---**							
Period which is concerned [year(s)]	**Current situation (2001/02)**							
B. Roosting Sites								
Cormorant Damage Control Activities								
1. Avoid foundation of new roost sites	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Scaring by use of live ammunition	Rarely	Days	2	3	3	Unknown		Annecdotal information.
Shooting some birds to reinforce scaring	Rarely	Days	3	1/4	2	Unknown		As above.
Pyrotechnics / Fireworks	Rarely	Days	2	3	3	Unknown		As above.
Scaring by human presence	Rarely	Days	2	2	3	Unknown		As above.
2. Existing roost sites: Hinder cormorants from roosting	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Removal of trees	Rarely	Highly variable days to years	2	1/4	4	Unknown	Effectiveness depends on proximity of alternative roost sites and turnover of birds. Not acceptable at nature reserves.	As above.
Scaring by use of live ammunition	Regularly	Days	2	3	3	Unknown	As above	As above.
Shooting some birds to reinforce scaring	Regularly	Days	3	1/4	2	Bavaria, others	Shooting is allowed in most places of Bavaria. There is no special programme to shot at roost, but it is supposed to happen frequently as it is not forbidden.	Schmidt *et al*. (1998); Annecdotal information.
Gas bangers / cannons (propane gas exploders)	Rarely	Days	2	3	4	Nordrhein-Westfalen, others		Conrad *et al*. (2002); annecdotal information.
Pyrotechnics / Fireworks	Rarely	Days	2	3	3	Unknown		Annecdotal information.
Simple scarecrows	Rarely	Days	2	2	4	Nordrhein-Westfalen, others		Conrad *et al.* (2002); annecdotal information.
Intense light	Rarely	Days	2	2	3	As above.		As above.
Scaring by human presence	Regularly	Days	2	2	3	As above.		As above.

References:

Conrad, B., Klinger, H., Schulze-Wiehenbrauck, H. & C. Stang (2002): Kormoran und Äsche - ein Artenschutzproblem. LÖBF-Mitteilungen 1/02: 46 - 54.

Schmidt, J., Keller, T. & A. von Lindeiner (1998): Effizienzkontrolle von Vergrämungsabschüssen bei Kormoranen an ausgewählten Fließgewässern. Abschlußbericht, Landesbund für Vogelschutz in Bayern e.V., Hilpoltstein, 28 pp.

Remarks:

Only in Nordrhein-Westfalen, the management plan officially includes actions at roost-sites. Bavaria, Baden-Württemberg and Saxony do not specially exclude roost sites from the areas where shooting is/can be allowed. Thus, roots are not especially protected, there.

NAME OF RESPONDENT AND YOUR AFFILIATION	**Thomas M. Keller - TUM**
COUNTRY	**Germany**
REGION / PROVINCE / etc. (if applicable)	**---**
Period which is concerned [year(s)]	**Current situation (2001/02)**
C. Feeding Sites	
C1. Small Rivers (Width < 100 m)	

Cormorant Damage Control Activities								
1. Resource Management	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Habitat management								
Improve habitat quality for fishes	Regularly	Years	2	1	1/2	Various	Not specifically used to deter cormorants	Anecdotal information
Fish management								
Altering fish stocking regimes. Please give details.								
(a) timing	Rarely	Days/weeks	2	3	4	Various		As above
(b) frequency	Rarely	Days/weeks	2	3	3	Various		As above
(c) density	Rarely	Days/weeks	2	3/4	4	Various	Low densities will not be favoured by anglers.	As above
(d) stocked fish sizes	Rarely	Months	2	3	2	Various		As above
2. Bird-proof barriers (overhead barriers and peripheral fencing/netting)	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
3. Wildlife Management								
3.1 Non-lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Human harassment								
Human patrol on foot or in vehicles (incl. boats)	Rarely	Hours/days	2	2	3	Experiment in Nordrhein-Westfalen; others		Klinger & Conrad (1999); Anecdotal information
Audio frightening techniques								
Pyrotechnics / Fireworks (shell crackers, screamers, whistling projectiles, exploding projectiles, bird bangers, flash/detonation cartridges)	Regularly	Hours	2	3	3	Various	Potential impacts on other wildlife and people	Anecdotal information
Live ammunition	Regularly	Hours	2	3	3	Various	As above	As above
3.2 Lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Shooting adults and immatures								
to reinforce non-lethal harassment	Regularly	Days	2	1/4	2	Nordrhein-Westfalen, Baden-Württemberg, Thüringen, Bavaria, others	Potential impacts on other wildlife and people. Unknown quantity of illegal shooting.	Schmidt *et al.* (1998); Wutzer & Hetmanek (2000); Fischereiforschungsstelle des Landes Baden-Württemberg (2001); Conrad et al. (2002);
to reduce bird numbers at specific sites	Regularly	Days	2	1/4	2	As above	As above	As above; Conrad *et al.* (2002); Various regional authorities pers. comm..

References:

Conrad, B., Klinger, H., Schulze-Wiehenbrauck, H. & C. Stang (2002): Kormoran und Äsche - ein Artenschutzproblem. LÖBF-Mitteilungen 1/02: 46 - 54.

Fischereiforschungsstelle des Landes Baden-Württemberg (2001): Abschußbericht über Begleituntersuchungen im Winter 2000/2001 zur Verordnung zur Abwendung erheblicher fischereiwirtschaftlicher Schäden durch Kormorane sowie zum Schutz der heimischen Tierwelt. Unpubl. Report, Langenargen, Germany, 25 pp. + App.

Klinger, H. & B. Conrad (1999): Versuch zur Vergrämung des Kormorans an der Lenne im Winter 1997/98. LÖBF-Mitteilungen 2/99: 45 - 50.

Schmidt, J., Keller, T. & A. von Lindeiner (1998): Effizienzkontrolle von Vergrämungsabschüssen bei Kormoranen an ausgewählten Fließgewässern. Abschlußbericht, Landesbund für Vogelschutz in Bayern e.V., Hilpoltstein, 28 pp.

Wutzer, R. & M. Hetmanek (2000): Der Erfolg der intensiven Vergrämung des Kormorans am Beispiel eines Fließgewässers (1995 mit 1999). Fischer & Teichwirt 51(5): 172 - 174.

NAME OF RESPONDENT AND YOUR AFFILIATION	**Thomas M. Keller - TUM**
COUNTRY	**Germany**
REGION / PROVINCE / etc. (if applicable)	**(esp. Bayern)**
Period which is concerned [year(s)]	**Current situation (2001/02)**

C. Feeding Sites

C2. Large Rivers (Width > 100 m)

Cormorant Damage Control Activities								
1. Resource Management	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Habitat management								
Improve habitat quality for fishes	Regularly	Years	2	1	1/2	Various	Not specifically used to deter cormorants	Anecdotal information
Others (please specify)								
Fish management								
Altering fish stocking regimes. Please give details.								
(a) timing	Rarely	Days/weeks	2	3	4	Various		As above.
(b) frequency	Rarely	Days/weeks	2	3	3	Various		As above.
(c) density	Rarely	Days/weeks	2	3/4	4	Various	Low densities will not be favoured by anglers.	As above.
(d) stocked fish sizes	Rarely	Months	2	3	2	Various		As above.
3. Wildlife Management								
3.1 Non-lethal techniques	**Technique**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s)**	**Remarks, Details, &**	**References**
Human harassment								
Human patrol on foot or in vehicles	Rarely	Hours	3	2	2	Unknown		As above.
Audio frightening techniques								
Live ammunition	Regularly	Not efficient / hours	3	3	2	Various	Potential impacts on other wildlife and people	As above.
Other sound producing devices (please specify)	Not used							
3.2 Lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Shooting adults and immatures								
to reinforce non-lethal harassment	Regularly	Days	3	1/5	2	Bavaria	Potential impacts on other wildlife and people. Unknown quantity of illegal shooting.	Bavarian regional authorities pers. comm.; Brändlein (1998).
to reduce bird numbers at specific sites	Regularly	Days	3	1/5	2	Bavaria	Potential impacts on other wildlife and people. Unknown quantity of illegal shooting.	As above.

References:

Brändlein, K. (1998): Effizienzkontrolle der Kormoranvergrämung in Bayern. Überprüfung und Verteilung der Kormoranabschüsse in ausgewählten Gebieten Bayerns. Unpubl. Report by order of Bayerisches Landesamt für Umweltschutz, Munich, Germany, 29 pp.

NAME OF RESPONDENT AND YOUR AFFILIATION	**Thomas M. Keller - TUM**
COUNTRY	**Germany**
REGION / PROVINCE / etc. (if applicable)	**---**
Period which is concerned [year(s)]	**Current situation (2001/02)**

C. Feeding Sites
C3. Small Still Waters (< 100 ha); not aquaculture

Cormorant Damage Control Activities								
1. Resource Management	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Habitat management								
Improve habitat quality for fishes	Rarely	Years	2	1	1/2	Various	Not specifically used to deter cormorants	Anecdotal information
Fish management								
Altering fish stocking regimes. Please give details.								
(a) timing	Rarely	Days/weeks	2	3	4	Various		As above.
(b) frequency	Rarely	Days/weeks	2	3	3	Various		As above.
(c) density	Rarely	Days/weeks	2	3/4	4	Various	Low densities will not be favoured by anglers.	As above.
(d) stocked fish sizes	Rarely	Months	2	3	2	Various		As above.
3. Wildlife Management								
3.1 Non-lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Human harassment								
Human patrol on foot or in vehicles (or by boat)	Regularly	Days	2	2	3	Various	Potential impacts on other wildlife and people	As above.
Audio frightening techniques								
Gas bangers / cannons (propane gas exploders)	Rarely	Days	2	3	4	Various	Potential impacts on other wildlife and people. Most effective if moved regularly and used in conjunction with other visual deterrents	As above.
Pyrotechnics / Fireworks (shell crackers, screamers, whistling projectiles, exploding projectiles, bird bangers, flash/detonation cartridges)	Regularly	Days	2	3	3	Various		As above.
Live ammunition	Regularly	Days	2	3	3	Various	Potential impacts on other wildlife and people. High manpower costs.	As above.
Visual frightening techniques								
Simple human effigies or scarecrows	Rarely	Not effective						As above.
Animated scarecrows (moving and/or in combination with automated sound devices)	Rarely	Days	2	3	4	Various	Best used in conjunction with other audio scarers and if moved regularly	As above.
Raptor silhouettes	Rarely	Not effective						As above.
Live raptors (trained birds of prey)	Rarely	Not effective						As above.
Mirrors	Rarely	Not effective						As above.
Moving disks	Rarely	Not effective						As above.
Mylar tape	Rarely	Not effective						As above.
Eye spot balloons	Rarely	Not effective						As above.
Combination of audio and visual techniques	Regularly	Days	2	3	4	Various		As above.
3.2 Lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Shooting adults and immatures								
to reinforce non-lethal harassment	Regularly	Days	2	1/4	2	Baden-Württemberg, Bayern, Brandenburg, Mecklenburg-Vorpommern, Schleswig-Holstein	Potential impacts on other wildlife and people. Unknown quantity of illegal shooting.	Regional authorities pers. comm.
to reduce bird numbers at specific sites	Regularly	Days	2	1/4	2	As above.	Potential impacts on other wildlife and people. Unknown quantity of illegal shooting.	As above.

NAME OF RESPONDENT AND YOUR AFFILIATION	**Thomas M. Keller - TUM**							
COUNTRY	**Germany**							
REGION / PROVINCE / etc. (if applicable)	**(esp. Bayern)**							
Period which is concerned [year(s)]	**Current situation (2001/02)**							
C. Feeding Sites								
C4. Very Large Waterbodies (Still Waters >100ha and Coastal Waters)								
Cormorant Damage Control Activities								
1. Resource Management	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Fish management								
Altering fish stocking regimes. Please give details.								
(a) timing	Rarely	Days/weeks	2	3	4	Various		Anecdotal information
(b) frequency	Rarely	Days/weeks	2	3	3	Various		As above.
(c) density	Rarely	Days/weeks	2	3/4	4	Various	Low densities will not be favoured by anglers.	As above.
(d) stocked fish sizes	Rarely	Months	2	3	2	Various		As above.
2. Bird-proof barriers (overhead barriers and peripheral fencing/netting)	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Others (please specify)	Rarely	not known	2	2	3	Mecklenburg-Vorpommern	Covering of fyke nets. Avoiding of Cormorants roosting on poles, etc.	Regueira Cortizo (1998)
3. Wildlife Management								
3.1 Non-lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Human harassment								
Human patrol on foot or in vehicles (or by boat)	Rarely	Hours/days	3	2	2	Various	Potential impacts on other wildlife and people	As above.
Audio frightening techniques								
Pyrotechnics / Fireworks (shell crackers, screamers, whistling projectiles, exploding projectiles, bird bangers, flash/detonation cartridges)	Rarely	Hours	3	3	2	Various	As above. Only localised impact.	As above.
Live ammunition	Regularly	Hours	3	3	2	Various	As above. High manpower costs.	As above.
Visual frightening techniques								
Simple human effigies or scarecrows	Rarely	Not effective						As above.
Animated scarecrows (moving and/or in combination with automated sound devices)	unknown							As above.
Mylar tape	Rarely	Not effective						As above.
3.2 Lethal techniques	**Technique is**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in**	**Remarks, Details, & Additional**	**References**
Shooting adults and immatures								
to reinforce non-lethal harassment	Rarely	Days	3	1/5	2	Bayern, Brandenburg, Mecklenburg-Vorpommern, Schleswig Holstein	Potential impacts on other wildlife and people. Unknown quantity of illegal shooting.	Regional authorities pers. comm.
to reduce bird numbers at specific sites	Rarely	Days	3	1/5	2	As above.	As above. Unknown quantity of illegal shooting.	As above.

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Regueira Cortizo, F. (1998): Der Entwurf eines Managementkonzeptes für die brandenburgische Karpfenteichwirtschaft zur Lösung der Kormoranproblematik. Diplom-Thesis, Univ. Potsdam, Math.-Nat. Fak., 98 pp.

NAME OF RESPONDENT AND YOUR AFFILIATION	**Thomas M. Keller - TUM**
COUNTRY	**Germany**
REGION / PROVINCE / etc. (if applicable)	**(esp. Bayern)**
Period which is concerned [year(s)]	**Current situation (2001/02)**
C. Feeding Sites	
C5. Aquaculture	

Cormorant Damage Control Activities

1. Resource Management	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Fish management								
Altering fish stocking regimes. Please give details.								
(a) timing	Rarely	Months	2	3	4	Unknown		Anecdotal information
(b) frequency	Rarely	Months	2	3	3	Unknown		As above.
(c) density	Rarely	Months	2	3/4	4	Mecklenburg-Vorpommern	Lower fish density in Carp ponds.	See (7)
(d) stocked fish sizes	Rarely	Months	2	3	3	Bavaria, Saxony, others		Anecdotal information
(e) Production of large one-year old (> 100 g) and two-year old Carp (> 700 g) by supplementary feeding	Rarely	Months	2	3	3	Saxony	Carp quickly get too big for Cormorants in their 2nd summer of life.	See (1,5)
Locating most susceptible fish species and size close to the centre of human activity or near buildings	Rarely	Months	2	2	4/5	Brandenburg, Bavaria, others		See (14); pers. comm.; Anecdotal information
Use/management of feeding ponds to attract Cormorants (i.e. to distract them away from production ponds)	Rarely	Days to Months	3	3	3	Blumberger Mühle in Brandenburg, Mecklenburg-Vorpommern, Saxony, others	Danger of attracting additional Cormorants. Cost/benefit relation can be unfavourable.	See (7, 12, 14)
Facility construction								
High-pressure water beam systems	Rarely	Weeks/Months	2	2	3	Not known	Positive side effect: aerating of the ponds.	See (4)
2. Bird-proof barriers (overhead barriers and peripheral fencing/netting)	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Physical exclosures with narrow meshed systems (mesh sizes < 20 cm) using wire, lines or string in parallel or grid patterns	Regularly	Years	2	2	1	Various	Mostly commercial systems from Gamsen and Forelco; mostly at Trout farms and at Carp wintering ponds	See (3, 10, 11)
Wire, lines or string in grid patterns (5 m mesh size)	Rarely	Years	2	2	2	Various (Bavaria, Brandenburg, Mecklenburg-Vorpommern)	Single birds of a wide variety of waterbird species may be entangled or killed by crashing into the structures.	See (2, 3, 6, 7, 9)
Wire, lines or string in grid patterns (7,5 m mesh size)	Rarely	weeks - years	2	2	2	As above.	May not be effective when great numbers of Cormorant are present.	See (2, 3, 7, 9)
Wire, lines or string in grid patterns (10 m mesh size)	Rarely	days - weeks - months	2	2	2	As above.	As above.	See (2, 3, 7, 9, 10)
Wire, lines or string in grid patterns (other mesh size)	Unknown							
Wire, lines or string in parallel patterns (please give spaci	Regularly	Years	2	2	1	Various	Spacing: ca. 20 cm; often older commercial systems.	Anecdotal information
Partial exclosures (narrow meshed)	Rarely	Years	2	2	3	Brandenburg	Experimental use	See (10, 14)
Polyethylene rope with foam floats	Not used							
Coloured streamers to increase visibility of wires and strings	Rarely	not effective						
Submersed fish refuges (submersed cages)	Unknown							
Others: vertical nets in parallel patterns (set 5 - 10 m apart)	Rarely	Months/Years	2	3	3	Various	Submersed fences that do not allow Cormorants to dive through.	cf. see (8)

3. Wildlife Management								
3.1 Non-lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Human harassment								
Human patrol on foot or in vehicles	Regularly	Days/Hours	2	2	3	Various (i.e. Brandenburg)		See (7)
Audio frightening techniques								
Electronic guards (devices that produce artificial noises)	Rarely	Not effective				Various experiments		See (12); Various anecdotal information.
Gas bangers / cannons (propane gas exploders)	Regularly	Days	2	2	4	Various (Brandenburg, Saxony, Bavaria, ...)	Potential impacts on other wildlife and people (see Note 1)	See (7, 12)
Live ammunition	Regularly	Days	2	2	3	Various	Potential impacts on other wildlife and people.	Anecdotal information
Visual frightening techniques								
Simple human effigies or scarecrows	Regularly	Not effective						As above.
Animated scarecrows (moving and/or in combination with automated sound devices)	Regularly	Days	2	3	4	Various	Best used in conjunction with other audio scarers and if moved regularly.	As above.
Raptor silhouettes	Rarely	Not effective						As above.
Mirrors	Rarely	Not effective						As above.
Moving disks	Rarely	Not effective						As above.
Mylar tape	Rarely	Not effective						As above.
Eye spot balloons	Rarely	Not effective						As above.
Laser light	Rarely	Days	3	1/5	1	Mecklenburg-Vorpommern, Brandenburg, Sachsen	See Note (2).	See (7, 13); Internet (cf. www.komitee.de)
Combination of audio and visual techniques	Regularly	Days	2	3	4	Various		
3.2 Lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Shooting adults and immatures								
to reinforce non-lethal harassment	Regularly	Days	2	1/4	2	Various (Schleswig-Holstein, Brandenburg, Bavaria, Saxony, Baden-Württemberg, Mecklenburg-Vorpommern)	See Note (3).	See (2, 7, 13, 15); various regional authorities pers. comm.
to reduce bird numbers at specific sites	Regularly	Days	3	1/4	2	As above.	See Note (4).	See (7, 13, 15, 16); Various regional authorities pers. comm.

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(1) Füllner, G. (2001): Aufzucht großer, konditionsstarker einsömmeriger Karpfen zur Verringerung der Satzfischverluste durch Kormorane. Zit. in: Reiter (2001): Aus der Bayerischen Landesanstalt für Fischerei Starnberg - Fortbildungstagung für Fischhaltung und Fischzucht. Fischer & Teichwirt 52: 184.

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Notes:

(1) Most effective if moved regularly and used in conjunction with other visual deterrents. Often used for short periods to restrict local damages, i.e. during the dewatering of Carp ponds.

(2) Mostly experimental use only! French DESMAN laser guns have been used at breeding sites; public discussion about laser safety; new American less powerful laser (Dissuader TM) may be more acceptable.

(3) Potential impacts on other wildlife and people. Only effective in changing the distribution of birds. Damage as a whole remains the same (Wünsche 1994). Nature protection authorities consider shooting as a way for fishermen to work off their frustation (Seiche 2002). Shooting of single birds that have specialized in ponds that are protected by wide-meshed exclosures may be advisable (Keller 1996). Unknown quantity of illegal shooting.

(4) Potential impacts on other wildlife and people. Only effective in changing the distribution of birds. Damage as a whole remains the same (Wünsche 1994). Nature protection authorities consider shooting as a way for fishermen to work off their frustation (Seiche 2002). Unknown quantity of illegal shooting.

Remarks:

In Saxony financial compensation for fish losses in aquaculture has been paid (about 0.5 - 0.7 million Euro, annually). Another approx. 2.25 million Euro have been paid annually to Carp pond owners for programmes of sustainable pond management and pond care (Seiche 2002). Finally, ponds highly valuable for nature conservation have been bought by non-profit conservation NGOs.

11.4 Stakeholders consulted

All 34 German federal and state ministries for the environment and for fisheries and a number of national parent fisheries and nature conservation NGOs were contacted. The next four lists only give those ministries and NGOs that responded.

11.4.1 German federal and state ministries for agriculture (including fisheries)

(1) Bundesministerium fuer Verbraucherschutz, Ernaehrung und Landwirtschaft, (The Federal Ministry of Food, Agriculture and Forestry), Postfach 14 02 70, D-53107 Bonn.
(2) Bayerisches Staatsministerium fuer Ernaehrung, Landwirtschaft und Forsten, Postfach 22 00 12, D-80535 Muenchen.
(3) Ministerium fuer Ernaehrung, Landwirtschaft, Forsten und Fischerei des Landes Mecklenburg-Vorpommern, Paulshoeher Weg 1, D-19061 Schwerin.
(4) Ministerium fuer Landwirtschaft, Umweltschutz und Raumordnung (MLUR) des Landes Brandenburg, Abteilung Fischerei, Postfach 60 11 50, D-14411 Potsdam.
(5) Ministerium fuer Raumordnung, Landwirtschaft und Umwelt des Landes Sachsen-Anhalt, Abteilung Fischerei, Olvenstedter Str. 4, D-39108 Magdeburg.
(6) Ministerium fuer Umwelt des Saarlandes, Abteilung Fischerei, Halbergstr. 50, D-66121 Saarbruecken.
(7) Ministerium fuer Umwelt und Naturschutz, Landwirtschaft und Verbraucherschutz des Landes Nordrhein-Westfalen, Abteilung Fischerei, Schwannstr. 3, D-40476 Duesseldorf.
(8) Ministerium Laendlicher Raum Baden-Wuerttemberg, Postfach 103444, D-70029 Stuttgart.
(9) Niedersaechsisches Ministerium fuer Ernaehrung, Landwirtschaft und Forsten, Postfach 243, D-30002 Hannover.
(10) Saechsisches Staatsministerium fuer Umwelt und Landwirtschaft, Abteilung Fischerei, Postfach 10 05 50, D-01075 Dresden.
(11) Senator fuer Wirtschaft und Haefen der Freien Hansestadt Bremen, Postfach 10 15 29, D-28015 Bremen.
(12) Thueringer Ministerium fuer Landwirtschaft, Naturschutz und Umwelt, Abteilung Fischerei, Postfach 1003, D-99021 Erfurt.
(13) Behoerde fuer Wirtschaft und Arbeit der Freien und Hansestadt Hamburg, Amt fuer Wirtschaft und Landwirtschaft, Abteilung Landwirtschaft, Postfach 11 21 09, D-20421 Hamburg.

11.4.2 German state ministries for the environment (including nature conservation)

(14) Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Postfach 81 01 40, D-81901 Muenchen.
(15) Ministerium fuer Landwirtschaft, Umweltschutz und Raumordnung (MLUR) des Landes Brandenburg, Abteilung Naturschutz, Heinrich-Mann-Allee 103, D-14473 Potsdam.
(16) Ministerium fuer Raumordnung, Landwirtschaft und Umwelt des Landes Sachsen-Anhalt, Abteilung Naturschutz, Olvenstedter Straße 4, D-39108 Magdeburg.
(17) Ministerium fuer Umwelt des Saarlandes, Abteilung Naturschutz, Postfach 10 24 61, D-66024 Saarbruecken, Germany.
(18) Saechsisches Staatsministerium fuer Umwelt und Landwirtschaft, Abteilung Naturschutz, D-01075 Dresden.
(19) Thueringer Ministerium fuer Landwirtschaft, Naturschutz und Umwelt, Abteilung Naturschutz, Postfach 10 03, D-99021 Erfurt.

11.4.3 German Fisheries Organisations (national parent organisations only)

(20) Deutscher Fischerei-Verband e.V. (DFV), Union der Berufs- und Sportfischer, (Union of the Commercial and Sports Fishermen), Venusberg 36, D-20459 Hamburg.
(21) Verband der Deutschen Kutter- und Kuestenfischer e.V. (VDK), (German Coast Fishermen Association), Venusberg 36, D-20459 Hamburg.
(22) Verband der Deutschen Binnenfischer e.V. (VDBI), (German Inland Fishermen Association), Hohenzollerndamm 184, D-10713 Berlin.
(23) Verband Deutscher Sportfischer e.V. (VDSF), (German Sports Fishermen Association), Siemensstr. 11-13, D-63071 Offenbach.
(24) Deutscher Anglerverband e.V. (DAV), (German Angling Association), Weissenseer Weg 110, 10369 Berlin.

(25) Verband der Deutschen Binnenfischerei e.V., (German Inland Fisheries Association), Koenigstorgraben 11, D-90402 Nuernberg.

11.4.4 German Nature Conservation Organisations (national parent organisations only)

(26) NABU-Bundesgeschäftsstelle, BirdLife Deutschland (BirdLife Germany), D-53223 Bonn.
(27) Landesbund für Vogelschutz in Bayern e.V. (LBV), Artenschutzreferat, (Bavarian Section of BirdLife Germany), Eisvogelweg 1, D-91161 Hilpoltstein.
(28) BUND – Bundesgeschäftsstelle, (German Environment Protection and Conservation Association), Am Koellnischen Park 1, D-10179 Berlin.
(29) WWF Deutschland, (WWF Germany), Postfach 190440, D-60325 Frankfurt.

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12. Greece

12.1 National overview
By Savas Kazantzidis

Background

Breeding Great Cormorants (*P.c. sinensis*) were first documented in Greece in 1944 at the Axios Delta. In 1971 there were two colonies, at Prespa National Park in Northwestern Greece and at Evros Delta in Thrace, with a total population of between 540-570 pairs. In the early 1990s there were four wetland colonies (Prespa, Evros, Axios and Kerkini) with a total population of 600 pairs when a sudden increase of the breeding population took place. For example, in 1995, the breeding population in Kerkini Lake increased to around 900-1,000 pairs (Handrinos & Akriotis 1997). Currently (2002) in Kerkini Lake there are approximately 3,5000 breeding pairs of Great Cormorants. In 2002 the total breeding population in the four wetland regions was estimated to be ca. 4,300 pairs (Kazantzidis & Naziridis 2003) and another one small colony (3-5 pairs) at Kastoria Lake was also established.

The wintering population varies from 20,000-25,000 individuals and is thus much more widespread. Evros Delta, Kerkini Lake, Axios Delta, Porto Lagos (Thrace), Messolonghi, Amvrakikos and Kalamas Delta (Western Greece) hold the largest proportion of wintering Cormorants (Handrinos 1989). Data concerning the wintering population comes mainly from mid-winter wildfowl counts although it is estimated that the number may be higher.

Distribution of Cormorant colonies in Greece (black dots).

12.1.1 Conflicts with Cormorants in Greece

The conflict between fish-eating birds and the fishermen in Greece became prevalent during the 1990s. The main reason was the increase in the number of Cormorants, particularly in Thrace and Macedonia (northern Greece). Today, there is some form of conflict in at least four wetlands:

(a) Kerkini Lake where the highest breeding population of Cormorants in Greece has been recorded.
(b) Porto Lagos lagoon where fisheries and fish farms have been developed. The problem with the Cormorants occurs mainly during the winter. The fishermen, in order to reduce the loss, put nets above the wintering basins.
(c) Axios Delta: During the 1994 breeding season, fishermen, believing that Cormorants are the main reason of the reduced catches, shot almost all nestlings found in their nests (Goutner *et al*. 1997). Apart from that unique event no other intervention has taken place.
(d) Amvrakikos Bay where the highest number of wintering Cormorants has been recently recorded.

Although conflicts also exist at other inland lakes or coastal wetlands (such as Kastoria Lake in Western Macedonia and Pylos lagoon in Peloponnese), the current situation is not considered as serious as in the four regions mentioned above.

12.1.2 Case Study: Lake Kerkini

Lake Kerkini is an artificial lake created from the Strymon River for flood control and irrigation purposes at the former Boutkovou marshes. The dam closes from February to September flooding the northern parts of the lake where the colony is located. The Great Cormorants breed in a mixed colony with Pygmy cormorants *P. pygmaeus*, Herons (Grey Herons *Ardea cinerea*, Night Herons *Nycticorax nycticorax*, Squacco Herons *Ardeola ralloides* and Purple Herons *Ardea purpurea*), Egrets (Little Egrets *Egretta garzetta* and Great White Egrets *Egretta alba*), Glossy Ibis *Plegadis falcinellus)* and Spoonbills *Platalea leucorodia*. The colony is located in a forest (formed mainly by willow trees - *Salix* spp), which is flooded during the breeding period (Crivelli *et al.* 1995, Naziridis & Papageorgiou 1996).

Kerkini Lake with flooded forest (Photograph Theodoros Naziridis).

The Cormorants at Kerkini

The breeding population of the Great Cormorant at Kerkini Lake is the highest in Greece (2,500 pairs in 2001 and 3,500 pairs in 2002, Table 12.1) and the breeding population of Pygmy Cormorant is the second highest (450 pairs in 2001 and 350 pairs in 2002) (Crivelli *et al.* 1995, 2000, Naziridis unpublished data).

Year/species	***P. carbo***	***P. pygmaeus***
1986	40	46
1987	>100	> 100
1988	230	350
1989	315	400
1990	500	570
1991	340	430
1997		500
1998	2000	500
1999		500
2001	2,500	450
2002	3,500	350

Table 12.1 The breeding population changes (pairs) of *P.carbo* and *P. pygmaeus* in Kerkini since 1986 (from Crivelli *et al.* 1995, Kazantzidis and Naziridis 1999).

Both cormorant species also winter at the Lake in high numbers. Lake Kerkini is among the most significant sites for wintering Pygmy Cormorants in Greece (the maximum recorded number was approximately 2,600 birds). The wintering population of Great Cormorant at the Lake has increased significantly during recent years from 400-600 birds in the early 1990s to more than 3,000 birds in 2000.

Aerial view of the forest colony in Kerkini (Photograph Theodoros Naziridis).

The fish

Although Kerkini Lake is mainly used for irrigation purposes, it also supports a fishery for people who live in the surrounding villages. Some fish species (Eel, Perch, Tench, see Appendix 2 for scientific names), started disappearing from the wetland many years ago particularly after the construction of the second and higher dam in 1982 (the first was built in 1932). At least 30 fish species live in the Lake and river system, four of which have been introduced and two of which are endemic sub-species. The fish with the highest economical value is Carp, followed by the Goldfish while the other species are of less commercial importance (Tatarakis 1995).

The fishermen

At Kerkini Lake in the early 1990s there were at least 200 fishermen and approximately 150 boats. The majority of them are "part time" fishermen who have diversified their livelihood activities into agriculture and other occupations. Fishing in the Lake is mainly carried out during winter and spring.

Fish productivity – yield

The total yield of fish is estimated at 25-35 kg/ha/year (Crivelli *et al*. 1995). The total yield according to that estimation is 112,500-157,500 kg/year. According to data given by fishermen the total yield is 101,605–152,407 kg/year (Tatarakis 1995).

The most important species is Carp with a decreasing yield during the last decade (53 tonnes in 1994 and 17 tonnes in 2002). Other species such as Goldfish (40 tonnes in 1994 and 100 tonnes in 2002) and Bleak (37 tonnes in 1994 and 10 tonnes in 2002) are of less economic importance. The rest of the fish catch was 18.2 tonnes (including mainly Roach).

The diet of Great Cormorant nestlings

The diet of Great Cormorants has been studied from nestling regurgitations. According to Crivelli *et al*. (2000) and to a recent unpublished study, six fish species were found in nestling regurgitations. These were Bleak, Pumpkinseed, Carp, Roach, Goldfish and Chub. The most abundant species found in the nestling regurgitations was Bleak (68%), followed by Pumpkinseed, Carp, Goldfish and Roach. In a similar study during 2001 and 2002 of Great Cormorant nestling regurgitations, Goldfish was commonest and no Carp was found (Kazantzidis & Naziridis 2004).

The impact

The impact of Cormorants on fish stocks seems to be substantial due to their vast numbers (approximately 11,000 birds). The impact from other fish-eating birds such as Pelicans (more than 1,000 birds during the winter), Grebes, Herons and Egrets is also significant. Fishermen believe that the majority of birds feed on non-commercially important fish species and so they are not blamed for reduced catches. However, Cormorants are identified as possible culprits mainly because of their large numbers and continuous presence in the area.

The conflict

The conflict between fishermen and fish-eating birds is a relatively recent occurrence in coastal lagoons and inland lakes across Greece but is particularly prevalent when fisheries are affected. The escalation of conflicts has coincided with a decrease in fishery yields as well as an increase in Cormorant numbers. Many wetland areas are affected although conflicts are more serious alongside intensive fisheries where commercially valuable fish are farmed.

Other relevant projects in Kerkini Lake

The Integrated Management of European Wetlands (IMEW): this is an EU funded project carried out in the framework of “Energy, Environment and Sustainable Development”, coordinated by the University of Durham (Bell 2004, see also http://www.dur.ac.uk/imew.ecproject/). Other contracting parties included Gouladris Natural History Museum, Greek Biotop-Wetland Centre (Greece), Finnish Game and Fisheries Research Institute (Finland), Klaipedos University (Lithuania), Danube Delta Research Institute (Romania).

Winter in Kerkini: A view of the forest colony before the breeding period (Photograph Theodoros Naziridis).

Gaps to be filled

(1) The diet of both Great and Pygmy Cormorants during the winter, (2) the exact number of Great Cormorants feeding at the Lake (taking into account that, especially during the winter, part of the population travels to Doirani Lake 30 km to the west of Kerkini for feeding), (3) studies on fish population dynamics in the Lake.

12.1.3 Case Study: The Axios Delta

The Axios Delta in central Macedonia, 12 km southwest of Thessaloniki city is one of the biggest deltas in Greece. It is a part of a wider wetland complex that contains the estuaries of the Gallikos and Loudias rivers as well as the delta of the Aliakmon River. The Great Cormorants (*P. c. sinensis*) breed in a mixed colony with Herons (Night Herons and Squacco Herons), Little Egrets, Glossy Ibis and Spoonbills. The colony is located in a riverine forest formed mainly by Tamarisks (*Tamarix* spp.), willow trees and Alder (*Alnus glutinosa*) (Kazantzidis 1998).

The cormorants in Axios Delta

During the 1980s the breeding population of the Great Cormorant was approximately 100-120 pairs. However, the breeding population gradually increased to 500 pairs but since 1998 the population seems to have stabilized at 220-260 pairs. The Pygmy Cormorant used to breed in small numbers (5-9 pairs) until 1989.

Both cormorant species winter in the delta in large numbers. Indeed, the Axios Delta is the second most significant site for wintering Pygmy Cormorants in Greece. The maximum number of Pygmy Cormorants recorded at the Axios Delta was approximately 6,000 birds in 1998 while the wintering population of Great Cormorants seems to have stabilised at approximately 2,000 birds during recent years (Kazantzidis & Naziridis 1999).

The fish

At least 36 fish species have been recorded in Axios River but there are no data available concerning the number of fish species in the sea. Among the fish recorded is an endemic species of Roach (*Rutilus macedonicus*). Carp and Eel are systematically fished in the river whereas coastal fishermen catch a variety of other sea fish species.

Diet of Great Cormorants at Axios Delta

The diet of Great Cormorants has been studied from nestling regurgitations. According to Goutner *et al.* (1997) the diet consisted mainly of non-economically important fish species. Just a small proportion (10-27%) of the total number of fish identified in the regurgitations were economically important species (e.g. Sole and Striped Sea Bream).

The conflict

During the 1994 breeding season, fishermen, believing that Cormorants are the main reason of the reduced catches, shot almost all nestlings found in their nests (Goutner *et al*. 1997). However, the increase in breeding population after this intervention discouraged fishermen from repeating further actions against the Cormorants.

Relevant studies at Axios Delta

A study (PhD) concerning the breeding and feeding ecology of the Great Cormorant in the wetland is being undertaken by University of Thessaloniki, Department of Biology. Earlier research is also available in Liordos (2002).

12.2 Cormorant conflicts with fisheries

Care must be taken when interpreting information provided in this section. Please refer to section 2.2.3 (*Methodological limitations and difficulties*).

12.2.1 Conflict site descriptions

Four Cormorant conflicts were reported from Greece: on 2 lakes (Kerkini and Kastoria) and two coasts (Porto Lagos Lagoon, Axios Delta). Most conflicts were reported from low altitudes except for 1 lake at 500+m, all waters were eutrophic and natural except for 1 of the lakes that was semi-natural.

12.2.2 Birds and fish

In Greece, Cormorants reported to be involved in conflicts were both *P.c. sinensis* and *P. pygmeus*. Reported Cormorant densities are given in Table 12.2

Habitat	No. cases	Cormorant density (maximum no. ha^{-1})		
		Average	Minimum	Maximum
Lakes	2	0.88	1.51	0.25
Coasts	2	0.81	0.73	0.89

Table 12.2 Cormorant density (average, minimum and maximum) for Greek cases in relation to 2 habitat types.

Five fish species were recorded in conflict with Cormorants in the 2 Greek coastal case studies reported: Carp, Leaping Mullet, Grey Mullet, Sole, and Striped Sea Bream. One fish species (Carp) was reported in the 2 Greek lakes.

12.2.3 Seasonality

Cormorant conflicts in Greece were reported to occur in winter (i.e. Sep-Mar): grey boxes indicate months where fewer conflict cases were reported.

Month of conflict												
COUNTRY	J	F	M	A	M	J	J	A	S	O	N	D
Greece												

12.2.4 Finance

Financial information on the 'costs' of Cormorant predation was reported for only 1 conflict case. 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. It was requested that the values provided be categorised as either 'actual' or 'estimated'. The information provided for 1 Greek case was actual (turnover) and estimate (loss). For this case, turnover for the commercial fishery was 120,000 euro and loss was 10,000 euro (8% of turnover). According to recent information from Amvrakikos Bay (Dimitriou *et al.* 2003), approximately 70% of fish found at nets are injured due to Great Cormorant attacks. Gilthead Sea Bream was the most affected fish species and its market price was much reduced.

12.2.5 Conflict issues: magnitude of conflict

On Greek lakes (n = 2 cases) commercial fisheries stakeholders cited 22 conflict issues. All were scored as either 'not claimed /not applicable' or as 'no impact', except for scaring/shooting disturbance, scored as 'major effect'. Here nature conservationist stakeholders cited 24 conflict issues, all as either 'not claimed /not applicable' or as 'no impact'. On Greek coasts (n = 2 cases) commercial fisheries stakeholders cited 22 conflict issues, recreational fisheries stakeholders cited 21 issues and nature conservationist stakeholders cited 15 conflict issues. Few issues were scored as 'major effect', and only by commercial fishermen (Table 12.3).

12.2.6 Conflict issues: status of information used by stakeholders

Overall, stakeholders provided 136 records of the status of the information they used to inform themselves about Cormorant conflict issues in Greece. The highest proportion of records (97%) was for 'popular' articles, followed by 'scientific literature' (2%) and 'grey literature' (2%). Overall, there were no differences in the use of popular, grey and scientific literature sources between the 3 stakeholder groups providing information (Table 12.4).

	Stakeholder group			
Status of information	**Recreational**	**Commercial**	**Aquaculture**	**Nature conservation**
Popular	100.0%	100.0%	-	92.9%
Grey literature	-	-	-	3.6%
Scientific literature	-	-	-	3.6%
Total no. records (= 100%)	**21**	**59**	**None**	**56**

Table 12.4 Categorisation of the status of information used by stakeholders to inform themselves about Cormorant conflict issues.

Conflict issue	Not claimed/not applicable	No impact	Minor effect	Major effect
(1) FISHERIES				
Reduced catch		(1) [1]	2 [1]	
Loss of stocked fish			1 (1) [2]	3
Reduced value of catch (damage)		2 (1) [1]		
Removal of fish from nets		1	(2)	
Damage to fishing gear		(1)		1
Reduced catchability (stress/behaviour)		1 (1)		1
Loss of earnings from the fishery		(1)	2 [2]	
Reduced capital values of fisheries		1	1 (2) [1]	
Reduced fishing tackle sales		2 (1)		
Increased recurrent costs		(1)	2 [1]	
Loss of employment		(1) [1]	1	
(2) FISH STOCKS				
Reduced stock - lowered production		(1) [1]	1 [1]	1
Effects on popn. dynamics/community structure		1 (1) [1]		1
Threats to endangered fishes				1
Vectors of diseases/parasites		(1)		
Loss of juvenile fish - lowered recruitment		(1)	1 [1]	1
Loss of spawners			2 (1) [2]	
Loss of aquaculture stock			1 [2]	1
(3) ENVIRONMENTAL				
Eutrophication			[1]	
Interactions with other birds		(1) [1]	2	
Scaring/shooting disturbance			2 (1) [2]	
Landscape alteration			1 (1)	
Drowning in fishing gear			1 (1)	
Damage to vegetation/landscape		1	(1)	

Table 12.3 Cormorant conflict issues as recorded by commercial fisheries stakeholders, recreational angling stakeholders (round brackets) and nature conservationist stakeholders [square brackets] for Greek coasts (n = 2 cases). Each figure is the number of times a particular issue was cited by stakeholders.

12.3 Potential Cormorant management tools

Information (summarised in the following tables) was provided on (1) general actions taken against Cormorants in Greece, (2) management plans/legal regulations, (3) actions at breeding sites, (4) at roosts, (5) at two very large water bodies.

NAME OF RESPONDENT AND YOUR AFFILIATION	**Savas Kazantzidis (Forest Researcn Institute - Hellenic Ornithological Society)**
COUNTRY	**GREECE**
REGION / PROVINCE / etc. (if applicable)	**Macedonia - Thrace**
Period which is concerned [year(s)]	**1995-2002**

General information on actions against Cormorants in Greece (annual numbers)

	Total numbers		**Regional numbers**	
	National numbers	**Count/Estimate?**	**Axios Delta**	**Porto Lagos**
Number of breeding colonies destroyed or disturbed	1	C	1 (see 1)	
Number of nests destroyed	0	E	0	
Number of nestlings killed	>50	E	>50	
Number of adults killed in the non-breeding season	not known	E	0	
Number of breeding adults killed	0	E	0	
Number of night roosts destroyed or disturbed	1	E	0	1 (see 2)

1. During the breeding season of 1995 fishermen killed about 50 nestlings of *P. carbo* in their nests. Local authorities and enviromentalists reacted to this action which caused serious disturbance to the mixed colony (Cormorants breed in a mixed colony with herons, egrets, and ibises). After that fishermen never repeated any action against the cormorants in this region.

2. During the 1950s fishermen used to put dynamite at an island where *P.carbo* used to roost, killing hundreds of them in each time. After repeated times of "bombing", cormorants stopped using this islet as roosting site for a period (exactly how many years is unknown). In recent years the number of cormorants wintering at Porto Lagos increased to 4,000 and they started roosting at the same islet. Fishermen having no any right to take similar measures against the cormorants but are permitted to take measures to protect their fishery around the site where they fish (see "very large water bodies - Porto Lagos").

Management plans / legal regulations (Greece 1995-2002)	
	Total country
Are there any management plans in effect? Please list all national or regional plans and give details	**No (see 1)**
Are there any regulations in effect that allow Cormorant culling? Please list all national or regional regulations and give details	
Are there any coordinated culling programmes in your country?	
Is it mandatory to obtain single permits for Cormorant killing?	
Has a general permit for Cormorant killing been issued?	
Is there any financial compensation for fish losses?	
Is there any financial aid for the construction of Cormorant exclosures or for scaring programmes, etc.?	

Remarks (on General information & on Management plans /legal regulations):

1. All sites where *P. carbo* breeds are protected areas (Ramsar, Spacial Protected Areas) and no any intervantion is allowed. No any financial aid or compensation is given to fishermen (according to the Ministry of Agriculture no any aid was required). No financial aid or compensation is given to fishermen (according to the Ministry of Agriculture no aid was required). No permission is given in order to kill cormorants (never required by fishermen).

NAME OF RESPONDENT AND YOUR AFFILIATION	**Savas Kazantzidis (Forest Researcn Institute - Hellenic Ornithological Society)**							
COUNTRY	**GREECE**							
REGION / PROVINCE / etc. (if applicable)	**AXIOS DELTA - MACEDONIA**							
Period which is concerned [year(s)]	**1995-2002**							
A. Breeding Sites								
Cormorant Damage Control Activities								
1. Avoid foundation of new colonies	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Shooting some adults to reinforce scaring	rarely	not efficient	5	4	3	At mouth of Axios river	Not efficient because during the breeding season of 2002 cormorants established a new colony next to the previous one at the mouth of Axios River.	
Scaring by human presence	rarely	not efficient	4	2	3	At mouth of Axios river		
Killing of young	rarely	not efficient	3	4		At the colony (near mouth of Axios river)	This action took place once (see 3 : Existing colonies - Reduce breeding success)	(see 1)
2. Existing colonies: Hinder cormorants from breeding	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Removal of trees	Rarely	not efficient	3	5		At mouth of Axios river	Fishermen removed, in 1995, some trees where used to nest cormorants. Cormorants reacted moving and placed their nests at the neighbouring trees	
3. Existing colonies: Reduce breeding success	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Killing of young	rarely	not efficient	3	4	3	At the colony (near mouth of Axios river)	This action took place once (1995).	(see 1)

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NAME OF RESPONDENT AND YOUR AFFILIATION	**Savas Kazantzidis (Forest Researcn Institute - Hellenic Ornithological Society)**							
COUNTRY	**GREECE**							
REGION / PROVINCE / etc. (if applicable)	**Porto Lagos - Thrace**							
Period which is concerned [year(s)]	**1950s**							
B. Roosting Sites								
Cormorant Damage Control Activities								
2. Existing roost sites: Hinder cormorants from roosting	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Shooting some birds to reinforce scaring	Regularly	Oct.- Feb.	3	3	3	around the lagoon		
Pyrotechnics / Fireworks	Regularly	not known	1	2	3	On a roosting islet (Agios Christophoros)	During the 1950s fishermen used to put dynamite at the roosting site (at the Aghios Christophoros islet). This practice is not now used and cormorants roost here.	Balasis Stelios (President of Fishermen cooperation of Porto Lagos) - (Pers. Comm.)

NAME OF RESPONDENT AND YOUR AFFILIATION	**Savas Kazantzidis (Forest Research Institute - Hellenic Ornithological Society)**							
COUNTRY	**GREECE**							
REGION / PROVINCE / etc. (if applicable)	**Kerkini (Macedonia)**							
Period which is concerned [year(s)]	**1995-2002**							
C. Feeding Sites								
C4. Very Large Waterbodies (Still Waters and Coastal Waters)								
Cormorant Damage Control Activities								
1. Resource Management	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Fish management								
Altering fish stocking regimes. Please give details.	rarely	not efficient	3	3	3	Lake Kerkini		
(b) frequency	once per year							
3. Wildlife Management								
3.1 Non-lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Human harassment								
Human patrol on foot or in vehicles	rarely	all years	3	4	3	around Lake Kerkini		
Audio frightening techniques								
Tin plates	regularly	all years	3	3	5	in certain places at the south part of Lake Kerkini		
Visual frightening techniques								
Simple human effigies or scarecrows	Rarely	all year	3	3	5	in certain places at the south part of Lake kerkini mainly		
Combination of audio and visual techniques	regularly	all year	3	3	5	around the shore of Lake Kerkini	See 1	

(1) Fishermen use a combination of visual and audio technique consisting of a system of ropes laid on poles put across the lake shore. On the ropes they hang bells and empty cans. When cormorants approach, fishermen from the lake shore pull the rope thus moving the bells and cans. This scares cormorants that leave the area for a short period (few hours max.).

NAME OF RESPONDENT AND YOUR AFFILIATION	**Savas Kazantzidis (Forest Research Institute - Hellenic Ornithological Society)**							
COUNTRY	**GREECE**							
REGION / PROVINCE / etc. (if applicable)	**Porto Lagos - Thrace**							
Period which is concerned [year(s)]	**1995-2002**							
C. Feeding Sites								
C4. Very Large Waterbodies (Still Waters and Coastal Waters)								
Cormorant Damage Control Activities								
1. Resource Management	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Habitat management								
Improve habitat quality for fishes	Regularly	years	3	4	1	At Porto Lagos Lagoon	Creation of hibernating basins by excavations and deepening of certain areas of the Lagoon	
Fish management								
Altering fish stocking regimes. Please give details.	Yes							
(b) frequency	Twice per year							
2. Bird-proof barriers (overhead barriers and peripheral fencing/netting)	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Submersed fish refuges (please specify)	Regularly	all years	1	1	1	Lagoon	Nets over hibernating basins	
3. Wildlife Management								
3.1 Non-lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Human harassment								
Human patrol on foot or in vehicles	Regularly	Oct-Feb	2	2	3	Lagoon		
Audio frightening techniques								
Gas bangers / cannons (propane gas exploders)	Regularly	Oct - Feb	2	2	3	Around hibernation basins	Although gas canons are used widely they are not effective. Cormorants are used of them and they do not leave the area any more.	
Visual frightening techniques								
Simple human effigies or scarecrows	Rarely	all year	2	3	5	Lagoon		
3.2 Lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Shooting adults and immatures								
to reduce bird numbers at specific sites	Rarely	Oct. - Feb.	3	3	3	Around hibernation basins	Cormorants are shot rarely only when they are concentrated in high numbers around a certain site.	

12.4 Stakeholders consulted

In Greece, REDCAFE contacted relevant stakeholders by phone. The Ministry stated that they would not reply as the problem of Cormorants had not been raised in an official capacity and they did not want to make an issue of it. Currently, there is no process for providing compensation for losses from fish-eating birds. The majority of information came from discussions with fishermen. However, the REDCAFE participant noted:

"*Fishermen in Kerkini, and generally in Greece, are usually poor men [and] the only thing they know is fishing. So, they have no access to scientific papers and all that they answer is all that they know from their own experience. Their instinct or their thoughts sometimes may fail. For example, many years ago they blamed Pelicans for the low catches in their nets and they were considering them as antagonists. They used to shoot them too…Scientists from the Aristotelian University of Thessaloniki, in order to save the Pelicans, took the initiative to discuss with the fishermen and after a period of two years (more or less) the fishermen were persuaded that the Pelicans were not the 'enemies'. Nowadays, fishermen and Pelicans live together and fish each next to the other and in many cases Pelicans are fed by fishermen with fish discharges*".

(1) Representative, Ministry of Agriculture, Direction of Fisheries and Inland Waters, Department of Water Ecosystems Protection, Aharnon 381 St, GR-11143 Athens.
(2) Representative, Ministry of Agriculture, Direction of Fisheries and Inland Waters, Department of Inland Waters, Aharnon 381 St., GR-11143 Athens.
(3) Representative, Fishery Cooperation of Chalastra, GR- 57300, Chalastra.
(4) Representative, Wetland Information Centre of Chalastra, GR-57300, Chalastra.
(5) Representative, Society for the Protection of Kastoria Lake, Karaoli 12 St., GR-51200 Kastoria.
(6) Representative, Fishery Cooperation of Lithotopos, Lithotopos, Serres.
(7) Theodoros Naziridis, Virona, GR-62043 N. Petritsi, Greece.

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(8) Handrinos G. & T. Akriotis. (1997) The Birds of Greece. Christopher Helm A& C BLACK. London.
(9) Kazantzidis S. (1998) The breeding ecology of the Little Egret [*Egretta g. garzetta*, (L. 1766)] at the Axios Delta, Macedonia, Greece. Doctorate Thesis. Aristotelian University of Thessaloniki, Thessaloniki, 208 p. (in Greek with English summary).
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13. Ireland

13.1 National overview

By Ger Rogan

13.1.1 Background

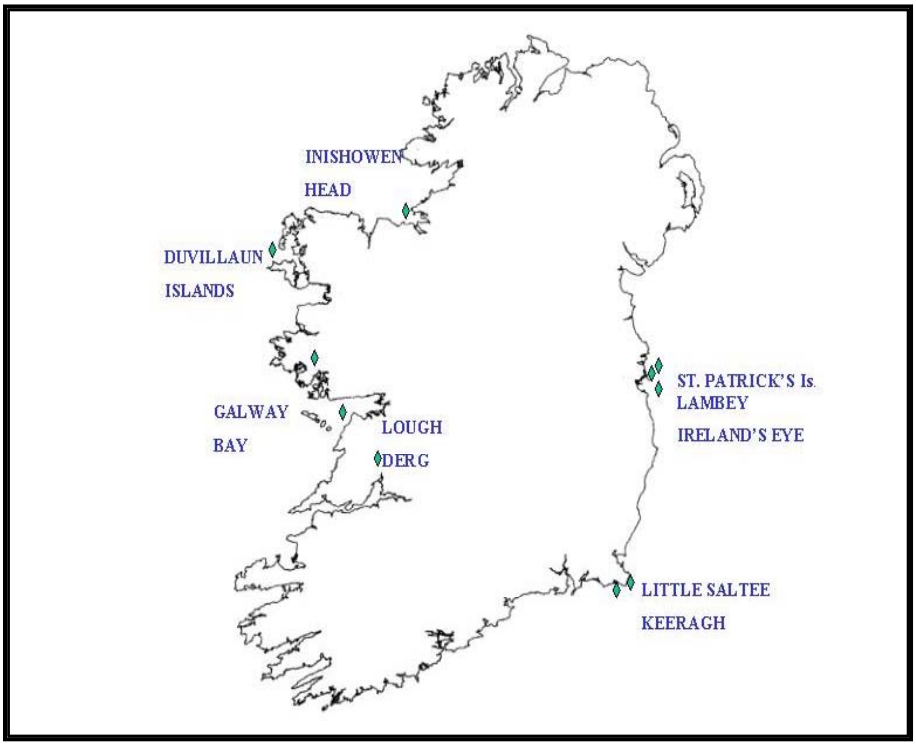
The endemic subspecies of Great Cormorant breeding in Ireland is *P. c. carbo.* They breed primarily in coastal regions with some breeding also occurring inland. As in other European countries, Cormorants are considered by some to have an adverse effect on fish stocks. During the 1900s some fishery managers offered rewards for the killing of Cormorants in their fisheries. This was later followed by a national bounty system introduced by the Department of Fisheries and between 1973 and 1976, 3,527 Cormorants were reported killed under the scheme. With the implementation of the Wildlife Act (1976), Cormorants were given full protection and can now only be disturbed or shot by license in exceptional circumstances under Section 42 of the Act. The National Parks and Wildlife Division of the Department of Environment, Heritage and Local Government is responsible for the issuing of licences.

The protection of Cormorants led to concern among fishery interests that any population increase or change in distribution would have an adverse effect on fish stocks, particularly due to the increase in use of inland waters for feeding by Cormorants. Sellers (1991) estimated that roughly half the wintering population of Cormorants are found inland.

Cormorant breeding colony on the west coast of Ireland

During the mid-1980s the Forest and Wildlife Service carried out a Cormorant breeding census to monitor changes in population size since the previous census in 1969/70. The results of this census showed the population had increased from 1,865 pairs in 1969-70 (Operation Seafarer) to 4,455 pairs in 1986-87 (Macdonald 1987, SCR census 1985-88). The reasons given for the increase in population size were: (1) reduction in human persecution; (2) the increased availability of winter food in inland waters as a result of Pike (see Appendix 2 for scientific names) predation control; (3) a fish stocking programme run by the Central Fisheries Board.

The most recent census of Cormorants in Ireland was carried during the Seabird 2000 breeding survey. It reports that the Irish coastal population has remained stable since the SCR census (1985-88). However, regional changes were reported. On the east coast the colony on Lambay Island, which had been the largest colony in Britain and Ireland, has decreased as a result of birds forming new colonies on nearby islands. Elsewhere declines in breeding numbers were reported for both the west and south of the country.



Location of main Irish Great Cormorant breeding sites.

13.1.2 The diet of Cormorants

Studies of Cormorant diet have been carried out both in the breeding and non-breeding season. Examination of Cormorant diet during the non-breeding season showed a high incidence of coarse fish, particularly Roach and Perch, with Roach providing over 80% of the diet in late winter (Mcdonald 1987). Mcdonald (1987) also showed that systems with high populations of Roach coincided with the highest concentrations of wintering Cormorants. Doherty & McCarthy (1997) found that Cormorants in the lower reaches of the Shannon fed predominantly on Perch in winter and Eel in summer and concluded that the 'greatest potential for impact on economically important fish stocks seems to involve Eels'.

A study carried out at two breeding colonies on the west coast identified Wrasse and Eel as the dominant prey species (Mcdonald, 1987). This was similar to the findings of West *et al*. (1975) who suggested that Cormorants exploited locally available fish species within the local range of their breeding colony. Piggins (1959) found that in a study of 22 Cormorant stomachs collected between May and October, the main freshwater prey was Brown Trout and Eel.

Ballan Wrasse: occurs in the coastal diet of Cormorants in Ireland.

A study carried out on the Erne to assess the impact of Cormorants on salmonid stocks suggests that Cormorants did not pose a serious threat to Atlantic Salmon smolts (Crowley, Mathers & O' Teangana 2001). This was similar to the findings of Doherty & McCarthy (1997) who suggested that it was unlikely that Atlantic Salmon smolts were extensively predated on by Cormorants in the lower river Shannon system.

(Left) Atlantic Salmon (juvenile) and (Right) Eel: species of considerable economic importance in Ireland.

13.1.3 Stakeholders (the conflict)

In comparison to some other European countries, the conflict issue between Cormorants and fisheries in Ireland does not appear great. The Cormorant is not seen as a major problem to the aquaculture industry, as a result of adequate predator control measures being in place. However, Cormorants are perceived as a problem by many in the angling sector, particularly in relation to predation at larger water bodies. The continued stocking of inland waters, with coarse (non-salmonid) and game (salmonid) fish, which are a suitable size for Cormorants, continues to attract the birds, as they are opportunistic feeders. The presence of Cormorants at these fisheries is considered by many anglers to have a significant impact. However, in most cases there is a lack of scientific data on the actual impact of Cormorants on fish stocks in comparison to other potential mortality factors. In relation to salmonid fisheries, the main periods of potential conflict with Cormorants occur during smolt migration and stocking. Concern has been raised in relation to the impact of Cormorant predation on migrating smolts and the subsequent potential reduction in numbers of adult fish returning to freshwater. Concern has also been raised in relation to vulnerability of stocked fish to predation by Cormorants, which could result in a potential reduction in both stock and angling revenue. Despite these perceived problems, the number of applications to shoot Cormorants has been low. In recent years the number of Cormorants permitted to be shot has not exceeded 150 birds in any one year. To gauge the present level of conflict in Ireland between Cormorants and fisheries, information was gathered from stakeholders in the aquaculture sector (freshwater and marine), salmonid (‘game’) fisheries, cyprinid (‘coarse’) fisheries and conservation groups.

13.2 Cormorant conflicts with fisheries

13.2.1 Conflict site descriptions

No specific Cormorant conflicts were reported from Ireland. Instead, four institutions representing semi-state conservation, the Environmental Agency, aquaculture industry and recreational fisheries provided generic information for their areas of responsibility. The responses of these institutions are summarized below.

13.2.2 Birds and fish

In Ireland, Cormorants reported to be involved in conflicts were *P.c. carbo*. Cormorant density figures and information on the species of fish involved in specific conflicts were not available. The main fish species involved in conflict issues are commercially exploited species, which are fished in recreational game and coarse fisheries, (see 13.1.2).

13.2.3 Seasonality

Cormorant conflicts in Ireland were reported to occur throughout the year. As some inland waters have a Cormorant presence throughout the year, the perception is that they are causing damage to fish stocks throughout the year. In relation to salmonid fisheries, Cormorants were reported to cause damage to adult fish during the spawning season in winter as well as to adults and juveniles during other periods of the year.

13.2.4 Finance

Financial information on the ‘costs’ of Cormorant predation was not available for Irish cases.

13.2.5 Conflict issues: magnitude of conflict

On Irish waters, commercial and recreational fisheries stakeholders (n = 2 of each) both cited 25 conflict issues, aquaculture stakeholders (n = 1) cited 13 conflict issues and nature conservationist stakeholders (n = 10) cited 3 issues. In all cases, all 4 stakeholder groups scored issues as being either ‘no impact’ or ‘minor effect’ (Table 13.1)

13.2.6 Conflict issues: status of information used by stakeholders

Overall, stakeholders provided 95 records of the status of the information they used to inform themselves about Cormorant conflict issues in Ireland. The highest proportion of records (94%) was for ‘grey literature’ followed by ‘popular’ articles (6%) and no records of ‘scientific literature’. Overall, there were no differences in the use of popular, grey and scientific literature sources between the 4 stakeholder groups providing information (Table 13.2).

	Stakeholder group			
Status of information	**Recreational**	**Commercial**	**Aquaculture**	**Nature conservation**
Popular	-	12.0%	-	-
Grey literature	100.0%	88.0%	100.0%	100.0%
Scientific literature	-	-	-	-
Total no. records (= 100%)	**29**	**50**	**13**	**3**

Table 13.2 Categorisation of the status of information used by stakeholders to inform themselves about Cormorant conflict issues.

13.3 Potential Cormorant management tools

Cormorants are protected in Ireland under the Wildlife Act (1976) and can only be disturbed or shot by license in exceptional circumstances under Section 42 of the Act. This, together with limited scientific evidence in relation to Cormorant damage to fisheries, has resulted in few damage control activities in use in Ireland. Due to the protected status, no damage control measures are carried out at roost or breeding sites. Limited damage control is carried out at feeding sites but rather than breaking feeding sites down into river or water body sizes, here they are broken down into the three main fishery sectors in Ireland: (a) finfish aquaculture (freshwater and marine), (b) salmonid game fisheries, and (c) coarse (i.e. cyprinid, Perch and Pike) fisheries.

13.3.1 Aquaculture

The culture of finfish is well established in Ireland and consists of both freshwater rearing in either tanks or cages in lakes and rearing in marine cages. Predator control measures are carried out at all freshwater and marine sites as standard practice. The principal control method used is anti-predator protection netting. In relation to rearing cages, the netting consists of both top nets and underwater nets. The nets used are generally standard predator nets and are not usually specific for Cormorants.

Conflict issue	Not claimed/not applicable	No impact	Minor effect	Major effect
(1) FISHERIES				
Reduced catch		2 (1)	[1]	
Loss of stocked fish		2 (1)	[1]	
Reduced value of catch (damage)		2 (1)	[1]	
Removal of fish from nets		2 (1)	[1]	
Damage to fishing gear		2 (1) [1]		
Reduced catchability (stress/behaviour)		2 (1)	[1]	
Loss of earnings from the fishery		2 (1)	[1]	
Reduced capital values of fisheries		2 (1)	[1]	
Reduced fishing tackle sales		2 (1)		
Increased recurrent costs		2 (1)		
Loss of employment		2 (1)		
(2) FISH STOCKS				
Reduced stock - lowered production		1	1 (1) [1]	
Effects on popn. dynamics/community structure		2 (1) [1]		
Threats to endangered fishes		2 (1)		
Vectors of diseases/parasites		2 (1)	[1]	
Loss of juvenile fish - lowered recruitment			2 (2) [1]	
Loss of spawners		2 (1)		
Loss of aquaculture stock		2 (1)	[1]	
(3) ENVIRONMENTAL				
Eutrophication		2 (1)		
Interactions with other birds		2 (1)		
Scaring/shooting disturbance		2 (1)		
Lead contamination (birds/environment)		2 (1)		
Landscape alteration		2 (2)		
Drowning in fishing gear		1 (1)	1 (1)	
Damage to vegetation/landscape		1 (1)	1 (1)	

Table 13.1 Cormorant conflict issues as recorded by 2 commercial fisheries stakeholders, 2 recreational angling stakeholders (round brackets) and 1 aquaculture stakeholder [square brackets] for Irish waters (generic overviews by stakeholder groups). Each figure is the number of times a particular issue was cited by stakeholders. In addition, 1 nature conservationist stakeholder recorded scaring/shooting disturbance and damage to vegetation/landscape as ‘minor effect’ and lead contamination (birds/environment) as ‘no impact’.

In general Cormorants are not considered a major predator problem to the aquaculture industry and in most cases are controllable. Some sites have reported damage by Cormorants stabbing fish through the netting but predator nets are generally effective at most sites. Human presence also acts as a deterrent and human presence outside normal working hours is used during specific periods (e.g. smolt transfer)when fish are more vulnerable.

Coastal cage (net pen) aquaculture in Ireland.

Other methods used at Irish aquaculture sites include gas bangers, scarecrows and predator silhouettes, but these are considered to be effective only in the short term.

13.3.2 Salmonid recreational fisheries

In salmonid fisheries the main periods of potential problems with Cormorants occur during smolt migration and spawning periods (in relation to wild fisheries) and during stocking (in relation to reared fish). Damage control activities, when used, are generally human disturbance and, in exceptional circumstances, shooting.

Fly fishing for salmonids in an Irish lough.

13.3.3 Coarse fisheries

Due to the expanse of inland waters used as coarse fisheries and the limited resources of the Fishery Boards, few damage control activities are used. As in the case of salmonid fisheries, the main damage control measures used are disturbance and limited shooting.

Stillwater coarse angling in Ireland.

13.4 Stakeholders consulted

(1) Dúchas The Heritage Service, 6 Ely Place Upper, Dublin 2.
(2) Electricity Supply Board, Fishery Division, Ardnacrusha, Co. Clare.
(3) The Central Fisheries Board, Balnagowan House, Mobhi Boreen, Mobhi Road, Dublin 9.
(4) Eastern Regional Fisheries Board, 15a Main Street, Blackrock, Co. Dublin.
(5) Southern Regional Fisheries Board, Anglsea Street, Clonmel, Co. Tipperary, Ireland.
(6) Shannon Regional Fisheries Board, Ashbourne Business Park, Dock Road, Limerick, Ireland.
(7) Western Regional Fisheries Board, The Weir Lodge, Earl's Island, Galway, Ireland.
(8) North Western Regional Fisheries Board, Abbey Street, Ballina, Co Mayo, Ireland.
(9) Northern Regional Fisheries Board, Station Road, Ballyshannon, Co Donegal, Ireland.
(10) South Western Regional Fisheries Board, 1 Nevilles Terrace, Masseytown, Macroom, County Cork.
(11) BirdWatch Ireland, Ruttledge House, 8 Longford Place, Monkstown, Co.Dublin, Ireland.
(12) Marine Institute, Aquaculture & Catchment Management Services, Newport, Co. Mayo, Ireland.

Roach: a common quarry species for coarse anglers in Ireland.

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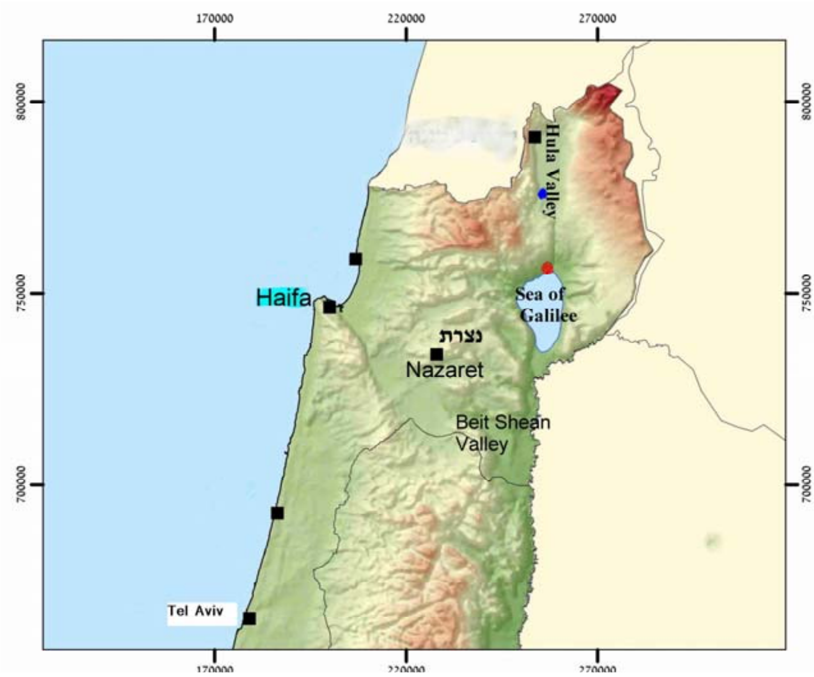
(13) Smiddy, P., (1998) Cormorant *Phalacrocorax carbo* breeding numbers in Waterford , east Cork and mid Cork. *Irish Birds* 6, 213-26

(14) West, B., Cabot, D.& Greer-Walker, M., (1975) The food of the Cormorant (*Phalacrocorax carbo*) at some breeding colonies in Ireland. Proceedings of the Royal Irish Academy. 75: 285-304.

14. Israel

14.1 National overview
By Tamir Strod & Jonathan Harari

Background
In Israel, there are virtually no rivers, except the Jordan (5-20m in width). The Sea of Galilee (see map) in the Northeast is the only natural lake in Israel (area of ca. 20,000 ha). The Hula Valley is ca. 25km north of it and the Beit-Shean Valley is ca. 20 km south of it. Approximately 16-20,000 Great Cormorants (*P. c. sinensis*) have over-wintered (generally from October to the end of March) in Israel over the last 8 years. In March 2003, 23,500 Cormorants were counted, half of them in the valleys of the Northeast and the rest along the coastal lowlands in the west. Maximum numbers of Cormorants are observed in December (see Table 14.1). According to recovered rings it appears that this population flies in from the Ukraine.



Sea of Galilee and Hula Valley, Israel.

Since 1994, regulations have sanctioned the killing of five Cormorants a day in each block of fishponds (fish farms). However, most of the fishermen do not kill that number.

14.1.1 The Conflict
The Great Cormorant is considered as a major pest at fishponds causing direct and indirect economical damage. Many hundreds of Cormorants have been shot every winter over the past ten years but the problem remained at the same level up to 2001:

shooting is costly and ineffective. Shooting also pollutes the environment, at least by: (i) lead in carcases and (ii) lead in the water.

	Hula Valley and Sea of Galilee	**Beit-Shean Valley**	**Coastal lowland North**	**Coastal lowland South**
No. of Cormorants	10,000	1,000 – 1,500	9,000	2,000 – 3,000
Roosting sites	3	3-4	2-3	2-3
Fishponds total area	400 ha	1,400 ha	1,100 ha	
Total yield	2,700 tonnes	8,000 tonnes	ca. 5,000 tons	None
Main fish	Carp	St Peter's fish	Carp	None

Table 14.1 Details of Cormorants, by region, in Israel.

14.1.2 Case Study: Hula Valley

There are fishponds in the Hula Valley, Sea of Galilee, Beit-Shean Valley, and in the northern part of the coastal lowland. Most of the fishponds are 3-10ha in area and 1-7m in depth. The common fish density (biomass) is 8-15 tonnes/ha. In each fishpond block, there are usually some small 'storage ponds' (0.3-1.0 ha), most of which are mesh-covered. During the winter (when Great Cormorants are present), the main commercial fish, is Carp (see Appendix 2 for scientific names). In addition, there are some tens of tonnes of Flathead Mullet and Silver Carp. Around 10,000 Great Cormorants over-winter in the Northeastern part of Israel, roost at the Sea of Galilee and in the Hula Reserve. Most of these Cormorants at Hula Valley forage regularly in the Sea of Galilee.

Since October 2001, a "Cormorant Project" has been organized in the Hula Valley in order to cope with the economical problem caused by the Great Cormorants. The project is based on co-operation of the fishermen's organization in this area and representatives of the Israel Nature & Parks Authority (INPA). The goals were to (a) decrease cormorants' damage, (b) decrease expenses for activities against Cormorants, (c) decrease the Cormorant killing to a minimum, and (d) monitor the effects on the Cormorant population as a basis for continued actions. After difficulties of co-operation in the first winter, it was found that the economical damage caused by Cormorants was much smaller than the fishermen had believed before (ca. 3% of the fish yield). During the following two winters, the organized actions achieved (a) no recorded damage, (b) a decrease in the total expenses by ca. 85%, and (c) a decrease in shooting of Cormorants by >90% (and a similar decrease in Cormorant carcasses). The majority of the Cormorants had moved to a large roosting area (ca. 10,000 birds) near the Sea of Galilee. It was shown that killing Great Cormorants is 'a false tool'. The above conclusions rely on regular counts and on original financial documents.

14.1.3 Case Study: Pygmy Cormorants and Great Cormorants in Beit-Shean Valley

In Beit-Shean valley, the St. Peter's fish (hybrid of Tilapia) is an important commercial fish in open fishponds. The Pygmy Cormorant (*P. pygmeus*) is a resident species in Israel (more than 800 individuals), mainly in Beit-Shean Valley and the Sea of Galilee. The fishermen of Beit-Shean Valley claim that there is a tremendous conflict with the Pygmy Cormorant during the summer, especially in ponds with small, young St. Peter's fish. Despite its position as a species on the verge of extinction, there have been a number of violent acts against this cormorant species.

The total fishpond area in Beit-Shean Valley and the surrounding neighbourhood is ca. 1,400ha, where some of the fishponds are reservoirs of >15ha. The area along the Jordan River is of low altitude (220m or less) and very hot. Fishponds contain mainly Carp and St. Peter's fish. The latter species has been documented as the preferred food of Great Cormorants. In addition, some small ponds are used for ornamental Goldfish.

The fishermen claim that Great Cormorants cause huge damage, but numbers are not available and are 'roughly estimated'. Cormorant damage can be direct (predation) and indirect (avoidance of populating fish as a precautionaary measure against Cormorants). The financial income of the fishery is a primary component of the local/regional economy. Nevertheless, as a result of the area's characteristics, it is the central foraging ground for the Pygmy and Great Cormorant during the winter.

There are no recent records for Great Cormorants but a survey carried out during 1995-1998 provides some data. Great Cormorants winter in the Beit-Shean valley during late December-mid March. Violent actions in the area resulted in a decrease in the Cormorant population, from ca.1,600 in 1995 to only a few hundreds (roughly estimated in the last two winters). The Cormorants, which forage in the fishponds of this area, roost in several small colonies along the Jordan, with a few hundreds coming daily from a roosting site ca. 20 km to the north. Data are sparse and mostly based on fishermens' estimations. However, the financial costs of this action were high. This kind of activity was continued during the winters of 1996, 1997 and 1998 and so on. The amount of killing decreased when Cormorant presence declined.

14.1.4 Gaps to be filled

There are no available data on the number of Cormorants that are being killed and there has been no available data on Cormorant numbers since 1998.

14.2 Cormorant conflicts with fisheries

Care must be taken when interpreting information provided in this section. Please refer to section 2.2.3 (*Methodological limitations and difficulties*).

14.2.1 Conflict site descriptions

One Cormorant conflict was reported from Israel: at an aquaculture pond system in the Hula Valley. This 400 ha natural system was eutrophic and at an altitude of < 100m.

14.2.2 Birds and fish

In the Israeli case, Cormorants reported to be involved in conflicts were *P.c. sinensis*. However, *P. pygmeus* birds (14 pairs in summer and up to 60 birds at other times) were also reported but 'not yet in real conflict'. Reported Cormorant (*sinensis*) density was 21.2 birds ha^{-1}. Stocked Carp and natural Mango Tilapia were recorded in conflict with Cormorants in the single Israeli aquaculture pond case study reported.

14.2.3 Seasonality

Cormorant conflicts in Israel were reported to occur in winter (i.e. Oct-Mar).

Month of conflict												
COUNTRY	J	F	M	A	M	J	J	A	S	O	N	D
Israel	■	■	■							■	■	■

14.2.4 Finance

Financial information on the 'costs' of Cormorant predation was reported for the single Israeli conflict case. 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. It was requested that the values provided be categorised as either 'actual' or 'estimated'. The information provided for the Israeli case was estimated. Based on 1 case, estimated turnover for the aquaculture fishery was 9,000,000 euro and estimated loss was 1,000,000 euro (11% of turnover).

14.2.5 Conflict issues: magnitude of conflict

Eight Cormorant conflict issues associated with the single aquaculture fishery were reported. Of these, 2 issues were cited as 'no impact' and 6 as 'minor effect': loss of stocked fish, reduced value of catch (damage), loss of earnings from the fishery, increased recurrent costs, reduced stock through lowered production, and loss of aquaculture stock.

14.2.6 Conflict issues: status of information used by stakeholders

Overall, aquaculture stakeholders provided 10 records of the status of the information they used to inform themselves about Cormorant conflict issues in Israel. Half the records were for 'popular' articles and half for 'grey literature'.

14.3 Potential Cormorant management tools

Information (summarised in the following tables) was provided on (1) general actions taken against Cormorants in Israel, (2) management plans/legal regulations, and (3) actions at aquaculture sites. There are currently no breeding Great Cormorants in Israel (all are wintering *sinensis* from Ukraine). In Israel, there are only 4-5 main roosting sites and, in general, there are no actions against roosting sites. During winters 1997-8, a roost in the Beit-Shean Valley was terminated by shooting during days & nights. Since then, only small and sparse roosting sites were founded there. 'Scaring by human presence' at roosts is not relevant, since most of the roosting sites (except the Hula Reserve) are on (or adjacent to) very busy roads. No actions are taken against Cormorants in small still waters.

NAME OF RESPONDENT AND YOUR AFFILIATION	**Tamir Strod & Jonathan Harari, Hula Reserve, Israel Nature & Parks Authority**					
COUNTRY	**Israel**					
REGION / PROVINCE / etc. (if applicable)	**Hula Valley**					
Period which is concerned [year(s)]	**2001 and before**					
General remark: All the great cormorants in Israel appear to belong to an over-wintering population of *P.c.s* , origin in Ukraine.						
General information on actions against Cormorants in your country (please give annual numbers)						
	Total numbers		**Regional numbers**			
	National numbers	**Count/Estimate?**	**Hula Valley**	**Beit-Shean Valley**	**Coast lowland-north**	**Coast lowland- south**
Number of breeding colonies destroyed or disturbed	0					
Number of nests destroyed	0					
Number of nestlings killed	0					
Number of adults killed in the non-breeding season	200	est	200			
Number of breeding adults killed	0					
Number of night roosts destroyed or disturbed	2		1	1	0	0

Management plans / legal regulations (Israel 2001 and before)

	Total country	Hula Valley	Beit-Shean Valley	coast lowland-north	coast lowland-south
Are there any management plans in effect? Please list all national or regional plans and give details	Plan 1- since 1996 Plan 2- at 2002	Plan 2	Plan 1	no	no
Are there any regulations in effect that allow Cormorant culling? Please list all national or regional regulations and give details	5 cormorants a day, per fishpond block				
Are there any coordinated culling programmes in your country?	no	2002	yes	no	no
Is it mandatory to obtain single permits for Cormorant killing?	yes				
Has a general permit for Cormorant killing been issued?	5 cormorants a day, per fishpond block				
Is there any financial compensation for fish losses?	no				
Is there any financial aid for the construction of Cormorant exclosures or for scaring programmes, etc.?	no	no	little	no	no

Remarks (on General information & on Management plans /legal regulations):

Plan 1: killing cormorants by a special team + fishermen, everywhere in the fishponds areas, including in roosting sites
Many cormorants were killed. This is a costy project (3 times more than "2"), partialy aided by the Ministry of Agricoltural

Plan 2: controlled shootings, mainly for frightening, at all fishponds simultaneously + monitoring the use of alternative foraging sites
fishermen love it.

NAME OF RESPONDENT AND YOUR AFFILIATION **Tamir Strod & Jonathan Harari, Hula Reserve, Israel Nature & Parks Authority**
COUNTRY **Israel**
REGION / PROVINCE / etc. (if applicable) **Hula Valley**
Period which is concerned [year(s)] **2001 and before**
C. Feeding Sites
C5. Aquaculture

Cormorant Damage Control Activities

1. Resource Management	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Fish management								
Altering fish stocking regimes. Please give details.								
(a) timing	regularly	months	1	4	1	Hula Vally	Aborted winter (10-2 months) stocking	
(d) stocked fish sizes	unknown	unknown	5	5	1			
Locating most susceptible fish species and size close to the centre of human activity or near buildings	rarely	unknown	3	4	2			
Use/management of feeding ponds to attract Cormorants (i.e. to distract them away from production ponds)	not used	unknown	1	3	4		Planned to be used on 2002-3 winter, in the Hula Valley	
2. Bird-proof barriers (overhead barriers and peripheral fencing/netting)	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Physical exclosures with narrow meshed systems (mesh sizes < 20 cm) using wire, lines or string in parallel or grid patterns	regularly	3	3	3	1		It is in use for small ponds only (<1ha). It is partially effective, but the maintanance is too expensive.	
Wire, lines or string in grid patterns (other mesh size) **>15m**	regularly	not efficient	2	3	1		In use for many years against Pelicans. Not efficient both for Pelicans and cormorants.	
Wire, lines or string in parallel patterns (please give spacing) **>15m**	regularly	not efficient	2	3	1		As above.	
3. Wildlife Management								
3.1 Non-lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Human harassment								
Human patrol on foot or in vehicles	regularly	3	1	1	2		The costs are high due to working costs	
Audio frightening techniques								
Electronic guards (devices that produce artificial noises)								
Sirens	regularly	hours	1	1	2		As above.	
Vehicle horns	regularly							
Gas bangers / cannons (propane gas exploders)	rarely	hours	2	2	2		Rare because: technical & safety problems; low efficiency	
Live ammunition	regularly	days+	1	1	2		Effectiveness is highly dependent on the level : a) regional coordintion b) continuity.	
Visual frightening techniques								
Simple human effigies or scarecrows	rarely (2002)	days(-)	1	2	4		Tested in 2002 only. The effect seems to depend on adjacent scaring shots of live ammunition.	
Parked vehicles	rarely	unknown	---	---	5			
3.2 Lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Shooting adults and immatures								
to reinforce non-lethal harassment	regularly	months	1	1	3		Effectiveness depends on the type of harrasment	Studied in winter 2002
to reduce bird numbers at specific sites	regularly	days-months	1	1	3		Effectiveness depends on existing alternatives and on additional measures.	Studied in winter 2002
to reduce regional population levels	regularly	days-months	1	1	3		Effectiveness depends on: existence of preffered prey; alternatives; additional measures.	Studied in winter 2002

14.4 Stakeholders consulted

(1) Head of fish marketing at the Hula Valley.
(2) Officer in charge for preventing animal damage to agriculture in the Hula Valley.

14.5 Bibliography

(1) Gissis, G., J. Harari and T. Oron (1998) Summary of Countings of Great Cormorants in the Hula Reserve, 1996-1998 (In: annual reports of the Hula Reserve, INPA (in Hebrew,.

(2) Shy, E. & A. Geva (2000) Tracing the Over-Wintering Populations of Great Cormorants and its Damages to Fishponds, in relation to the means for Reducing the Damages. Final report for 1995-1997, INPA (in Hebrew).

(3) Strod, T. (2002) Visual capacities and prey preference in the Great Cormorant (*Phalacrocorax carbo sinensis*). PhD Thesis, Technion, Israel (in Hebrew, with English abstract).

(4) Shmueli, M. (2001) Comparative ontogenesis of the Pygmy cormorant (*Phalacrocorax pgmeus*) and the Great Cormorant (*P. carbo sinensis*): morphometry and energetics. PhD Thesis, Technion, Israel (in Hebrew, with English abstract).

(5) Shy, E. et al. (2003) Resolving the conflict between Great Cormorants *Phalacrocorax carbo* and aquaculture in Israel. Vogelwelt 124: 355-367.

15. Italy

15.1 National overview

By Stefano Volponi

Background

Nowadays, the Great Cormorant *P. carbo* is a common species in Italy. Birds of the continental race *sinensis* are widespread in the whole country as regular migrants, locally sedentary, not yet abundant as breeders. There were about 1,200 pairs in 2004 (Volponi unpublished data), but birds are numerous during migrations and winter time (Baccetti & Cherubini 1995, Brichetti *et al*. 2000, Baccetti *et al*. 2002). Overall, numbers increased sharply during the 1980s and early 1990s following the spectacular growth of populations breeding in central and northern Europe. More recently numbers have stabilised, showing signs of a gradual saturation.

Data from ring recoveries and colour-ringing (Figure 15.1) show that Cormorants visiting Italy originate from a wide geographical area, ranging from Wales to the Czech Republic, although the core area is centred in The Netherlands and the Baltic countries (Italian Ringing Scheme unpublished data, Baccetti & Giunti 2002).

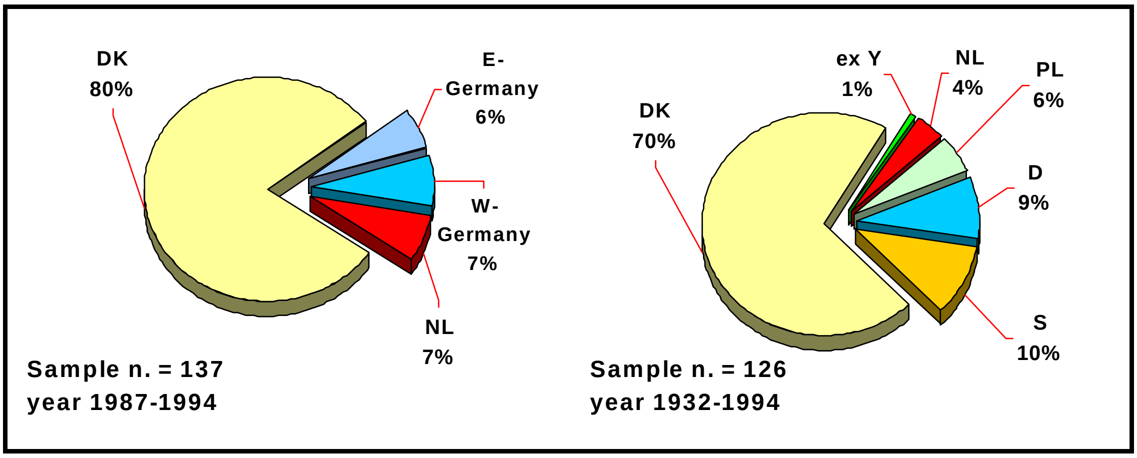


Figure 15.1 Origin of Great Cormorants recovered in two different areas located respectively inland in NW Italy (left: Piedmont) and in a coastal area in NE Italy (right: Po Delta). These data support the hypothesis that birds from different breeding areas reach Italy through two main flyways running west and east of the Alps.

Continental Italy was colonised by Great Cormorants in 1985 (Spina *et al*. 1986) with the first colony established in N.E. Italy. Since then several colonies have settled in areas formerly used for wintering, such as Piedmont (Carpegna *et al*. 1990), the Po Delta (Volponi 1994, 1999), the Lagoon of Venice and Sicily (Baccetti & Brichetti 1992). At present Great Cormorants live in a wide range of habitats from alpine lakes and rivers to eutrophic freshwaters, brackish lagoons and coastal waters.

15.1.1 Cormorant numbers in winter

Great Cormorants were uncommon in Italian wetlands until the early 1980s, when 2,500-3,500 birds were estimated in mid-winter (Brichetti 1982). Sightings were mostly limited to brackish lagoons along the Tyrrhenian Sea coast (Tuscany, Latium) during migration periods. An exception was the small, almost sedentary and relict, population breeding along the western Sardinian coast.

In the late 1980s, the first mid-winter national census showed that Cormorants had become more numerous than ever (13,000 birds) and were more concentrated in the largest brackish coastal wetlands (84%) than in rivers and freshwater basins (16%) (Baccetti 1988). Since then, Cormorant numbers and distribution have changed again (Figure 15.2)

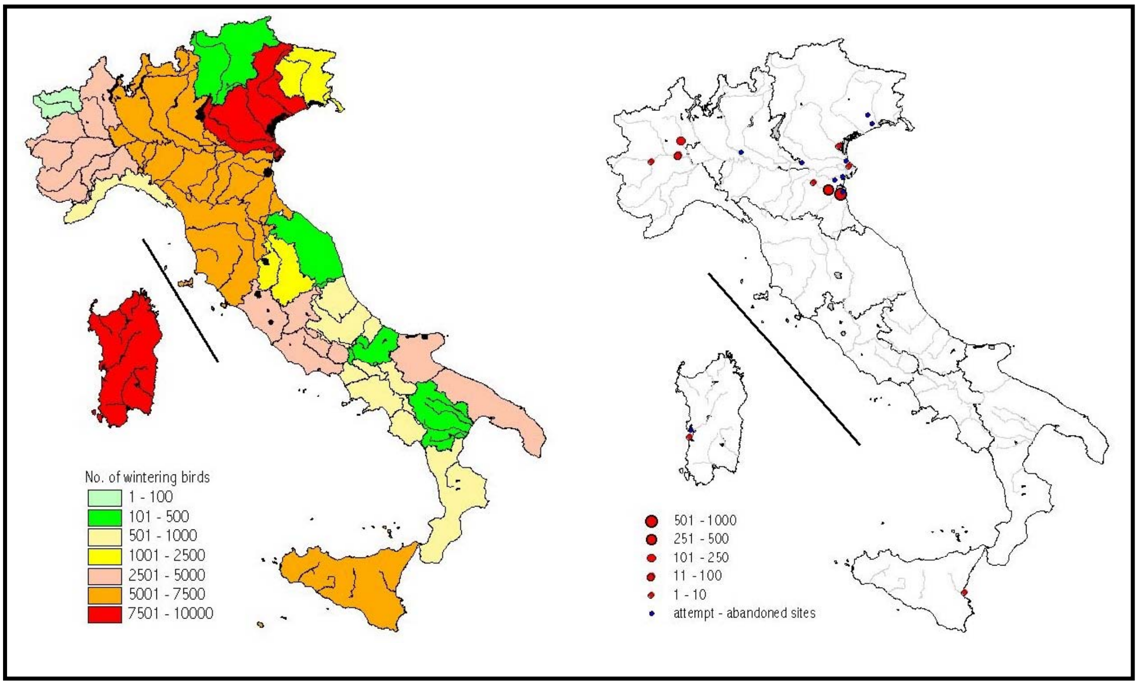


Figure 15.2 Regional distribution of wintering Cormorants in January 2001 (left) and distribution of breeding colonies (right). Nowadays Cormorants live in a wide range of different habitats, from alpine lakes and rivers to eutrophic freshwaters, brackish lagoons and coastal sea waters.

Data for the whole country estimated 25,000 birds in January 1993 and more than 36,500 in January 1994 (Baccetti & Cherubini 1995). More accurate figures of 49,100 birds (58% in coastal brackish lagoons and 42% in freshwaters) and 57-64,000 birds were estimated from national counts carried out, respectively, in mid-January 1995 and winter 1998-2001 (Baccetti *et al*. 1997, Baccetti *et al*. 2002) (see Figure 15.3). Annual growth rates were estimated at 18.1% in the period 1987-1995 and in the range 5.2-6.5% in the period 1998-2001. Although knowledge on the winter distribution and numbers of the Great Cormorant is incomplete (WI-CRG 2003), Italy appears to hold around 15% of the total European population according to the most recent estimates (Veldkamp 1997).

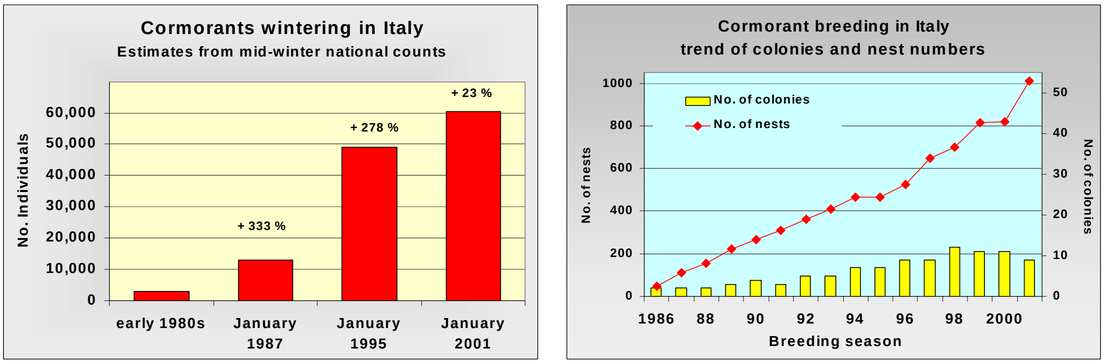


Figure 15.3 Trend of wintering (left) and breeding (right) Cormorants in Italy.

Breeding

After decades of local persecution (Baccetti & Brichetti 1992), permanent colonies have settled in areas formerly used only for wintering (Carpegna *et al*. 1997). Nowadays, about 1,200 pairs breed in 8-12 colonies located in the western Po Plain (Piedmont), the lagoon of Venice and the Po Delta, west Sardinia and Sicily (Volponi 1999, Serra *et al*. 2002, Volponi unpublished data, see also Figure 15.3). According to the most recent estimates (Veldkamp 1997), although growing, the Italian population accounts for less than 1% of the European population.

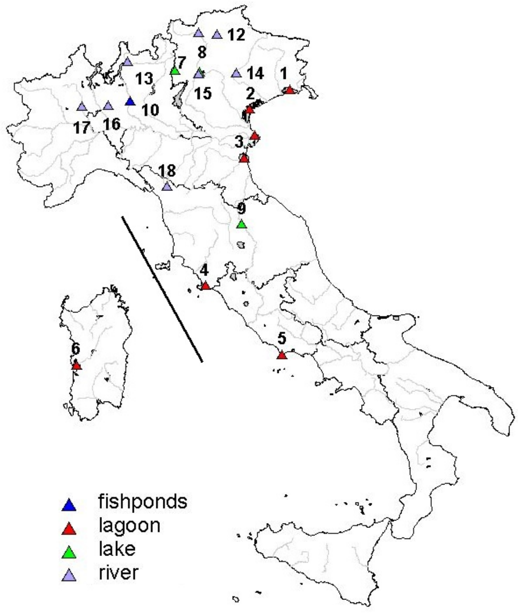
15.1.2 The Conflict

Conflicts between piscivorous birds and several human activities related to fish started rather recently (mid 1980s), but in the last 10-15 years have grown considerably and reached a state of socio-economical and environmental emergency in some areas.

The main reason for conflict has been the sharp increase in numbers and the wider distribution of most piscivorous bird populations wintering and breeding in Italy after the new national hunting law (L. 968/77 first and then L. 157/92) and the EU Bird Directive (409/92/CEE) came into force at the end of the 1970s. Before the new regulation, all but a few species could be hunted but, since then, most species are protected and only a minority are considered as gamebirds. These include most ducks, some shorebirds (e.g. Lapwing *Vanellus vanellus*) and Passerines (e.g. Skylark *Alauda arvensis*, Crows Corvidae and Thrushes Turdidae), whereas all piscivorous species are fully protected. Among them, Yellow-legged Gull (*Larus cachinnas*), Grey Heron (*Ardea cinerea*) and Great Cormorant, greatly benefited from full protection and promptly increased in number. Other concurrent positive factors, such as large amounts of food from anthropogenic sources (aquaculture stocks, fish-stocking in rivers and lakes, increased fish productivity in eutrophic waters, open urban rubbish dumps) and mild winters have assisted population increases for all piscivorous birds. Cormorants are now spread over the whole country, recolonising regions once abandoned and establishing colonies in new areas.

The sharp rise in Cormorant numbers has been accompanied by widespread and increasing complaints by people who have an interest in fish: initially fish farmers protested about the socio-economical effects of Cormorant predation (increased recurrent costs, loss of earnings and of employment) and lately anglers have complained about the futility of restocking programs as well as the reduced catch and fish catchability. Finally, producers and retailers have highlighted decreasing fishing tackle sales. Fish farmers and, more recently, anglers, have asked for the introduction of shooting and other measures to reduce Cormorant numbers. In several districts, fish farmers have also asked for reimbursement of several million euros/year for fish-loss as well as increased recurrent costs leading to suing local administrators for damages and economic loss. Sometimes fish farmers have obtained such compensation, usually as a means of supporting wetland management and the continuation of traditional economic activities (e.g. *vallicoltura* the typical extensive form of aquaculture in brackish lagoons along the N Adriatic cost).

The geographic distribution of the Cormorant-human conflict has changed quite quickly according to the spread and increase of Cormorants. Not surprisingly, the pattern of complaints closely followed the changing distribution of Great Cormorants: birds first colonised the largest coastal wetlands and major rivers along migratory routes then redistributed inland occupying all kinds of basins and water courses from the plains to medium altitudes. Nowadays, the conflict is present in all the coastal wetland areas, some inland lakes and in several upper and medium river courses in North and central Italy (Figure 15.4, section 15.2).



Stakeholder	Main complaint
Fish-farmers	reduced catch loss of stocked fish increased recurrent costs loss of earnings loss of employment
Fishermen	reduced catch loss of earnings loss of employment
Anglers	reduced catch reduced fish catchability decrease fish populations change popul. structure
Sport fishing producers & retailers	decrease of fishing tackle sales

Figure 15.4 (Left) Geographical distribution of Cormorant conflicts in Italy. Numbers refer to the sites described in section 15.2. (Right) Most commonly reported stakeholders' complaints in Italy.

Several other factors are affecting fish declines, these include poor water conditions, competition or predation by other fish exotic species (e.g. Wels, Large-mouthed Bass, Pikeperch, see Appendix 2 for scientific names), strong changes in the fish community due to introduced exotic species (in the Po river basin the majority of the fish species are of exotic origin), over fishing, flooding or cold winter spells. However, the effect of Cormorant predation on extensive fish farming and traditional fisheries carried out in coastal brackish lagoons locally maybe of concern from a socio-economical point of view. Effects on angling catches and fish populations in freshwater lakes and rivers have not been well studied and, at the moment, the conflict in these habitats seems to be less serious than elsewhere.

15.1.3 Case Studies

The following four case studies refer to three large coastal areas where conflict between Cormorants and fishermen arose after the early phase of Cormorant population increase and local stakeholders have tried different management options to reduce impacts on fisheries and fish farming. The fourth case refers to a river system in north-west Italy.

15.1.3.1 The Po Delta, NE Italy

In Italy, the Po Delta represents a major wintering area for Great Cormorants as well as for commercial fisheries and *vallicoltura*, a traditional form of low-tech aquaculture consisting of specific lagoon management and extensive fish exploitation (Ardizzone *et al*. 1988). Commonly, the Po Delta is the considered as the coastal belt stretching from the River Adige to the wetlands north of the town of Ravenna, including both the actual and historical delta. The Delta consists of a mosaic of more than 38,000 ha of wetlands incorporating coastal bays, brackish lagoons, freshwater marshes, canals and river branches. Here, since the early 1980s, the Great Cormorant population has increased considerably. The occurrence of high Cormorant numbers first during the six month period from October to March, which corresponds to the fishing season and the fish-stocking, then also in the breeding season, have caused increasing complaints from fishermen.

In the Po Delta, the management of Cormorant conflicts is a complex task as a series of stakeholders is involved in multiple use of the wetland system: wildfowl hunting, birdwatching and nature tourism, habitat and waterbird conservation, commercial fishing and *vallicoltura* are common and often concurrent activities. Wildfowl hunting is a traditional and popular recreational activity that may have high commercial value and give high economical return (a single hunting hide for ducks in a good area may yield several thousand euros/season), whilst nature tourism represents a fast growing economic resource attracting more and more people interested in estuarine habitats (for example, more than 20,000 visitors attended the first Italian birdwatching fair held in spring 2004 in Comacchio in the Po River Delta Regional Park). Nature conservation is essential in the Delta which is one of the most important areas in Italy and the Mediterranean for habitat diversity and the invaluable waterbird community (Figure 15.5).

Commercial fishing is carried on a seasonal basis using fyke nets and gill nets in open bays and river estuaries while about 30 different sites, named *valli* from the Latin *vallum* "embankment", are managed for *vallicoltura*. Both in open bays and *valli*, fish catches show wide annual and site-to-site fluctuations, ranging between 70-112 and 11-84 kg/ha/year, respectively (Volponi 1997). Management of fishing valli is highly specific because (a) water levels and exchanges with the sea are actively managed throughout the year, (b) fish fry are recruited from the sea or, more often, artificially stocked, (c) there is no use of artificial food or drugs, (d) non commercial-sized fishes are usually stocked at very high densities in small deep basins from December to March for wintering, (e) exploited fish species are Eel, Sea Bass, Sea

Bream, Grey mullets (Mugilidae belonging to five species of different commercial value), Big-scaled Sand Smelt.

Figure 15.5 Multiple uses of the Po Delta wetland system makes the management of the Cormorant conflict a complex task. Other than fishing and fish-farming, wildfowl hunting may represent an economically relevant economic resources for most fishing *valli* which grants huge earnings, often larger than those from aquaculture. Nature tourism is based on the great diversity of habitat and waterbirds and represents a fast growing economic resource, especially valuable outside the summer holiday season.

Cormorants are able to forage opportunistically in all available habitats, but especially in winter (when the effects of low temperatures on the distribution of freshwater and shallow-water prey are greatest) they feed more regularly and intensively in the fishing-*valli* (Boldreghini *et al*. 1997) where fish availability and predictability is higher than in river and open coastal water. From November to late December, simultaneously with the peak of Cormorant arrivals, the fall in water temperature prompts fish to migrate from shallow lagoons to the deeper and warmer sea waters (Gandolfi *et al*. 1985).

Figure 15.6 Extensive aquaculture carried out in fishing *valli* is rather different from other kinds of fish-farming because it involves large basins (up to some thousands hectares) and does not involve feeding or drug treatments. On the left an aerial view of the Comacchio lagoons (about 8.000 ha). On the right a fishing station in a Po Delta valle: this includes the fish-farmer’s house and fixed fish barriers (in Italian named "*lavoriero*").

This behaviour is exploited by fish-farmers to collect fish at fixed fish barriers (Figure 15.7) where, depending on size, fish is sold to the market or driven to deep ponds for wintering. During the coldest period (mean air temperature in January is 2°C), open brackish waters are almost depleted of fish and Cormorants are forced to forage in flowing freshwaters or in wintering ponds where fish density is very high (thousands per m³ of water) and predation may be very relevant (Volponi 1997).

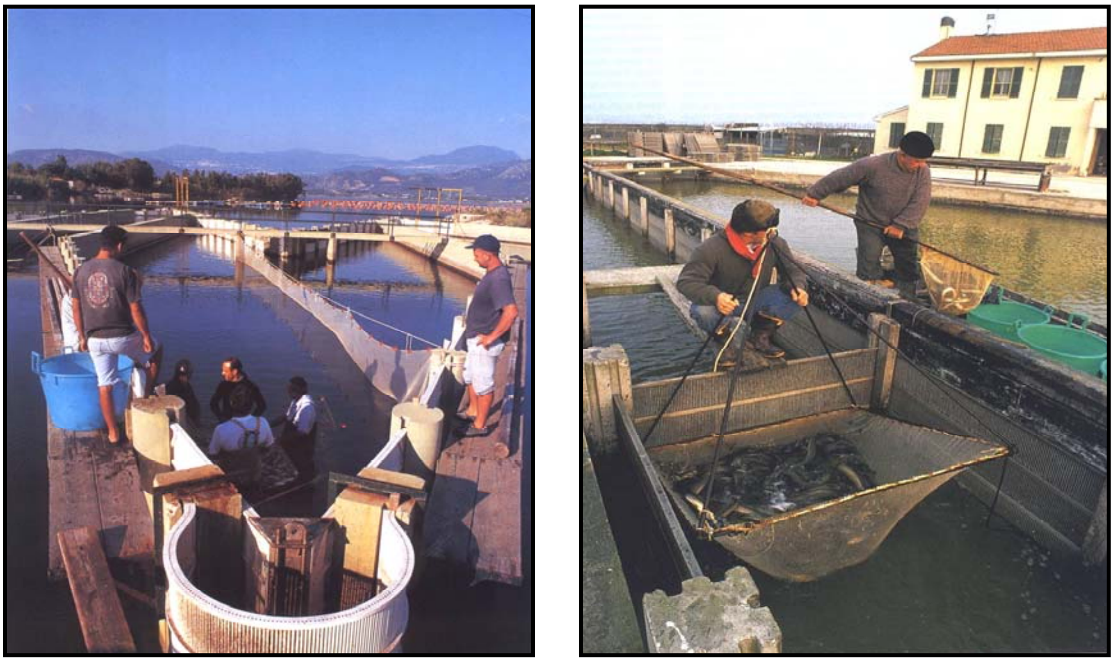


Figure 15.7 *Vallicoltura* is a traditional low technology form of extensive aquaculture. Even if some fish may be taken in the open basins using fyke-nets, fishing is mainly carried out at fixed gears where fish is attracted by the influx of marine saltwater.

Cormorant impact on the *vallicoltura* system can be potentially serious for several reasons:

(1) Fish prey are of high economical value: in the market, Eel, Sea Bream and Sea Bass from *vallicoltura* are sold at 10-15 euro/kg, a price double of that for fish produced in intensive condition (Donati *et al*. 1999, Volponi pers. comm.).
(2) Especially in recent years, fish fry are artificially stocked and they represent a very expensive investment cost: juveniles of the above fish species are priced around 0.1-0.5 Euro each (Franzoi *et al*. 1999).
(3) Predation affects both the catch of commercially-sized fish and the yield of successive fishing seasons because the productive cycle of different species lasts from 2 (Sea Bream) to 6 years and more (Eel).
(4) Fish may also suffer high additive mortality due to wounds and disturbance caused by Cormorant foraging activity especially in high-density stocked basins in winter.
(5) Disturbance and other non-lethal scaring techniques (e.g. scaring devices based on sight and sound) are ineffective and the use of physical barriers is limited to small areas being too expensive or unsuitable to cover all areas

vulnerable to predation and large productive basins typical of *vallicoltura* which can cover hundreds of hectares (Volponi & Rossi 1998).

(6) Shooting, allowed under regulation in some areas, is time-consuming and has only a local, temporary effect (Volponi 2001).

Every day experiences of fish-farmers and field tests of non-lethal techniques has shown that to evaluate the level of efficiency, practicability, acceptability and costs of damage control activities it is necessary to consider if the main commitment is to reduce or prevent economical losses at either (1) **the small local scale** (i.e. single productive area such as a group of related basins, or (2) **the regional scale** (i.e. whole productive district inside the daily cormorant home range of 20-40 km).

A management plan for the Northern Po Delta

Besides its environmental aspects, the Po Delta is also complex from an administrative point of view being divided in two administrative regions (each with a proper regional park with separate regulations), three districts and many different private and public landowners. This complexity is not a secondary aspect in Cormorant conflict management and means that operations at a regional level are complex tasks requiring a co-ordinated and integrated approach.

This approach (see Figures 15.8 and 15.9) was considered when elaborating the Cormorant management plan for the district of Rovigo in the northern Po Delta. The main aims were to reduce direct (e.g. biomass removed by predation) and indirect impact (e.g. loss due to stress and wounds) due to Cormorants in fishing *valli*; the plan didn't consider those birds foraging in open lagoons, freshwater basins and river branches where no impact was claimed.

The plan did not include massive shooting among its activities because (1) it was not intended to reduce the overall Cormorant numbers, considered an unaffordable task considering habitat characteristics and geographical position, and (2) it should not impact the large numbers of non-target waterbirds (e.g. ducks *Anatinae*, herons, Flamingos *Phoenicopterus ruber* etc).

However, because the conflict was related to Cormorant numbers, a decrease in bird presence was desired through a reduction of the carrying capacity as a result of the management of density-dependent factors such as the availability and predictability of easy prey and safe roosting sites. Considering that the minimal habitat requirements of wintering Cormorants include open water, food, roost sites and security (Suter 1995), several strategies or reducing Cormorant predation in the fishing-*valli* were considered:

(1) To promote among the fish farmers the use of physical barriers to protect vulnerable fish-stocks in the most sensitive and high-density fish areas (stocking and wintering ponds, see Figure 15.9).
(2) To scare away foraging flocks from larger basins by means of non-lethal techniques reinforced by limited shooting.
(3) To manage a roost-dispersal program across the Po Delta to move Cormorants as far as possible from fishing *valli* and increase daily flying time from night roosts and foraging areas.

(4) To discourage the establishment of new roosts and colonies within/close to the fishing *valli*.

Such activities, along with the continuous monitoring of Cormorant numbers and distribution, and analysis of the stomach contents of birds shot in fishing-*valli* were carried out in the Northern Po Delta during the winters 1999-2002 (Volponi 2001, Volponi 2002). Briefly, the results showed that:

(1) The wintering population is demographically open and subject to individual influx from nearby areas (inland wetlands, Lagoon of Venice, Southern Po Delta) due to changes in climatic conditions which, in turn, effect fish distribution and feeding water accessibility.
(2) The wintering population is controlled by density-dependent factors.
(3) High Cormorant numbers do not by themselves mean high impact on *vallicoltura*: as observed during a strong spell of cold weather, which froze the surface of both freshwater basins and brackish *valli*, high Cormorant numbers may be sustained for weeks by prey available in the river course and estuary which represent alternative feeding areas.
(4) Management activities caused a change in the trend of Cormorant numbers and a distributional shift from the Northern to the Southern Delta (where actions to reduce Cormorant predation were carried out but not coordinated.
(5) There was a reduction of predation pressure (expressed as Cormorant-days) compared to data from previous winters.
(6) In the long term, the proportion of Cormorants feeding in open waters (i.e. outside the fishing *valli*), greatly increased, accounting for more than the 60-80% of the Cormorants counted at night roosts (Provincia di Rovigo unpublished data).
(7) No colonies settled in the N Delta fishing-*valli* area even if some breeding attempts were observed. For comparison, in the southern Delta the colony established in 1993 was abandoned by Cormorants because of nest destruction and tree cutting, while another colony located in a natural reserve has become the largest in Italy (about 650 nests in 2004), and perhaps most importantly,
(8) Stakeholders significantly changed their approach to the Cormorant conflict. Relationships between fish farmers and the local administration improved, complaints decreased in so far as most fish farmers involved reacted positively and cooperated in the management plan.

Figure 15.8 A view of different visual and acoustic means employed to protect fishponds of various size from Cormorant predation in the Po Delta. The photos show the use of colour bands, alone of reinforced by electronic noise broadcasting, cannon gas, coloured scarecrows.

Figure 15.9 Vertical and horizontal nets to protect large basins (fishing, wintering and pre-fattening ponds and canals) from Cormorants in Po Delta fishing *valli*. When economically and technically possible, a complete protection with horizontal 20x20 cm nets offered the best solution.

If control efforts continue, or even increase, given the available data on population trends and Cormorant responses to present control measures, it is possible to foresee that in the Po Delta, habitat diversity will allow Cormorants to establish themselves permanently all year round. Their minimum wintering and breeding numbers will be determined by the amount of food in non-commercially exploited waters and by the availability of safe breeding and wintering sites inside protected natural reserves.

15.1.3.2. The Oristano Area, West Sardinia

The Oristano area includes a series of coastal lagoons covering about 7,500 ha, characterised by shallow waters (0.4 to 2 m depth), muddy bottoms, artificial regulated canals and mouths connected to the sea. There are large salinity variations caused by high evaporation during summer and low supply of continental freshwater. Commercial fishing is the main economic resource and is carried out by a few hundred fishermen. In brackish ponds fish yield is on average 210 kg/ha/yr, consisting mainly of Grey mullets (Mugilidae) (Rossi & Cannas 1992, Cataudella *et al*. 1995).

Along the Sardinian coast and especially in the Oristano area, Great Cormorants were quite common in the 1960s and 1970s well before the increase of the central European population. By the mid-1960s, occasional surveys reported up to 100 birds and the presence of a small relict colony established on the sea-cliff north of the lagoon area. Further counts suggested that Cormorant numbers remained fairly low until mid-1980s, indicating few winter visitors joined local individuals at that time. With Cormorant populations increasing all over continental Europe, mid-January numbers promptly also increased in the Oristano area, averaging more than 1,000 birds in 1985-1989, and reaching a maximum of 7,840 birds in 1993. Peak numbers were usually recorded in November-December and the maximum figure of 13,685-15,500 birds was recorded in the late autumn of 1995. This caused a sudden and large rise in complaints by fishermen and fish farmers who urged the local administration to start an annual management plan aimed at reducing Cormorant numbers and predation.

Control measures, which involved shooting and disturbance at roosts, greatly affected both the overall Cormorant presence and the size of the local breeding population. In comparison to the pre-shooting time, Cormorant numbers peaked slightly during the autumn migration, before the onset of disturbance activities, and then stayed fairly steady during the wintering period. However the local breeding population declined dramatically from 70-75 pairs 1989-1993, to 30-35 pairs in 1995-1997 and 10 pairs in 1998 (Carpegna *et al*. 1997, APM-IVRAM 1998, Brichetti *et al*. 2000). After a new colony settlement in the southern part of the Oristano gulf (3-8 nests in 1997-2000 [Murgia & Canargiu 2001]), the local breeding population is now likely extinguished (W. Piras unpublished data).

As a result of mild winters (mean January temperature 9°C) and high levels of natural fish productivity, the Oristano lagoons are excellent quarters for Cormorant wintering. High availability and predictability of fish-prey, which remain active and wintering in the shallow lagoon waters, allow the highest densities ever recorded in Italy: a mean of 0.6 (SD = 0.21; range 0.27-1.05) birds/ha of potential feeding area was recorded in mid-winter from 1990 to 2000, with peaks of 1.5-2.1 birds/ha in late autumn (Volponi & Addis 2003). There are no detailed data on diet, distribution of feeding Cormorants or fish-stocks and so predation on commercial fish-species and actual damage to the fishery cannot be quantified. However, according to Schenk (1997) it is possible to estimate the fish biomass consumed by Cormorants during their five-month stay at about 300 tons, i.e. 40 kg/ha. In a previous calculation, Addis *et al.* (1997) estimated a consumption of 400 tons, i.e. 70 kg/ha/yr for the period 1992-1993. These figures correspond to 20-30 % of the mean yearly fish production and may justify fishermen's' concerns and the measures taken to reduce Cormorant predation. Shooting, arbitrarily limited to 10 % of the autumn population size (Baccetti 1996), and heavy disturbance at feeding and roosting sites led to the observed decline in Cormorant numbers. However, no information is available on the effects of these measures on fish production, which in turn is greatly affected by management operations and water conditions. For example, during summer 1999 a severe dystrophic crisis caused the loss of a thousand tonnes of fish and reduced almost to zero the autumn fish catch. However, this had negligible effects on Cormorant numbers recorded during the following wintering season.

Considering that the Oristano area is rather homogeneous and there is little other suitable habitat except the lagoons, and the available data on population trends and Cormorant responses to present control measures, it is possible to foresee that (1) during the wintering season, Cormorant numbers will show large fluctuations determined by a balance between the influx of migrating birds, effort put into control measures, and prey availability set by water conditions, and (2) the relict breeding population will stay very small or become extinct.

15.1.3.3 The Lagoon of Orbetello (Tuscany, central Italy)
Cormorant numbers

Nowadays the Great Cormorant is a migrant and wintering species in Tuscany. Only a few birds remain during the summer, while in the past (at least until the 19th century),breeding colonies were reported for Castiglione della Pescaia and Orbetello wetlands. According to data gathered during national counts (Baccetti & Giunti 2002), Tuscany is one of the most important areas for Cormorants wintering in Italy: numbers recorded during the winters 1998-2001 ranged between 4,644 and 6,728 (i.e. about 10% of the national wintering population). Most of the Great Cormorants observed in Tuscany were hatched in colonies in central Europe, from Netherlands to Poland, but especially in Denmark (82%).

In Tuscany, the most important area for Cormorants (and fish farming) is the coastal area in the district of Grosseto. Here, between 1,000 and 1,900 wintering Cormorants have been recorded since the mid-1980s (Baccetti *et al.* 2002). As is typical for wintering areas located in central and south Italy, the numerical intra-annual Cormorant trend is bell-shaped (Figure 15.10): numbers increase sharply in late October and reach a peak in December, then decrease smoothly until March; from April to September only few summering birds are recorded.

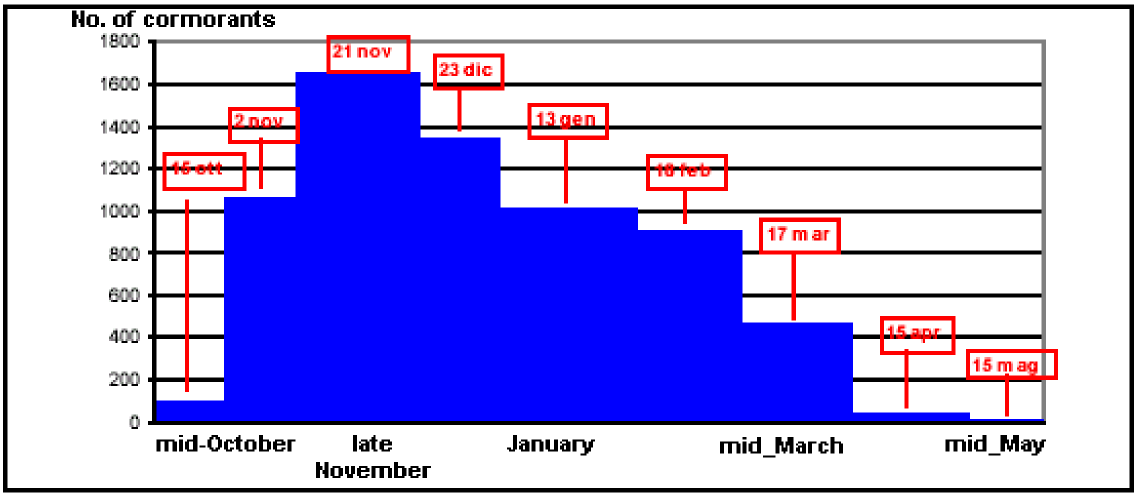


Figure 15.10 Cormorant numbers in the Orbetello lagoon from mid-October 2002 to mid-May 2003 (after NEMO & TEMI 2004).

As observed in other coastal areas, the Cormorant population wintering in the Grosseto district has probably reached its carrying capacity. Mid-winter numbers show wide inter-annual variations with a significant positive trend in the period 1987-2003 and the tendency to stabilise in the last 4-5 winters (Figure 15.11).

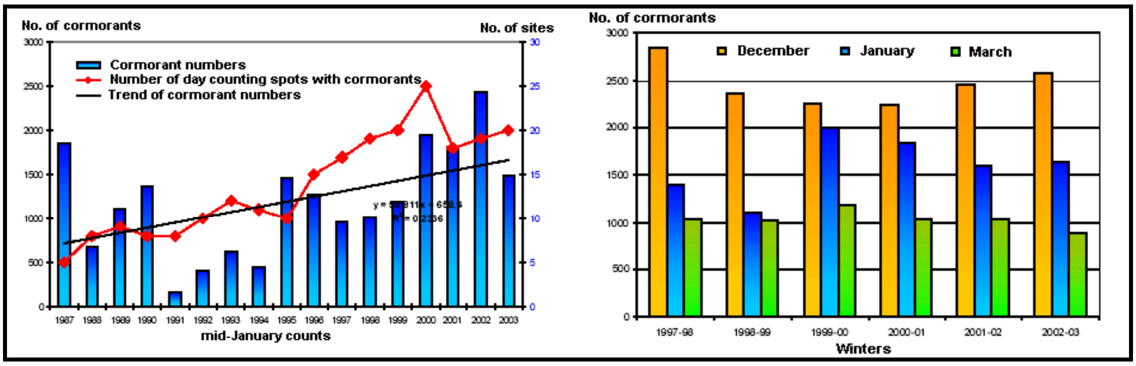


Figure 15.11 Numbers of Cormorants and sites of diurnal presence recorded in the Grosseto district from winter 1987 to winter 2003 (left). Number of Cormorants counted in early December, mid-January and early March during the last six winetrs. (After NEMO & TEMI 2004).

Aquaculture

Aquaculture is carried out both in extensive and intensive ways. Extensive low technological aquaculture is traditionally carried out in the Lagoon of Orbetello where fish are collected (a) at fixed fish barriers located along channels connecting the lagoon and the sea in late autumn and winter, and (b) in open water using fyke-nets and nets operated from boats. Fish species of commercial interest are Grey mullets (Mugilidae spp.), Sea Bass, Sea Bream, Eel, Big-scaled Sand Smelt.

Management practices are typical of extensive aquaculture and include fry stocking, wintering of non commercial-sized fish, and fish-harvest. Sea Bass and Mullet fry are stocked directly in the open lagoon, while Sea Bream fry are subject to pre-fattening in small basins until they reach 70-80 g. In the 5-year period 1999-2003, overall fish yield ranged between 210,000 and 260,000 kg/year, showing a small decrease in 1999-2000 followed by a linear increase in 2001-2003. However, wide annual variations have been recorded for yield of different fish-species. In the Grosseto district, intensive fish farming is carried out in ten plants, nine in coastal brackish or marine water and one offshore. Farmed species are almost exclusively Sea Bass and Sea Bream, which account for 99% of the overall annual harvest.

The conflict

Nowadays, Cormorant conflicts involve almost exclusively extensive aquaculture carried out in the Lagoon of Orbetello where, on average, 65% of all Cormorants wintering in the area forage. Here, Cormorant numbers account for 180,000 bird-days/year and a mean density of about 30 birds/ha (winter 2003-2003). As with fisheries in brackish ponds in Sardinia and fishing-*valli* in NE Italy, Orbetello fish farmers started to complain about damage after the early increase of Cormorant presence in the mid-1980s. Main complaints were over the loss of stocked fish (up to 50%), lowered production, reduced catchability and value of catch (damaged fish), while minor effects included the increase of recurrent costs (bird scaring and culture protection) and the spread of parasites and disease. Impact on fish production was aggravated by the presence of significant numbers of other piscivorous bird such as Grey heron, Great White Egret (*Casmerodius albus*), Little Egret (*Egretta garzetta*), Black-necked Grebe (*Podiceps nigricollis*) and especially of Great-crested Grebe (*P. cristatus*) for which the lagoon is one of the most important wintering areas in Italy (Baccetti *et al*. 2002).

Figure 15.12 An increasing number of sites used for intensive fish-culture (left) or stock fish in winter are covered with horizontal nets to limit predation due to cormorants and other piscivorous birds. (After NEMO & TEMI 2004).

Until recently, Cormorant and other piscivorous bird impacts on intensive aquaculture and fish ponds was considered a disaster. Here, the presence of huge densities of small and medium sized fish, combined with the short-term effectiveness of non-lethal scaring techniques meant high levels of predation and significant economical loss. Nowadays most intensive fish farms are provided with physical barriers (net or wire or even tent enclosures, see Figure 15.12) that prevent piscivorous birds gaining access to the fish. However, this required unexpected additional investments (hundreds of thousands of euros). At the moment, piscivorous bird predation is limited to few areas not yet protected with physical barriers.

An estimate of the economical impact of Cormorant predation

Very recently, the local administration of the Grosseto district commissioned research aimed at evaluating the impact of Cormorant predation on extensive aquaculture in the Lagoon of Orbetello (NEMO & TEMI 2004, Tables 15.1, 15.2). This research integrated, probably for the first time in Italy, both economical (total amount and species composition of annual fish-harvest, market price of different fish-species, cost for damage prevention) and ecological factors (bird numbers and diet, predator-prey relationships).

Predator / Fish prey	Cormorant	Other piscivorous birds	Piscivorous fish	Fishery	Total removed
Sea bass (commercial size)	0	0	0	0.289	0.289
Sea bass (not commercial size)	0.021	0.08	0.07	0	0.171
Eel	0	0	0	0.353	0.353
Sea bream (commercial size)	0	0	0	0.702	0.702
Sea bream (not commercial size)	0.01	0	0.211	0	0.221
Sand smelt	0.013	0.131	2.903	0	3.047
non commercial fish species	0	0.002	0.431	0.072	0.505
Grey mullets (commercial size)	0	0	0	0.452	0.452
Grey mullets (not commercial size)	0.028	0.117	2.173	1.154	3.472
Total	0.072	0.33	5.788	3.022	9.212

Table 15.1 Fish biomass removed (tonnes/km²) during the winter season by different predators and the fishery in the Orbetello lagoon according to ECOPATH simulations (After NEMO & TEMI 2004).

Fish species and size	Additional fish harvest with no cormorant predation	Average selling price (Euro/kg)	Average production cost (Euro/kg)	Economic loss due to predation (Euro)
Sea bass (large size)	0	10.25	8.42	0
Sea bass (small size)	12,291	10.25	8.42	22,480
Eel	140	5.97	4.90	149
Sea bream (large size)	0	7.60	6.24	0
Sea bream (small size)	23,879	7.60	6.24	32,381
Sand smelt	282	3.50	2.88	176
"Bottarga" (Mullets eggs)	18	180.00	100.00	1,429
Grey mullets (commercial size)	1,522	2.83	1.82	1,532
			Total	**58,147**

Table 15.2 Estimated economic loss due to Cormorant predation supported by the fishery in the Orbetello lagoon during the 2002-03 fishing season (After NEMO & TEMI 2004).

On the basis of the model assumptions, the ECOPATH model led to an estimated economic loss of 58,147 euro/year, i.e. 3.5% of the annual financial turnover.

15.1.3.4 Case study: River Serchio (Tuscany, Italy)

This section by Arianna Chines

Background

Since 1995, the basin of the Serchio, a small river in Northern Tuscany (Italy), hosts about 500 wintering Cormorants. On the basis of landscape and geographic features the Serchio Valley (Figure 15.13) can be subdivided into three main areas: (1) the Garfagnana Valley, the upper course of the river with mountains above 1800 m, (2) the Middle Valley, with an average altitude of 100 m, and (3) the Floodplain, extended from the plain around the city of Lucca (43°51'N; 10°31'E) westwards to the Tyrrhenian sea.

In the 19th century Cormorants only frequented the coast, in particular the Massaciuccoli Lake (Giglioli 1889) one of the major wetlands of Tuscany. In the 20th century there has been here a progressive increment of wintering cormorants and the creation of a big roost in the San Rossore Natural Park (Baccetti 1988) currently containing about 1,000 birds. Cormorants were first observed flying and feeding in the Serchio inner waters in autumn 1995. They daily reached the river in large groups (400-500 birds) from San Rossore, where they returned late in the afternoon. Nowadays, they regularly use the Serchio as a wintering site. They feed along the whole course of the river (about 100 km), in its main tributaries and in its hydroelectric lakes. The main feeding waters are populated by cyprinids (mainly Chub, Italian Barbel and a Roach species *Rutilus rubilio),* whereas the upper course and tributaries are characterised by the Brown Trout and the Soufie. Cormorants have established three main separate roosts/groups: the Floodplain population (max. N = 150), the Middle Valley population (max. N = 300), and the Garfagnana population (max. N = 150). Cormorant displacement towards the coast is limited to few tens of birds when the condition of the river is particularly adverse (i.e. water turbidity), but it confirms the tight link that exists between the San Rossore and Serchio populations. The arrival of the Cormorants immediately ignited the conflict between them and fisheries. Fishing activities are an important resource for the region: sporting fishing is the main attraction even for people from outside the region and the stocking of the endemic Mediterranean Brown Trout is of national relevance. Hence, the conflict has involved also fishponds and intensive aquaculture sites.

Management politics

The Province of Lucca, administratively competent for this issue, faced the problem in two phases. First, an evaluation of the impact (Chines & Cima 2001), which showed that Cormorants, even though their prey has low economic value (i.e. cyprinids), have an estimated intake of 22 tonnes of food a year (1999-2000). The analysis of the pellets showed cyprinids to be the commonest fishes in their diet. Second, a multidisciplinary project monitored wintering populations of Cormorants, to investigate the status of the natural fish stocks, for applying ecological fish-eating mitigation measures, and developed a dialogue among stakeholders.

The total biomass and the fish yield of the Serchio river are still to be precisely quantified. However, during the season 2003-2004 data on fish populations were collected using electric fishing at 3 sites in winter and at 5 in summer. They demonstrated that the amount of predation signs on fishes was very low (about 2%).

Moreover, the issue usually associated with fish-eating predators, namely the absence of fish from the middle-size ranges of the length-frequency distributions, were observed only in areas with a demonstrably poor habitat due to an excess of water exploitation and to artificial river banks without natural fish refuges. In more conserved areas, the populations of the main cyprinid species were large and well-structured.

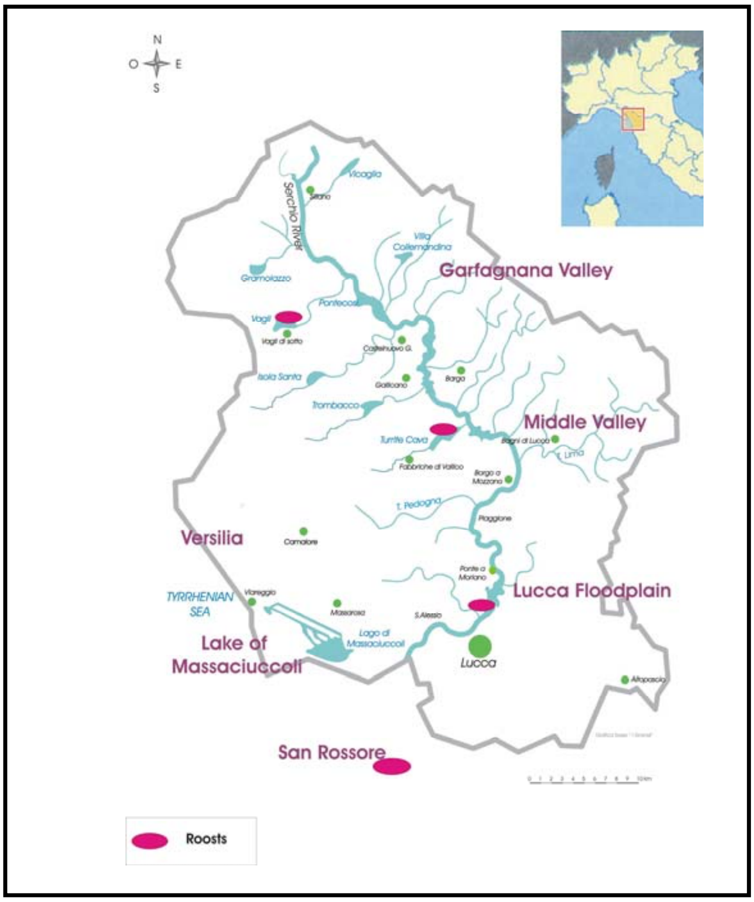


Figure 15.13 Map of the Serchio basin in the Province of Lucca (Tuscany, Italy).

An appropriate mitigation protocol fitting the hydrological and ecological specificities of the Serchio basin was applied last year (winter 2004). The techniques consisted mainly of visual (balloons, laser guns) and acoustic (gas bangers) scaring tools. Looking at the census data from 1997 to 2004 (Figure 15.14), it is apparent that the population of wintering Cormorants along the Serchio Valley has progressively grown since 2003 (most likely meaning that the carrying capacity has not been reached) before sharply decreasing by 42% in 2004.

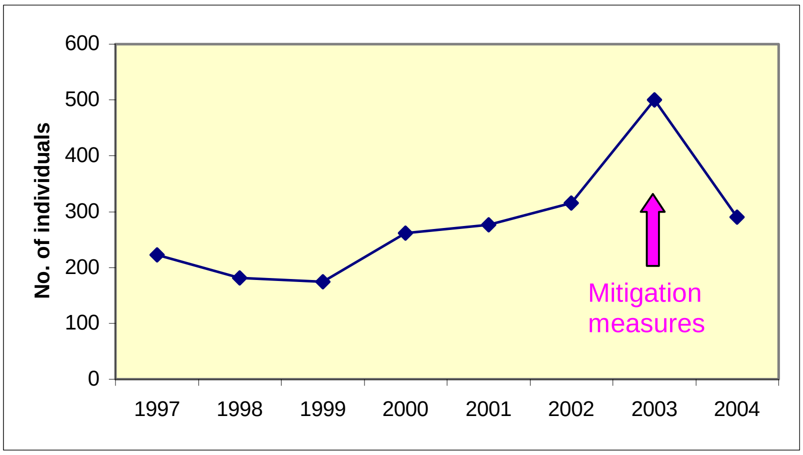


Figure 15.14 Cormorant wintering numbers in the Serchio Valley (trend 1997- 2004).

The dynamics of the Cormorant populations in Tuscany (Figure 15.15) and in the nearby roost of San Rossore (Figure 15.16) is more or less stationary and the fall in size along the Serchio did not follow a natural trend for Tuscan populations (data from COT – Centro Ornitologico Toscano). As previously described, the river has not suffered a decline in food resources. Moreover, during the last season there has been no other human disturbance, sites available for resting or roosting were not lost, nor were there adverse weather conditions.

Therefore, we can reasonably state that the most probable cause of Cormorant decline was the application of the mitigation strategies performed during the last wintering season. Success appeared to rely on two main issues. First, the geomorphological features of the Serchio basin, a narrow valley surrounded by high mountains, did not allow bird shifts out of the river guideline (NE–SW), that worked as a natural escape corridor. Second, the fruitful collaboration of a number of stakeholders, sometimes indispensable to daily updating data on such a long sampling area or to quickly identify the behavioural changes acting after each dissuading process (i.e. the forming of new smaller roosts).

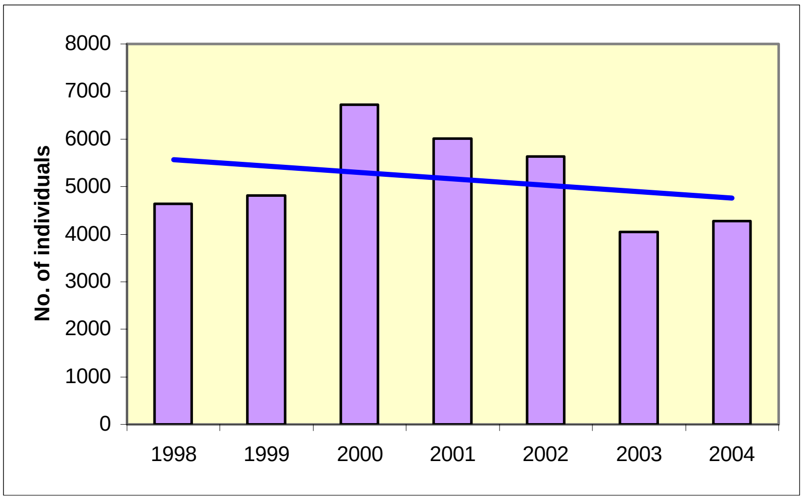


Figure 15.15 Cormorant wintering numbers in Tuscany (1998-2004).

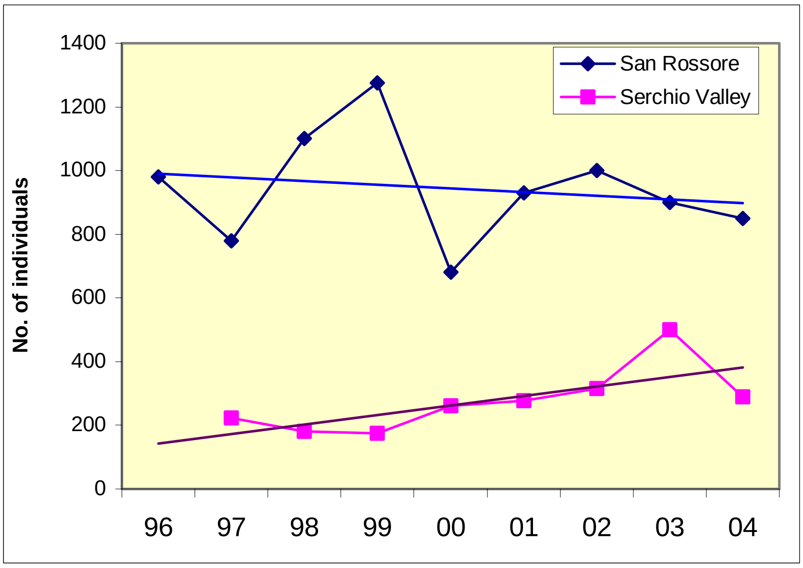


Figure 15.16 Cormorant wintering numbers in Serchio Valley and in San Rossore roosts (1996-2004).

Perspectives

The Serchio River project is still ongoing and the plans for the future include:

(i) monitoring Cormorants and other piscivorous birds
(ii) monitoring fish populations
(iii) assessment the ecological integrity of the river system
(iv) monitoring of biotic and abiotic factors in a larger number of water bodies (e.g. flow rates, water quality indexes, barriers for fish)
(v) a more integrated effort to manage the conflict (i.e. a better data flow between stakeholders)
(vi) application of the mitigation protocol elaborated to relevant cases

15.2 Cormorant conflicts with fisheries

Care must be taken when interpreting information provided in this section. Please refer to section 2.2.3 (*Methodological limitations and difficulties*).

15.2.1 Conflict site descriptions

Eighteen Cormorant conflicts were reported from Italy: on 8 coastal aquaculture systems (Laguna di Venezia, Laguna Grando e Marano, Valle San Leonardo, Valle Smarlacca, Laguna di Orbetello, Vale Bertuzzi, Comacchio Lagoons, and fishing valli in the northern Po Delta), 4 coasts (Lago di Monici, Lago di Fogliano, Lago di Caprolace, and Oristano lagoons), 3 rivers (River Po, River Adda & Mera, and River Adda & Ticino), 2 lakes (Lake Trasimeno and angling ponds in Lombardia, Milano, Cassano d'Adda) and 1 freshwater aquaculture pond system (Lombardia, Milano, Cassano d'Adda) (Table 15.3).

15.2.2 Birds and fish

In Italy, Cormorants reported to be involved in conflicts were *P.c. sinensis*. Reported Cormorant densities were 0.17 and 5.26 birds ha^{-1} for the two lake cases and 666.67 birds ha^{-1} for the single freshwater aquaculture pond system. Ten species of fish were recorded in conflict with Cormorants in 3 river cases, 8 species in 2 lake cases, 1 in the single freshwater aquaculture pond case, and 6 species in 8 extensive coastal aquaculture cases (Table 15.4).

Habitat	**Feature**	**Category**		
	Reach	**Upper**	**Middle**	**Lower**
Rivers	N = 2 cases	1	1	
	Width (m)	**< 10m**	**10-50m**	**50-100m**
Rivers	N = 2 cases	1	1	
	Altitude (m)	**< 100m**	**100-500m**	**500+m**
Rivers	N = 3 cases	2	1	
Lakes	N = 3 cases	2	1	
	Trophic status	**Oligotrophic**	**Mesotrophic**	**Eutrophic**
Rivers	N = 3 cases	2	1	
Lakes	N = 3 cases		2	1
Coasts	N = 11 cases	1	4	6
	Anthropogenic Influence	**Natural**	**Semi-natural**	**Artificial**
Rivers	N = 3 cases	3		
Lakes	N = 3 cases	1	1	1
Coasts	N = 12 cases	4	8	

Table 15.3 The number of Cormorant conflict cases reported from Italy in relation to habitat and habitat features.

15.2.3 Seasonality

Cormorant conflicts in Italy were reported to occur in winter (i.e. Sep-Mar).

Month of conflict												
COUNTRY	J	F	M	A	M	J	J	A	S	O	N	D
Italy	■	■	■						■	■	■	■

15.2.4 Finance

Financial information on the ‘costs’ of Cormorant predation was reported for 3 extensive coastal aquaculture cases and 1 lake case. 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. It was requested that the values provided be categorised as either ‘actual’ or ‘estimated’. The information provided for Italian cases was estimated. Based on the 3 extensive aquaculture cases, average estimated turnover was 1,735,000 euro and average estimated loss was 230,333 euro (13% of turnover) and estimated turnover for the single commercial lake fishery case was reported at 1,047,374 euro and estimated loss was 130,000 euro (12% of turnover).

Species	Frequency (% of cases)			
	Rivers (3 cases)	**Lakes (2)**	**F/w aq ponds (1)**	**Coastal aq (8)**
Chub	67	50		
Savetta	67			
S. European Nase	33			
Italian Barbel	33			
Grayling	33			
Salmonid spp.	33	50		
Pike	33	50		
Soufie	33			
Danube Roach	33			
Bleak	33			
Perch		100		
Tench		50		
Eel		50	100	88
Black Bullhead		50		
Carp		50		
Mullet spp.				100
Bass				100
Gilthead Sea Bream				62
Big-scale Sand-smelt				38
Sole				5

Table 15.4 Fish species reported to be involved in conflicts with Cormorants in 14 cases from Italian waters.

15.2.5 Conflict issues: magnitude of conflict

Cormorant conflicts with aquaculture stakeholders on coasts (n = 8 cases) were the most frequently reported (n = 17 issues) in Italy. Both nature conservationist and commercial fisheries stakeholders also reported conflicts here, citing 16 and 12 issues, respectively (Table 15.5).

15.2.6 Conflict issues: status of information used by stakeholders

Overall, stakeholders provided 392 records of the status of the information they used to inform themselves about Cormorant conflict issues in Italy. The highest proportion of records (61%) was for 'popular' articles, followed by 'grey literature' (34%) and 'scientific literature' (5%). Overall, there were differences in the use of popular, grey and scientific literature sources between the 4 stakeholder groups providing information (Table 15.6).

15.3 Potential Cormorant management tools

Information (summarised in the following tables) was provided on (1) general actions taken against Cormorants in Italy, (2) management plans/legal regulations, (3) actions at breeding sites, (4) at roosts, (5) at large rivers, (6) at small stillwaters, (7) at very large water bodies, and (8) at aquaculture sites.

Status of information	Stakeholder group			
	Recreational	**Commercial**	**Aquaculture**	**Nature conservation**
Popular	37.3%	84.6%	53.5%	95.6%
Grey literature	62.7%	12.8%	37.8%	4.4%
Scientific literature	-	2.6%	8.6%	-
Total no. records (= 100%)	**83**	**78**	**185**	**46**

Table 15.6 Categorisation of the status of information used by stakeholders to inform themselves about Cormorant conflict issues. Recreational fisheries stakeholders used more grey literature and less popular literature than expected, commercial fisheries stakeholders used less grey literature and more popular literature than expected ($X^2 = 81.444$, df = 6, $P < 0.001$).

15.4 Stakeholders consulted

(1) Regione Toscana, Assessorato Agricoltura, Foreste, Caccia e Pesca, Via di Novoli, 26, 50127 Firenze FI, Italia.
(2) Provincia di Ravenna, Assessorato Ambiente, Piazza Caduti 2/4, 48100 Ravenna RA, Italia.
(3) Regione Sardegna, Settore Caccia e Pesca, Via Biasi, 7/9, 09131 Cagliari CA, Italia.
(4) Provincia di Belluno, Ufficio Caccia e Pesca, Via S. Andrea, 5, 32100 Belluno BL, Italia.
(5) Provincia di Bolzano, Ufficio Caccia e Pesca, Via Crispi 3, 39100 BZ, Italia.
(6) Provincia di Cagliari, Ufficio Caccia e Pesca, Via F. Ciusa 19, 09131 Cagliari CA, Italia.
(7) Provincia di Ferrara, Ufficio Caccia e Pesca, Via Bologna, 534, 44100 Ferrara FE, Italia.
(8) Provincia di Gorizia, Ufficio Caccia e Pesca, Corso Italia, 55, 34170 Gorizia GO, Italia.
(9) Provincia di Grosseto, Via Trieste, 5, Ufficio Caccia e Pesca, 58100 Grosseto GR, Italia.
(10) Provincia di Livorno, Ufficio Caccia e Pesca, Via Grande,110 Livorno LI, Italia
(11) Provincia di Lucca, Ufficio Caccia e Pesca, Via Barsanti e Matteucci - Borgo Giannotti, 55100 Lucca, Italia.
(12) Provincia di Milano, Assessorato Caccia, Pesca e Polizia provinciale, Viale Piceno, 60, 20129 Milano, Italia.
(13) Provincia di Novara, Ufficio Caccia e Pesca, Piazza Matteotti, 1, 28100 Novara NO, Italia.
(14) Provincia di Grosseto, Settore Sviluppo E Tutela Del Territorio, Via Trieste, 5, 58100 Grosseto, Italia.
(15) Provincia di Oristano, Ufficio Caccia e Pesca, Via Mattei, 09170 Oristano OR, Italia.
(16) Provincia di Pavia, Ufficio Caccia e Pesca, Piazza Italia, 2, 27100 Pavia PV, Italia.
(17) Provincia di Perugia, Ufficio Caccia e Pesca, Piazza Italia, 11, 06100- Perugia, Italia.
(18) Provincia di Pisa, Ufficio Caccia e Pesca, Piazza Vittorio Emanuele II, 14, 56125 Pisa PI, Italia.
(19) Provincia di Ravenna, Ufficio Caccia e Pesca, Piazza Caduti 2/4, 48100 Ravenna RA, Italia.
(20) Provincia di Rovigo, Ufficio Caccia e Pesca, Via Celio 10, 45100 Rovigo RO, Italia.
(21) Provincia di Sondrio, Ufficio Caccia e Pesca, Via XXV Aprile, 22, 23100 Sondrio SO, Italia.
(22) Provincia di Torino, Ufficio Caccia e Pesca, Via Maria Vittoria, 12, 10123 Torino TO, Italia.
(23) Provincia di Trento, Ufficio Caccia e Pesca, Piazza Dante, 15, 38100 Trento TN, Italia.
(24) Provincia di Trieste, Ufficio Caccia e Pesca, Piazza Vittorio Veneto, 4, 34132 Trieste TS, Italia.
(25) Provincia di Udine, Ufficio Caccia e Pesca, Piazza Patriarcato, 3, 33100 Udine UD, Italia.
(26) Provincia di Varese, Ufficio Caccia e Pesca, Piazza Libertà, 1, 21100 Varese VA, Italia.
(27) Provincia di Vercelli, Servizio Tutela Fauna Selvatica, Caccia e Pesca, Piazza Mazzini, Vercelli, Italia.
(28) Provincia di Venezia, Ufficio Caccia e Pesca, Rampa Cavalcavia, 31, 30172 Mestre Venezia, Italia.
(29) Regione Veneto, Segreteria Regionale al Settore Primario, Via Torino, 110, 30172 Mestre VE, Italia.
(30) Regione del Friuli-Venezia Giulia, Ufficio Caccia e Pesca, Piazza Unità d'Italia, 1, 34121 Trieste TS, Italia.
(31) Ente Produttori Selvaggina, Via Monteverdi 15, 30173 Venezia-Mestre VE, Italia.
(32) Arci Pesca – Fisa, Via Pescosolido, 76, 00158 Roma RM, Italia.
(33) Associazione Piscicoltori Italiani, Viale Del Lavoro, 8, 37135 Verona, Italia.

Conflict issue	Not claimed/not applicable	No impact	Minor effect	Major effect
(1) FISHERIES				
Reduced catch			1 [1]	7 (1)
Loss of stocked fish			4 [1]	4 (1)
Reduced value of catch (damage)		1	6 (1)	
Removal of fish from nets		1 (1)		
Damage to fishing gear		1 (1)		
Reduced catchability (stress/behaviour)		[1]	4	4 (1)
Loss of earnings from the fishery			2 (1) [1]	6
Reduced capital values of fisheries			4 (1) [1]	4
Increased recurrent costs		1 [1]	6 (1)	1
Loss of employment			1 (1)	3
(2) FISH STOCKS				
Reduced stock - lowered production			5 [1]	1
Threats to endangered fishes			(1)	
Vectors of diseases/parasites		1 [1]	1 (1)	
Loss of juvenile fish - lowered recruitment			1	4
Loss of aquaculture stock			1 [1]	1
(3) ENVIRONMENTAL				
Eutrophication		[1]		
Interactions with other birds		[1]	1	
Scaring/shooting disturbance				4 [1]
Lead contamination (birds/environment)		[1]		
Landscape alteration			1 [1]	1
Drowning in fishing gear			[1]	
Damage to vegetation/landscape			[1]	1

Table 15.5 Cormorant conflict issues as recorded by aquaculture stakeholders (n = 8), commercial fisheries stakeholders (n = 1, round brackets), and nature conservation stakeholders [n = 1, square brackets] for extensive Italian coastal aquaculture sites (N = 8 cases). Each figure is the number of times a particular issue was cited by stakeholders.

NAME OF RESPONDENT AND YOUR AFFILIATION Stefano Volponi

COUNTRY

REGION / PROVINCE / etc. (if applicable)

Period which is concerned [year(s)]

General information on actions against Cormorants in Italy (annual numbers)

	Total numbers		Regional numbers									
	National numbers	**Count/Estimate?**	**Province of Ravenna**	**Province of Ferrara**	**Province of Rovigo**	**Province of Venezia**	**Province of Padova**	**Province of Belluno**	**Region Veneto**	**Region Friuli Venezia-Giulia**	**Region Sardegna**	**Province of Sondrio**
Number of breeding colonies destroyed or disturbed	5	C/E	0	2 of 3	2 (new breeding attempt)	2 (in 2000)					0	
Number of nests destroyed	< 100	C/E	0	200 in 2000	0	< 100					0	
Number of nestlings killed	0		0	0	0	0					0	
Number of adults killed in the non-breeding season	?	C/E	250	30 in 1999	official numbers: winter 99/00 n. 104; winter 00/01 n. 139; winter 01/02 n. 102	500-1000 (y 2001)	123 in winter 1999/2000	80 in winter 2001/02	?	10 (for diet study in 1999)	About 1000 in 1995. Unknow figures for following years but allowed shooting of up to 10% wintering numbers	63 (in late winter 2000)
Is there any killing of breeding adults?	?		N	N	N	Y			N		N	
Number of night roosts destroyed or disturbed	?		0	1	7	?		1		0	3	

Management plans / legal regulations	Total country	Province of Ravenna	Province of Ferrara	Province of Rovigo	Province of Venezia	Padova	Province of Belluno	Veneto	Region Friuli Venezia-Giulia	Region Sardegna	Province of Sondrio
Are there any management plans in effect? Please list all national or regional plans and give details		Y	Y	Y	Y			Y	N	Y	Y
Are there any regulations in effect that allow Cormorant culling? Please list all national or regional regulations and give details		Y	Y	Y	Y		Y	Y	N	Y	
Are there any coordinated culling programmes in your country?		N	N	N	N		N	N	N	Y	
Is it mandatory to obtain single permits for Cormorant killing?		Y	Y	N	N		N	N	Y	Y	
Has a general permit for Cormorant killing been issued?		N	N	Y	Y		Y	Y	N	?	
Is there any financial compensation for fish losses?		Y	Y	Y	Y		N	Y	N	Y	
Is there any financial aid for the construction of Cormorant exclosures or for scaring programmes, etc.?		N	N	N	N						

Remarks (on General information & on Management plans /legal regulations):

Province of Ravenna (Emilia-Romagna)
An experimental management plan has been elaborated since the winter 1995/96 for reducing cormorant damage in extensive aquaculture (vallicoltura) areas
The latest version of the plan:
- suggests the use of physical means to protect aquaculture facilities (orizontal nets with mesh 20x20 cm; vertical nets spaced 10 m or wire spaced 5 m along canals);
- allows shooting to reinforce non-lethal means from September to March (included)
- allows nest destruction to avoid foundation of new colonies and hinder cormorants from breeding in aquaculture areas

Province of Ferrara (Emilia-Romagna)
A management plan has been elaborated since the winter 1998/99 for reducing cormorant damage in extensive aquaculture (vallicoltura) areas.
The latest version of the plan:
- suggests the use of physical means to protect aquaculture facilities (orizontal nets with mesh 20x20 cm; vertical nets spaced 10 m or wire spaced 5 m along canals);
- allows shooting to reinforce non-lethal means from December to March (included);
- allows nest destruction to avoid foundation of new colonies in the whole province and hinder cormorants from breeding in the aquaculture areas

Province of Rovigo (Veneto)
A 3 years integrated management plan has been carried otu Provincia di Rovigo (from winter 1999/2000 to 2001/2002)
The plan:
- a regular roost harassment by non-lethal visual (laser light) and sound device (firework, blank shooting) sometimes reinforced by lethal shooting in the whole Northern Po Delta interested by extesive aquaculture;
- promote protection by physical means (nets and wire) of the fishing and fishstocking areas inside the aquaculture facilities;
- cormorant shooting as reinforcement of non-lethal techniques in physically protected areas and as deterrent in large basin
- prevention of colony settlement in the aquaculture area by patrolling and bird scaring at winter roost sites during the spring

Provincia di Venezia (Veneto)
A management plan was elaborated for the control of cormorant damage at extensive aquaculture area in Lagoon of Venice and Caorle during the winters 1999/2000 and 2000/01. A new version has been proposed in the autumn 2001. The latest version considers:
- promote the protection by physical means (horizontal nets with mesh 20x20 cm; vertical nets spaced 10 m or wire spaced 5 m along canals) of the fishing and fishstocking areas inside the aquaculture facilities;
- allows permanent cormraont shooting with any limitation of numbers all year round at the aquaculture facilities;
- allows nest/egg destruction inside aquaculture areas

Regione Veneto
A new regional regulation (L.R. n. 7, 14/03/2002) on the basis of the art. 9/1/a Directive n. 79/409/CEE allows hunters to shoot up to 10 cormorant day (maximum number(hunter in the hunting season is 50 birds) from late September to the end of December.

Province of Belluno (Veneto)
Since the winter 1999/2000 it has been carried out some shooting of cormraont feeding in the river Piave. Overall less than 150 birds have been shot so far.

Province of Sondrio (Lombardia)
To reduce cormorant predation on salmonids in the river Adda and Mera, since the winters 1999/2000-01 the local administration allowed the shooting of about 30% (i.e. about 50 birds) of the wintering numbers.

Province of Oristano (Sardegna)
On 15/11/1999 the Ministry for Agriculture and Forestry recognised the "state of exceptional natural disaster" and allowed reimbursemet caused by heavy cormorant predation in the Lagoon of Cabras (Oristano) during the period November 95 - March 1996.
At that time some less than 1000 birds were shot.
Since then, every winter local administration may allow shooting of up to the 10% of the wintering numbers to reduce impact on aquaculture and commercial fisheries in coastal lagoons

NAME OF RESPONDENT AND YOUR AFFILIATION	**Stefano Volponi**							
COUNTRY	**Italy**							
REGION / PROVINCE / etc. (if applicable)	**Emilia-Romagna, Veneto**							
Period which is concerned [year(s)]	**1993-2002**							
A. Breeding Sites								
Cormorant Damage Control Activities								
1. Avoid foundation of new colonies	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Scaring by use of live ammunition	regularly	months	1	2	4	Northern Po Delta		1,
Shooting some adults to reinforce scaring	regularly	months	1	3	4	Lagoon of Venice	Sometimes affects pygmy cormorant which roost/breed in same area as cormorant and are not recognised as a different species by most fish-farmers	
Pyrotechnics / Fireworks	regularly	months	3/5	3 / 4	4	Northern Po Delta		1,
Laser light	rarely	days	1	2	2	Northern Po Delta		1,
Scaring by human presence	regularly	days	5	2/5	5	Po Delta		1,
Removal of nests	regularly	months	3/5	2/4	2	Po Delta, Ostellato ponds, Lagoon of Venice	Establishment of the first breeding in the Po Delta (1993) was discouraged by nest removal. The site, regularly used as roost during the winter, was reoccupied by an increasing number of pair the following breeding seasons and used until the trees were cut.	2, 3
2. Existing colonies: Hinder cormorants from breeding	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Removal of trees	regularly	years	4	4	2	Southern Po Delta (Valle Bertuzzi)	The colony, established in a private property in 1993, was completely destroyed in 2000 (by nest removal); a further new refondation has been hindered by tree cutting. Then new small trees were planted.	2,
Scaring by use of live ammunition	regularly	months	1			Northern Po Delta, Lagoon of Venice		
Shooting some adults to reinforce scaring	regularly	months	1	3	4	Lagoon of Venice	Sometimes effected pygmy cormorant which roost and breed in the same area as cormorant and are not recognised as a different species by most of the fish-farmers	
Laser light	rarely	not efficient	3	5	2	Lagoon of Venice	tested in spring 2001	A. Costato, Province of Rovigo, pers. comm.
Scaring by human presence	rarely	days	5	4		Southern Po Delta (Valle Bertuzzi)		S. Volponi unpublished data
3. Existing colonies: Reduce breeding success	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Removal of nests	rarely	medium	3 / 5	4 / 5	2	Po Delta	In 2000 destruction of 190 nests resulted in a later nesting by 90 pairs which raised a larger brood maybe due to a release in food competition	S. Volponi unpublished data

1) Volponi S. 2001. Il piano sperimentale per la riduzione dell'impatto di predazione indotto dai cormorano svernanti nel Delta del Po veneto. In: M. Bon & F. Scarton, Atti 3° Convegno Faunisti Veneti. Boll. Mus. Civ. St. Nat. Venezia, suppl. vol. 51(2000) v 52-61.

2) Volponi S. 1999. Reproduction of a Newly-established Population of the Great Cormorant in Northeastern Italy. Waterbirds, 22(2): 263-273.

Altri riferimenti in Serra L. & Brichetti P. 2001. Uccelli rari. Avocetta.

NAME OF RESPONDENT AND YOUR AFFILIATION	**Stefano Volponi**							
COUNTRY	**Italy**							
REGION / PROVINCE / etc. (if applicable)	**Emilia-Romagna, Veneto, Sardinia, Trentino Alt**							
Period which is concerned [year(s)]	**1995-2002**							
B. Roosting Sites								
Cormorant Damage Control Activities								
1. Avoid foundation of new roost sites	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Scaring by use of live ammunition	regularly	days	2 / 5	3		Northern Po Delta, Alto Adige		
Shooting some birds to reinforce scaring	rarely	days	2 / 5	4		As above		
Pyrotechnics / Fireworks	regularly	days	2 / 5					
Other audio frightening techniques	rarely	days	4 / 5			Trials carried out in the Southern Po delta (Valle Bertuzzi)		Volponi & Rossi 1998
Intense light	rarely	not efficient	5			As above		
Laser light	regularly	days	1 / 3	1	2	Northern Po Delta,		
Scaring by human presence	rarely	not efficient	5	4 / 5	2			
Other visual frightening techniques								
Combination of audio and visual techniques	rarely	days	4 / 5			Trials carried out in the Southern Po delta (Valle Bertuzzi)		
Shooting	regularly	months	3 / 5	4	2			
2. Existing roost sites: Hinder cormorants from roost	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Removal of trees	rarely	years						
Scaring by use of live ammunition	regularly	days						
Shooting some birds to reinforce scaring	rarely	days					the results strongly depend on the availability of alternative roosting sites	
Gas bangers / cannons (propane gas exploders)	rarely	not efficient						
Pyrotechnics / Fireworks	regularly	days						
Other audio frightening techniques								
Simple scarecrows	rarely	not efficient						
Laser light	regularly	days						
Scaring by human presence	rarely	not efficient						
Other visual frightening techniques								
Combination of audio and visual techniques	regularly	days						
Other (please specify)								
Electronic guards (devices that produce artificial noises)								
Shooting	regularly	days					as above	

Volponi S. & Rossi R. 1998. Predazione degli uccelli ittiofagi in acquacoltura estensiva: valutazione dell'impatto e sperimentazione di mezzi di dissuasione incruenta. Biologia Marina Mediterranea, 5(3): 1375-1384.

Volponi S. 2001. Il piano sperimentale per la riduzione dell'impatto di predazione indotto dai cormorano svernanti nel Delta del Po veneto. In: M. Bon & F. Scarton, Atti 3° Convegno Faunisti Veneti. Boll. Mus. Civ. St. Nat. Venezia, suppl. vol. 51(2000): 52-61.

NAME OF RESPONDENT AND YOUR AFFILIATION	**Stefano Volponi**
COUNTRY	**Italy**
REGION / PROVINCE / etc. (if applicable)	**Province of Sondrio**
Period which is concerned [year(s)]	**2000-2002**
C. Feeding Sites	
C2. Large Rivers (Width > 100 m)	

Cormorant Damage Control Activities							
3.2 Lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**
Shooting adults and immatures							
to reduce bird numbers at specific sites	regularly	days / not efficeint				Rivers Adda and Mera	Shooting has been allowed to reduce predation on Salmonids; cormorants roost elsewhere but still forage in the area subjected to cormorant control.

NAME OF RESPONDENT AND YOUR AFFILIATION	**Stefano Volponi**
COUNTRY	**Italy**
REGION / PROVINCE / etc. (if applicable)	**Small ponds for angling in different regions in N-Italy (Emilia-Romagna, Lombardia, Veneto)**
Period which is concerned [year(s)]	**2000-2002**
C. Feeding Sites	
C3. Small Still Waters (< 100 ha); not aquaculture	

Cormorant Damage Control Activities						
3. Wildlife Management						
3.1 Non-lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**
Human harassment						
Human patrol on foot or in vehicles	regularly	days				
Gas bangers / cannons (propane gas exploders)	regularly	not efficient / days				
Pyrotechnics / Fireworks (shell crackers, screamers, whistling projectiles, exploding projectiles, bird bangers, flash/detonation cartridges)	regularly	not efficient / days				
Visual frightening techniques						
Simple human effigies or scarecrows	regularly	not efficient / days				

NAME OF RESPONDENT AND YOUR AFFILIATION	**Stefano Volponi**
COUNTRY	**Italy**
REGION / PROVINCE / etc. (if applicable)	**Sardinia**
Period which is concerned [year(s)]	**1995-2000**

C. Feeding Sites
C4. Very Large Waterbodies (Still Waters and Coastal Waters)

Cormorant Damage Control Activities								
3. Wildlife Management								
3.1 Non-lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Human harassment								
Human patrol on foot or in vehicles	regularly	hours, days	3 / 5	3 / 4	1 / 3	Oristano lagoons	In large basins patrolling is mainly carried out by motor boat	
Audio frightening techniques								
Electronic guards (devices that produce artificial noises)	trials	not efficient						S. Volponi unpublished data, Volponi & Rossi 1998
Gas bangers / cannons (propane gas exploders)	rarely	not efficient						
to reduce bird numbers at specific sites	regularly	days	2 / 3	5	3	Oristano lagoons	The effect on the cormorant numbers strongly depends wheter the cormorant population is open or closed. In the first case, any effect shewed to be partial and limited in time.	Baccetti 1996, Volponi & Addis (Vogelwelt in press)
to reduce regional population levels	regularly	days / months		5	1 /2	Oristano lagoons	see above	see above

Baccetti N. 1996. Mass kills of Great cormorants Phalacrocorax carbo in western Sardinia. Cormorant Research Group Bulletin, 2:36-38

Volponi S. & Rossi R. 1998. Predazione degli uccelli ittiofagi in acquacoltura estensiva: valutazione dell'impatto e sperimentazione di mezzi di dissuasione incruenta. Biologia Marina Mediterranea, 5(3): 1375-1384.

Volponi S. & Addis P. 2002. Development of Great cormorant populations in two key Italian wintering areas. Vogelwelt, 123(Suppl.): .

NAME OF RESPONDENT AND YOUR AFFILIATION	**Stefano Volponi**
COUNTRY	**Italy**
REGION / PROVINCE / etc. (if applicable)	**Emilia-Romagna, Veneto, Friuli Venezia-Giulia, Toscana**
Period which is concerned [year(s)]	**1995-2002**
C. Feeding Sites	
C5. Aquaculture	**Vallicoltura** - extensive aquaculture in coastal brackish waters (for a detailed description see Ardizzone et al. 1988)

Cormorant Damage Control Activities							
1. Resource Management	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**
Fish management							
Altering fish stocking regimes. Please give details!!!							
(a) timing	rarely	yes	3 / 4	1	5	Po Delta	At the end of the wintering season, fishes stocked at high density in protected basins (nets, etc.) are released later in the spring where wintering/migrating cormorants are less abundant.
(c) density	not used	not known	4 / 5				Fish density and fish size are managed according to many and very different aquaculture needs; changes may be difficult or not possible to be carried out.
(d) stocked fish sizes	not used	not known	4 / 5				as above
Locating most susceptible fish species and size close to the centre of human activity or near buildings	regularly	not efficient	3 / 4			Po Delta, Lagoon of Venice	Fishing gears and fish wintering basins are often located close to buildings and areas used by humans; however cormorants are not discouraged from foraging if active means are not used (blank shoots, shooting, human patrolling, etc).
Use/management of feeding ponds to attract Cormorants (i.e. to distract them away from production ponds)	not used		4 / 5	3			In areas with open cormorant populations the creation of new feeding areas or providing additional prey would have the effect of attract more birds; this management option would only work if/where all the productive areas are/can be physically protected. Practically this technique is similar to what happened in the N. Po Delta where cormorants were dissuaded to forage in the aquaculture areas (by non-lethal and lethal means) but were left feeding in non-commercially exploited waters.
Facility construction							
Design / construction (of an aquaculture facility)	not used						Estensive aquaculture (vallicoltura) is low impact activity involving a very little level of habitat management (mostly devoted to maintaining water exchange between productive basins and the sea).
Choice of / change of the location of an aquaculture facility/ponds	not used						Estensive aquaculture (vallicoltura) is an ancient and low impact activity traditionally carried out only in specific geographic areas (coastal lagoons) and habitats (shallow brackish waters).
2. Bird-proof barriers (overhead barriers and peripheral fencing/netting)	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**
Physical exclosures with narrow meshed systems (mesh sizes < 20 cm) using wire, lines or string in parallel or grid patterns	regularly	years	3 / 5	3	2		100% success if the enclosures cover all the water basin surface, otherways some cormorant has proven to be able to enter and forage. May have some impact on other bird species (piscivorous and not such as gull, coot, moorhen, herons) that become entangled in the net while trying to access to the water basins. Sometimes nets may cause high visual impact. Workers report a difficulties in accessing the water basins for management.
Wire, lines or string in grid patterns (5 m mesh size)	regularly	days	3 / 4	3	4		Cormorants may rather quickly learn how to enter the system and forage on prey stocked at high densities. Some results in discouraging social and mass feeding.
Wire, lines or string in grid patterns (7,5 m mesh size)	regularly	days	3 / 4	3	4		As above
Wire, lines or string in grid patterns (10 m mesh size)	regularly	days	3 / 4	3	4		As above
Partial exclosures (narrow meshed)	regularly	months	3 / 5	3	2/4		Usefull to reduce mass fishing, but some cormorant may quickly learn how to enter the system and easily forage; some non-lethal harassement mean or better shooting is then used as reinforcement
Coloured streamers to increase visibility of wires and stri	rarely	days	2	2	4		
complete enclosures (nets about 20 cm mesh size)	rarely	years	3 / 5	3	1 / 2	Po delta, Lagoon of Venice	Used for small winter basin and sometimes for canal leading to fishing gear where high value fish (e.g. sea-bream) is stocked for wintering at very high densities
vertical nets in parallel patterns (set 5-10 m apart)	regularly	days	2 / 3	3	3 / 4	Po delta, Lagoon of Venice	Used for discourage cormorant access to canals connecting large growth basins and small basins used for fish wintering and stocking.

NAME OF RESPONDENT AND YOUR AFFILIATION	Stefano Volponi						
COUNTRY	Italy						
REGION / PROVINCE / etc. (if applicable)	Emilia-Romagna, Veneto, Friuli Venezia-Giulia, Toscana						
Period which is concerned [year(s)]	1995-2002						
C. Feeding Sites							
C5. Aquaculture - continued	**Vallicoltura** - extensive aquaculture in coastal brackish waters (for a detailed description see Ardizzone et al. 1988)						
Cormorant Damage Control Activities							
3. Wildlife Management							
3.1 Non-lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**
Human harassment							
Human patrol on foot or in vehicles	regularly	hours	3 / 5	3 / 4	1 / 3	Widespread	In large basins used for vallicolture patrolling is carried out also by motor boat
Audio frightening techniques							
Bioacoustics (i.e. Cormorant distress calls, raptor vocalizations, etc.)	rarely	not effcient	3 / 5	2	1 / 3	Tested in the southern Po Delta (years)	Not useful to protect from predation: it has to be considered that cormorants forage approaching and pursuing fish swimming underwater where sounds can not be diffused efficiently.
Electronic guards (devices that produce artificial noises)	rarely	not effcient	4 / 5	4 / 5	1 / 3	Tested in the southern Po Delta and Sardinia (years)	As bioacustics artificial sounds and noises do not effect cormorant swimming underwater; moreover they have proven to effect negatively the behaviour of the stocked fish (e.g. during hybernation in winter) or result uncorfortable for people working or living in the area
Sirens	rarely	not effcient	1/5	4 / 5	4	Tested almost everywhere	Its use limited to small basins located; the sounds may negatively effect other not target species as well as workers and inhabitants.
Vehicle horns	rarely	not effcient	1/5	4 / 5	4	Tested almost everywhere	as above
Gas bangers / cannons (propane gas exploders)	regularly	days			4		as above
Pyrotechnics / Fireworks (shell crackers, screamers, whistling projectiles, exploding projectiles, bird bangers, flash/detonation cartridges)	rarely	hours, days	2 / 5	3 / 5	2 / 3	Po Delta	Pyrotecnics and other heavy sound devices which are manually activated can be used only for short time and specific situations (social fishing, areas close to buildings an/or roads); as other not selective frightening means the effect other bird fauna and are unacceptable where wildfowl hunting is carried out
Live ammunition	regularly	days	1/5	3 / 5	2 / 3	Widespread	Commonly used also to replace firework; at least in Italy the use of fireworks, powerful enough to have some deterrent effect, on cormraonts is restricted and required a special licence and a insurance; this greatly limits the possibility of a wide use of fireworks. Use of Live ammunitions is more widespread because hunting is very popular and most of the fish-farmer or their workers have a hunting licence.
Visual frightening techniques							
Simple human effigies or scarecrows	regularly	days	5	1	4	Widespread	
Parked vehicles							
Raptor silhouettes	rarely	not efficient	3 / 4	1	4	Val Cantone (southern Po Delta)	
Mylar tape	regularly	days	2 / 5	3	4 / 5		Mylar is short lasting and broken very easily in bad weather condition. Maybe a cause of visual and water pollution.
Laser light	rarely	not efficient	1 / 3	1	2	Northern Po delta	Laser may be efficient only at darkness or low level of light; it is completely useless with fog or heavy rain.
3.2 Lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**
Shooting adults and immatures							
to reinforce non-lethal harassment	regularly	days	2	2 / 3	4 / 5	Po Delta, Lagoon of Venice, Lagoon of Grado	
to reduce bird numbers at specific sites	regularly	days	2 / 3	5	3	Southern Po Delta, Oristano lagoons, Lagoon of Venice	The effect on the cormorant numbers strongly depends wheter the cormorant population is open or closed. In the first case, any effect shewed to be partial and limited in time.
to reduce regional population levels	regularly	days / months		5	1 /2	Oristano lagoons	see above

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(35) Federazione Italiana Pesca Sportiva, Viale Tiziano 70, 00196 Roma RM, Italia.
(36) Federcopesca, Via De' Gigli D'oro, 21, 00186 Roma RM, Italia.
(37) Lega Pesca, Via Nazionale, 243, 00184 Roma RM, Italia.
(38) Società Bonifica Terreni Ferraresi, Via Cavour, 44100 Ferrara FE, Italia.
(39) Dott. Alberto Giol, Valle San Leonardo, Porto Viro RO, Italia.
(40) Unione Pesca Sportiva, Via Fiume 85, 23100 Sondrio, Italia.
(41) Miraaf, Direzione Generale Pesca e Acquacultura, Via dell'Arte,16, 00144 Roma, Italia.
(42) Istituto Nazionale Fauna Selvatica, Via Ca' Fornacetta 9, 40064 , Ozzano Emilia BO, Italia.
(43) Consorzio Parco Lombardo della Valle del Ticino, Via Isonzo, 1, 20013 Ponte Vecchio di Magenta MI, Italia.
(44) Consorzio Parco regionale Delta del Po, Via Cavour, 44022 Comacchio FE, Italia.
(45) Ente Parchi e delle riserve naturali del Lago Maggiore, via Gattico, 6, 28040 Mercurago di Arona NO, Italia.
(46) Ente Parco fluviale fiume Po tratto Vercellese/Alessandrino, Piazza Giovanni XIII n. 6,15048 Valenza AL, Italia.
(47) Ente Parco Naturale del Fiume Sile, Via Tandura, 40, 31100 Treviso, Italia.
(48) Ente Parco Naturale della Valle del Ticino, Villa Picchetta, 28062 Cameri NO, Italia.
(49) Parco Naturale delle Lame del Sesia, Via XX Settembre, 12, 13030 Albano Vercellese VC, Italia.

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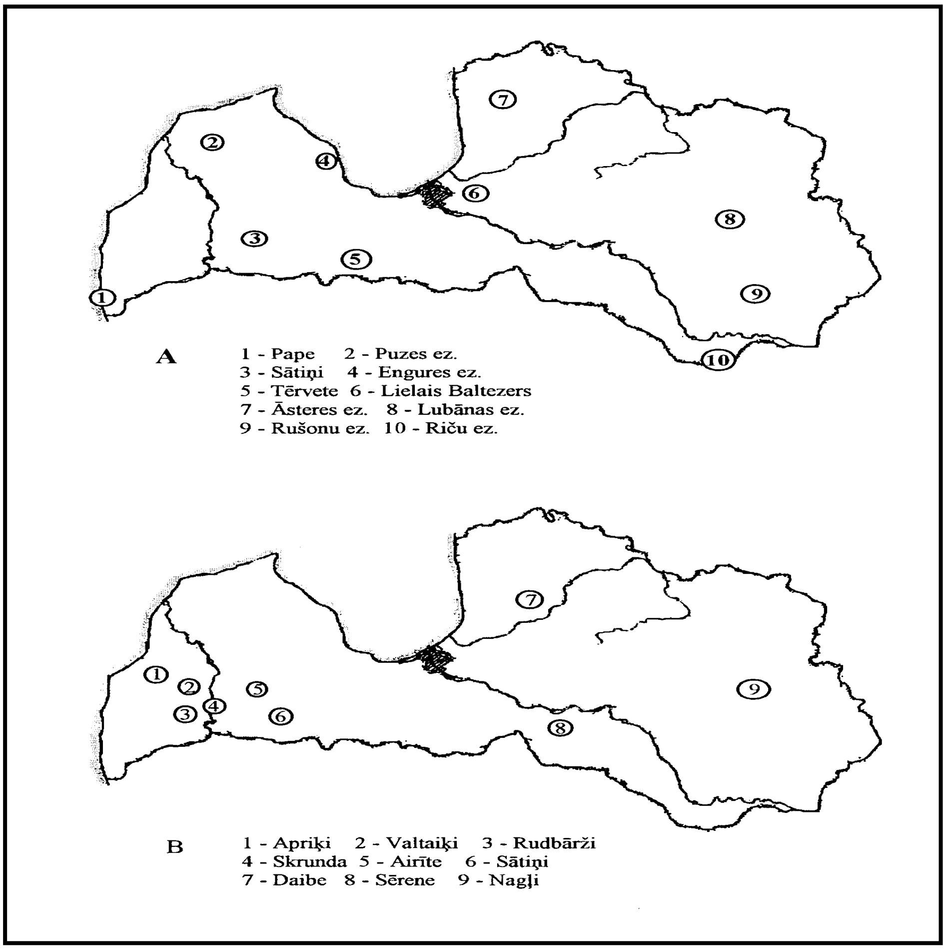
16. Latvia

16.1 National overview

By Janis Baumanis

Background

The numbers of Great Cormorants breeding in Latvia have increased from sporadic records in 1989 to the current (2002) population of approximately 1,000 pairs. The greatest concentration of Cormorants has been found at Nagli fish-farm (up to 1,000 birds), especially in late summer when breeding adults, non-breeding birds and fledged young (from the neighbouring breeding colony at Lake Lubana), together with immigrant birds of unknown origin (one recovery is of a bird ringed in Finland), congregate to feed in the ponds. Such large numbers of birds have undoubtedly given rise to conflicts between Cormorants and fish farmers. Although conflicts evidently exist at other fish farms and at some natural lakes (especially at Lake Rušonu), these do not seem to be as serious. To date, no complaints have been received from marine fishermen.



(A) Known breeding colonies (B) Main Staging sites of Great Cormorants in Latvia.

16.1.1 Cormorants in Latvia

Breeding Cormorants (around 16 pairs) were first documented at Lake Lubana in 1989 although they had probably started to breed there some years earlier (Baumanis *et al.*, 1997). Since then, breeding bird numbers have increased (see Table 16.1) although the population seems to have stabilized due to limited amount of suitable habitats.

Great Cormorant nests on Lake Lubana.

Year	Breeding Pairs
1990	30 pairs
1991	34 pairs
1992	68 pairs
1993	150 pairs
2000	200 pairs

Table 16.1 Counts at the Lake Lubana Cormorant colony.

The second largest breeding colony, at Lake Rušonu, was first documented in 1990 (2 pairs). Cormorant numbers also increased at this site (see Table 16.2).

Year	Breeding Pairs
1992	10 pairs
1993	30-40 pairs
1998	More than 100 pairs
1999	ca. 200 pairs

Table 16.2 Counts at the Lake Rušonu Cormorant colony.

In 1999, the first ground nesting birds were found on Lake Engure; 65 nests were counted in 2002. In 1992, two pairs of Cormorants started to breed on an old shipwreck at sea near Pape. In 1996, 70-80 nests were counted but the breeding colony disappeared after the wreck partly sunk (only 2 – 3 nests left). Small colonies with one to five pairs can be found scattered across Latvia on natural lakes or near fishponds. The total breeding population in Latvia was recently estimated to be approximately 1,000 pairs. Some 3,000 non-breeding Cormorants are also present during the summer on lakes and fishponds. In late summer, an additional 1,000-2,000 individuals of unknown origin arrive. The wintering population of Cormorants located on the coast varies from zero to 122 birds depending on the ice conditions (Stīpniece 2002).

16.1.2 Conflicts

Aquaculture fishponds

Almost all ponds are privatised, covering a total area of ca 8000 ha. Some of the pond owners illegally shoot Cormorants but the actual number of shot birds is not available. Most of the pond owners would be willing to tolerate Cormorants if compensation was offered.

Nagli fish farm

The Nagli fish farm covers a total of 3,000 ha. During the winter the ponds are covered with ice. Fish breeding activities last from April to September or October, the main fish species being Carp (See Appendix 2 for scientific names) with some stocks of Gibel Carp, Pike and Perch. Cormorants from the neighbouring breeding colony at Lake Lubana feed daily at the Nagli ponds. In 2001, four nests were also found on dams at the ponds but fish farmers soon destroyed these. In late afternoon all Cormorants leave the ponds and depart to night roosting sites at Lake Lubana, returning very early the next morning. In late summer (July-August) the number of feeding Cormorants can increase up to 1,000 individuals due to immigrants of unknown origin (most probably from Estonia, Finland and Leningrad region of Russia).

According to the rough calculations of local fish farmers, Cormorants cause damage amounting to USD 5,000 per season. Thus, in five years Cormorants can consume quantities of fish equivalent to the amount reared in one of these ponds during one year. To limit losses, farm owners illegally shoot up to 50 birds every season. Some other damage limitation activities have also been instigated, such as the cutting of trees around the ponds and scaring by using scarecrows at regular loafing sites. Scaring is, to some extent, an efficient technique for local birds as novel objects appearing suddenly at their loafing sites disturb them, however immigrant Cormorants accept these objects as normal. Unfortunately, data on damage caused by Cormorants at other fishponds and on natural lakes is not available.

16.2 Cormorant conflicts with fisheries

Care must be taken when interpreting information provided in this section. Please refer to section 2.2.3 (*Methodological limitations and difficulties*).

16.2.1 Conflict site descriptions

Two Cormorant conflicts were reported from Latvia: one on a lake (Lake Rušonu a natural, oligotrophic 2,373 ha lake at 100-500m altitude) the other on aquaculture ponds (Nagli fish farm: artificial, meso-eutrophic 1,000 ha ponds at 100-500 m altitude).

(Left) scarecrow and (Right) other scaring techniques at Nagli fish ponds, Latvia.

16.2.2 Birds and fish

In Latvia, Cormorants reported to be involved in conflicts were *P.c. sinensis*, possibly with some *P. c. carbo*. Reported Cormorant densities were 0.4 birds ha^{-1} (lake case) and 0.7 birds ha^{-1} (fish farm case). Cyprinids, Eel, Perch and Pikeperch were recorded in conflict with Cormorants in the single Latvian lake case study and Carp and Gibel Carp were recorded in the fish farm case.

16.2.3 Seasonality

Cormorant conflicts in Latvia were reported to occur in summer (i.e. Apr-Oct): grey boxes indicate months where fewer conflict cases were reported.

Month of conflict												
COUNTRY	J	F	M	A	M	J	J	A	S	O	N	D
Latvia												

16.2.4 Finance

Financial information on the 'costs' of Cormorant predation was not reported for either Latvian conflict case.

16.2.5 Conflict issues: magnitude of conflict

Cormorant conflicts with commercial fisheries stakeholders were reported from the lake case study and with aquaculturists from the fish farm case. Commercial fisheries stakeholders identified 5 conflict issues (all 'minor') while aquaculturists identified 6 issues (again, all 'minor'). Several other issues were cited as 'not claimed/not applicable' (Table 16.3)

16.2.6 Conflict issues: status of information used by stakeholders

Overall, commercial and aquaculture stakeholders provided 20 records of the status of the information they used to inform themselves about Cormorant conflict issues in Latvia. All records were for 'popular' articles.

Conflict issue	Not claimed/not applicable	No impact	Minor effect	Major effect
(1) FISHERIES				
Reduced catch			1	
Loss of stocked fish			1 (1)	
Reduced value of catch (damage)	(1)			
Damage to fishing gear	1			
Loss of earnings from the fishery	1 (1)			
Reduced capital values of fisheries	(1)			
(2) FISH STOCKS				
Reduced stock - lowered production	1		(1)	
Loss of juvenile fish - lowered recruitment	1 (1)			
Loss of aquaculture stock			(1)	
(3) ENVIRONMENTAL				
Interactions with other birds	1		(1)	
Scaring/shooting disturbance			(1)	
Landscape alteration			1	
Drowning in fishing gear			1	
Damage to vegetation/landscape			1 (1)	

Table 16.3 Cormorant conflict issues as recorded by commercial lake fishery stakeholders (and aquaculturists, round brackets) for Latvian case studies (n = 2). Each figure is the number of times a particular issue was cited by stakeholders.

16.3 Potential Cormorant management tools

No national or regional management plans exist in Latvia. Similarly, no official permits for killing Cormorants are issued although some hundreds of birds (exact numbers are unknown) are shot illegally every year, especially at private fishponds. Some attempts at Cormorant damage control have been made but only at Nagli fishponds (eastern part of Latvia). Here roosting sites were destroyed (tree removal) within the territory of the fish farm and visual frightening by scarecrows was undertaken at regular loafing sites (not efficient for newcomers). No financial compensation for fish losses is provided in Latvia.

16.4 Stakeholders consulted

(1) Director of Nagļi fish-farm. A/s "Nagļi" p.n. Nagļi, LV – 4631, Rēzeknes raj., Latvia.

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17. Lithuania

17.1 National overview

By Linas Ložys

Background

During the last decade, the number of breeding Cormorants in Lithuania has peaked and birds have come into conflict with some fisheries, especially in aquaculture. The conflict between Cormorants and fish farmers raises many problems for Lithuanian stakeholders as it often results in financial losses. The Cormorant colony near the Juodkrantė settlement on the coast of the Curonian Lagoon is the biggest in Lithuania. The Curonian Lagoon has greater fish landings in comparison with inland waters (Daulenskis 2001) but local fishermen consider Cormorants to be one of the main causes of reduced catches. However, according to Žydelis *et al.* (2002), Cormorant consumption does not exceed 5% of the total fish biomass in the Lithuanian part of Curonian Lagoon. Consequently, the impact of Cormorants on the fish stocks should be minimal despite the large colony near Juodkrantė, while the main cause of reduced landings is probably overfishing. The expanding colony on the Curonian Spit is causing some concern amongst foresters due to damage caused by Cormorants in the Kuršių Nerija National Park. However the main source of conflict between Cormorants and stakeholders in Lithuania occurs primarily at inland aquaculture facilities.

17.1.1 Cormorants in Lithuania

Breeding Cormorants (*P. c. sinensis*) in Lithuania have been documented since the 18th century (Ivanauskas 1938). Ivanauskas (1938) mentions a large Cormorant colony at the Curonian Spit near the Juodkrantė settlement in the 19th century. At the beginning of the 20th century a steep decline in the colony occurred and breeding birds were absent for many years (Jusys 1997, Stanevičius & Paltanavičius 1997). The first Cormorants reappeared in Lithuania in 1970 but they only started to breed at the Elektrėnai Reservoir in 1985. In 1990 the Elektrėnai Reservoir colony consisted of 30 breeding pairs. In the same colony, 150 breeding pairs were counted in 1995 (Idzelis 1998). Breeding Cormorants appeared again in the Juodkrantė colony, which was now occupied by Grey Herons (*Ardea cinerea*), in 1989 (Žydelis *et al.* 2002). Since then the colony has increased from 13 pairs in 1990 to nearly 2,800 pairs in 2004.

According to Daulenskis (2001) the Elektrėnai and Juodkrantė colonies have generated new inland colonies, which are mainly located near to aquaculture farms. In the colony near to the Armolė (Arnionys) aquaculture farm (eastern part of Lithuania), 200 breeding pairs were counted in 1992 and 1995 (Idzelis 1995). However, in 1995 and 1996 scaring techniques were used at the Elektrėnai and Arnionys colonies so that in 1996 Cormorants did not breed at these colonies (Svirskis & Idzelis 2000). In 2000, Svirskis & Idzelis (2000) documented that around 2,000 pairs of Cormorants successfully raised about 6,000 juveniles in Lithuania. In addition to breeding birds, about 4,000 non-breeding Cormorants were also counted. Moreover, during September and November unknown numbers of Cormorants add to the local population from the northern distributional range, which can contribute to local conflicts. For example, from April to July and August to October 2000, between 1,500 and 6,000 birds were believed to be feeding in aquaculture fishponds (Svirskis

& Idzelis, 2000). However, Cormorants do not stay in Lithuania all year around. In winter, mostly single individuals are observed on the Baltic Sea Coast. According to Žydelis *et al* (2002) up to 30 birds were recorded in the winter of 2001/02 along the coastal zone of the Baltic Sea.

17.1.2 Case Study: The Curonian Lagoon

The Lagoon

The Curonian Lagoon, a eutrophic water body, is situated in the eastern part of the Baltic Sea (see Figure 17.1). A narrow sand spit, the Curonian Spit (0.5 – 4.0 km), separates the Lagoon from the Sea. Characterized as a fresh water basin, the greater southern part of the Lagoon belongs to Kaliningrad region, while the northern part belongs to Lithuania. The Lagoon stretches over 1,584 km^2 but the Lithuanian side of the Lagoon covers about 413 km^2 with a mean depth of 3.7 m. The average water level in the Lagoon is 15 cm higher than that of the sea so the penetration of seawater into the Lagoon is rare and the salinity fluctuates from 0.03 ‰, in the southern part of the Lagoon, up to 1.60 ‰ in the Klaipėda Strait. During the season, water transparency fluctuates in the range of 0.35 and 2.0 m (I. Prochorova pers. comm.). In winter the Lagoon is usually covered in ice.

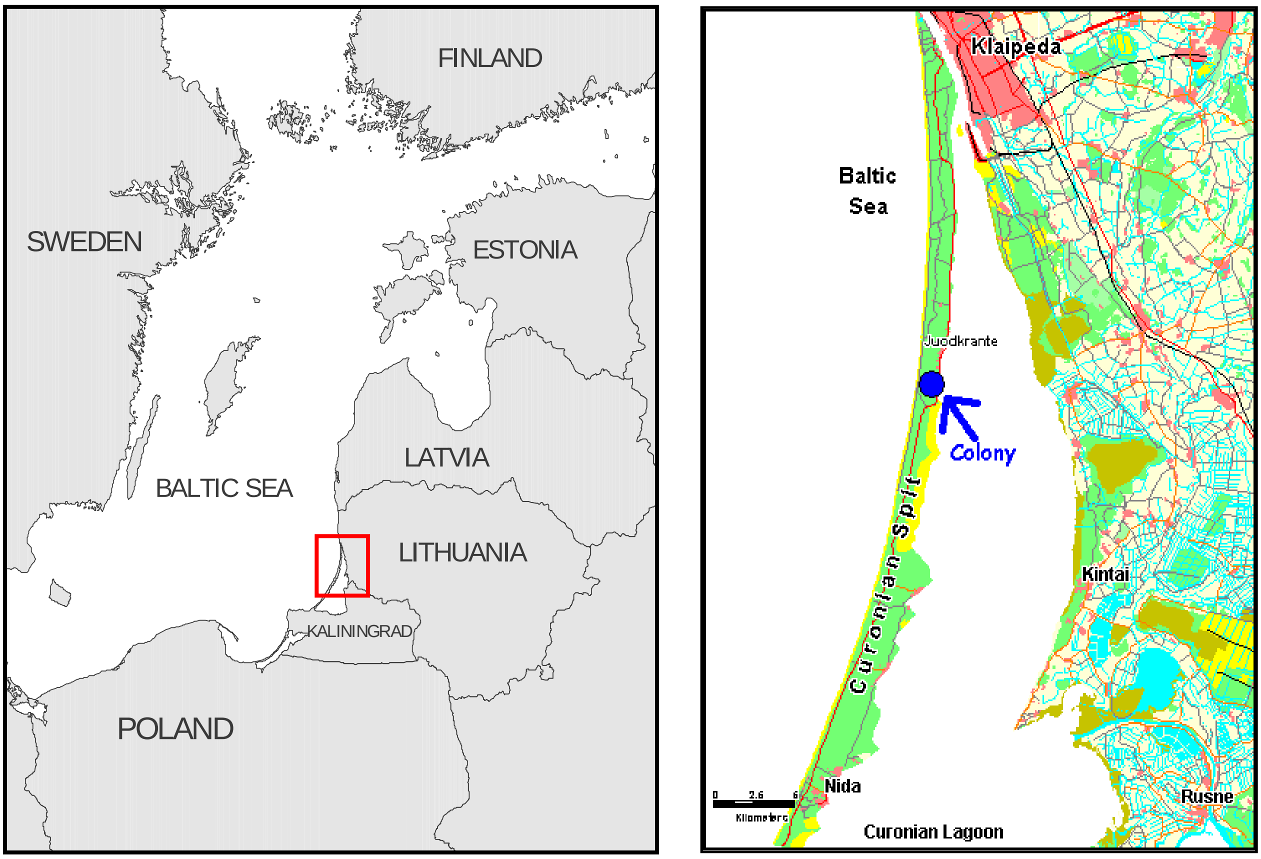

Figure 17.1 The northern part of Curonian Lagoon (the southern half belongs to Russia): the location of the biggest Great Cormorant and Grey Heron colony is indicated.

Cormorants in the Curonian Lagoon close to the Juodkrantė colony (Photograph K. Verbickas).

Great Cormorants in the Curonian Lagoon

Breeding Cormorants usually arrive on the Lithuania coast of the Baltic Sea in late February and within two weeks they lay eggs. Non-breeding individuals generally appear in late March to April. Cormorants usually stay in the Lagoon and coastal zone areas of the Baltic Sea until the middle of October (Žydelis *et al*. 2002). The Cormorants breed in a mixed colony with Grey Herons. The breeding population of the Cormorant colony, located in a forest (mainly Pine trees *Pinus silvestris*) close to Juodkrantė settlement is the biggest in Lithuania (about 2,800 pairs in 2004). Cormorants attempted to establish colonies on the Nemunas River Delta but, for unknown reasons, juveniles have not been raised successfully. Žydelis *et al.* (2002) assume that the colonies were abandoned due to intensive boat traffic.

The fish

The most common fish species in the Lagoon are Roach (see Appendix 2 for scientific names), Bream, White Bream, Perch, Pikeperch, Smelt, Ruffe, Burbot, Vimba, Asp, Eel, and Pike.

Fish productivity – yield

The Curonian Lagoon is known to be a highly productive water body. The estimated total biomass is 197 kg/ha (Repečka, 1997), thus the total biomass of the Lithuanian side of the Lagoon should be about 8,130 tonnes. The landings of different fish species varies from year to year in the Lagoon, however the largest are usually of Bream (ca. 400 tonnes per annum), Roach (ca. 450 tonnes), Pikeperch (ca. 80 tonnes), Smelt (ca. 60 tonnes), Perch (ca. 50 tonnes), and Vimba (ca. 50 tonnes). Ruffe is not a commercial fish species but they are abundant in the Lagoon and used as a food for poultry. Landings of Ruffe vary from 20 to 90 tonnes per annum. The fish with the highest economical value is Eel. Fishermen associations or state authorities increase Eel populations through artificial stocking of glass and yellow Eels. However stocked

Eel in the Lagoon probably contributes no more than 21% of all Eel stock, while the remaining fish are natural recruits (Ložys unpubl. data).

Diet composition and food consumption

The diet of Great Cormorants has been studied from nestling regurgitations during the nesting period in 2001 by Žydelis *et al*. (2002). Numerically, 51% of all consumed fish was Roach. The other important species were Pikeperch (11%), Perch (9%), Bream (7%), Smelt (7%), and Ruffe (7%). In terms of biomass, Roach accounted for 44% of all consumed fish, Pikeperch 21%, Bream 13%, and Perch 5%. Other species did not exceed 5% of total estimated biomass. The diet composition roughly corresponds to the structure of fish stock in the Lagoon, where in terms of biomass the most abundant fish species are Roach (33%), Bream (22%), Perch (15%), and Ruffe (13%) (Repečka, 1997).

The impact

By considering the numbers of breeding and non-breeding Cormorants, nesting success and the period of their presence in the area, Žydelis *et al*. (2002) estimated that the consumption should be 250-300 tonnes of fish per annum. This quantity is about 25% of the official commercial landing and does not exceed 5% of the total fish biomass in the Lithuanian part of the Lagoon.

The fishermen

Around 80 small enterprises operate at the Curonian Lagoon employing between 300-400 fishermen. Some of the fishermen have diversified their livelihoods to include farming, tourism or other jobs. However, most of the fishermen are full-time professionals and derive their main source of income from gill-net or trap-net fishing in the Lagoon.

The conflict

Local fishermen generally consider Cormorants to be one of the few main causes of reduced fish landings: Cormorant predation, increase in seawater inflows to the freshwater Curonian Lagoon due to the deepening of Klaipėda port, illegal fishing, over-fishing. The Cormorants feed not only on commercial fish species but on non-economically important species as well. Local fishermen usually cite Cormorant predation rather than over-fishing as the main cause of a reduction in the sustainability of fisheries. Moreover, old pine forest in the colony near Juodkrantė settlement dry out as a result of the acid excrements of Cormorants. As the colony expands the area of forest destroyed in the Nerija National Park increases annually and is a matter of great concern among the local society, foresters and environmentalists. However, by reducing intraspecific and interspecific competition in fish communities in the highly productive Lagoon, Cormorants can also have a positive impact. Thus, a conflict between fisheries and Cormorants should be considered within a wider socio-economic and ecological context. Such work has been recently undertaken by Bell (2004, see also http://www.dur.ac.uk/imew.ecproject/) in several European wetlands including the Curonian Lagoon.

Gaps to be filled

Four areas require further research: (1) further diet studies and counting of Cormorants in the Curonian Lagoon area, (2) estimation of causes of unsuccessful nestling production in Nemunas River Delta, (3) studies of Cormorants impact on fish population dynamics in the Lagoon, (4) socio-economic aspects of the impact of Cormorants on fisheries.

17.1.3 Case study: aquaculture fishponds

The fishponds

Aquaculture fish farms are located across Lithuania (Table 17.1, Figure 17.2). During the REDCAFE study 15 fish farms were contacted. All farms were private enterprises and covered approximately 9,000 ha of man-made ponds. In the winter ponds are usually covered in ice.

	Name of farm	**District**
1	Akvilegija	Vilniaus
2	Armolė	Molėtų
3	Bartžuvė	Kaišiadorių
4	Birvetos tvenkiniai	Ignalinos
5	Daugų žuvis	Alytaus
6	Išlaužo žuvis	Prienų
7	Karpis	Marijampolės
8	Kintai	Šilutės
9	Kabelių žuvis	Varėnos
10	Zemaitijos žuvis	Telšių
11	Raseinių žuvininkystė	Raseinių
12	Šalčininkų žuvis	Šalčininkų
13	Šilo-Pavėžupis	Kelmės
14	Šventjonis	Šiaulių
15	Vasaknos	Zarasų

Table 17.1 List of aquaculture farms questioned about conflicts with Cormorants.

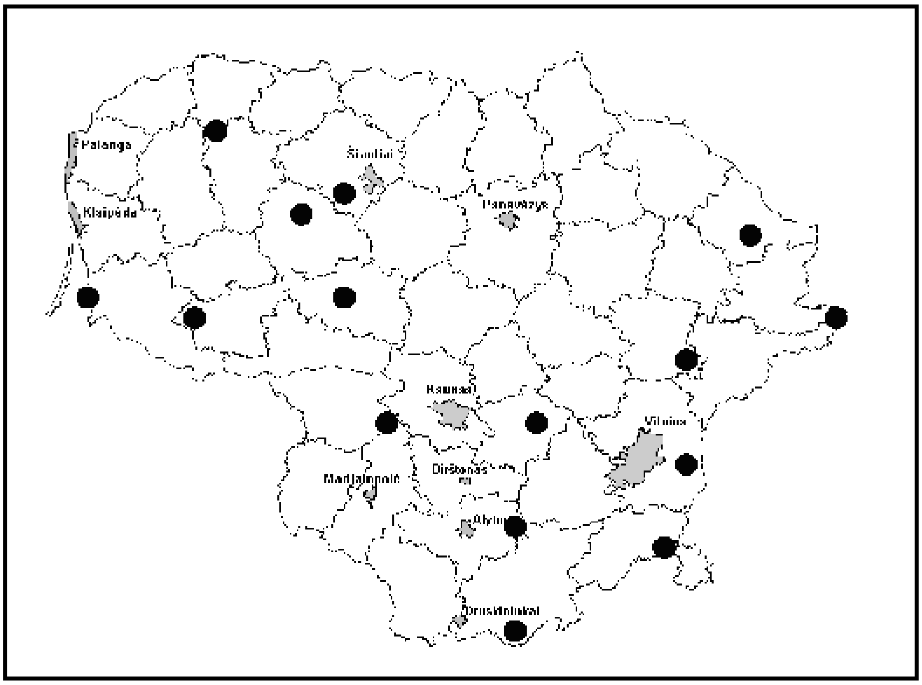

Figure 17.2 Map of Lithuania showing distribution of aquaculture fish farms.

Cormorants at aquaculture fishponds

In 1985 Cormorants started to breed in Elektrėnai water reservoir and in 1990, there were 30 breeding pairs in the colony. In 1992 in the region of Armolė (Arnionys) between 50 and 150 breeding pairs were counted in two colonies (Stanevičius & Paltanavičius 1997). In the Elektrėnai colony, 150 breeding pairs were counted whilst 200 breeding pairs were counted in the Armolė farm in 1995 (Idzelis, 1998). Between 1995 and 1996 many non-breeding bird groups were also observed along various inland water bodies. During this time Cormorants at the Elektrėnai and Armolė colonies were subject to systematic scaring at feeding sites although scaring was also occasionally employed at the colonies themselves. As a result Cormorants did not breed at these colonies (Svirskis & Idzelis 2000). According to Svirskis & Idzelis (2000) some new colonies were formed in settlements around Kurtuvėnai and Kapčiamiestis, Baluošai, Dringis, Drūkšiai and other lakes. However, quantities of breeding birds and the exact locations of colonies remain unknown. The authors point out that around 1,200 breeding, 4,000 non-breeding individuals and 1,800 juveniles fed on fish from inland waters in Lithuania. Approximately 1,000 birds were shot in 2000 (Svirskis & Idzelis 2000).

The fish

The most common fish species reared in the fishponds is Carp, although farmers also stock Peled (Northern Whitefish), Pike, Pikeperch, Crucian Carp, Goldfish, Brown Trout and Rainbow Trout. Non-commercial fish species such as small Perch, Roach and Sunbleak also inhabit ponds at fish farms.

Diet composition and food consumption

As with the Curonian Lagoon case study, the diet of Cormorants is largely related to the fish stock structure in the water body. The most common fish in the diet of Cormorants which feed from fish ponds is Carp, whilst Peled is hardly affected by Cormorant predation.

Fish farm production

About 650 people are employed in aquaculture fish farms (Vaitiekūnas, 1998). During a period of great change in the Lithuanian economy, after reinstatement of independence, the production of fish farms decreased from 5800 tonnes in 1990 to 1600 tonnes in 1995 (Table 17.2). However, fish farms started to recover and production increased to 2,300 tonnes in 2000 (Vaikutis 1998). The produce from fish farms is sold for direct consumption or used for the restocking of inland water bodies. Part of these ponds are also set aside for recreational fishing.

The impact

Fish farmers claim to lose around 200 tonnes of reared fish to Cormorants. The total annual turnover from fish farming is approximately 3,710,000 euro, while financial loses reach about 396,000 euro. Most farm owners state that without using any scaring techniques their financial loses would mean their businesses would go bankrupt. Thus, shooting birds at fishponds is the most common scaring technique in Lithuania. Other preventative methods such as scarecrows, wires or similar techniques have been characterized as ineffective in the long term.

Year	Fish farm production (t)
1990	5,800
1991	5,700
1992	3,900
1993	2,800
1994	1,800
1995	1,600
2000	2,300

Table 17.2 Fish farm production in Lithuania.

The conflict

The conflict between fishermen and Cormorants sometimes starts in January, but more often in April and finishes in November. Cormorants feed on reared commercial fish species and this is the essence of the conflict. Additional conflict occurs due to damage of fish by the birds, increasing the chance of disease and predation by other bird species as well as reducing the marketable value of the fish. In some cases farmers have indicated that the rearing of Peled has become unprofitable as a consequence. The use of expensive scaring devices increases the financial difficulties of fish farmers.

Gaps to be filled

Three areas require further research: (1) counts of breeding and non-breeding birds, locating unknown and newly established colonies, (2) exact studies of the influence of Cormorant predation on aquaculture fish farming, (3) development/introduction of existing and/or new effective scaring techniques.

17.2 Cormorant conflicts with fisheries

Care must be taken when interpreting information provided in this section. Please refer to section 2.2.3 (*Methodological limitations and difficulties*).

17.2.1 Conflict site descriptions

Fifteen Cormorant conflicts were reported from Lithuania: on 15 aquaculture pond systems (Akvilegija, Armolė, Bartžuvė, Birvetos tvenkiniai, Daugų žuvis, Islaužo žuvis, Karpis, Kintai, Kabelių žuvis, Žemaitijos žuvis, Raseinių žuvininkystė, Šalcininkų žuvis, Šilo-Pavėžupis, Šventjonis, Vasaknos fish farms). All conflict cases were artificial, eutrophic sites.

17.2.2 Birds and fish

In Lithuania, Cormorants reported to be involved in conflicts were *P.c. sinensis*. Reported Cormorant densities are given in Table 17.3.

Habitat	No. cases	Cormorant density (maximum no. ha^{-1})			
		Mean	SE	Minimum	Maximum
Aq ponds	15	0.4	0.09	0.06	1.25

Table 17.3 Cormorant density (mean, standard error [SE], minimum and maximum) for Lithuanian aquaculture pond cases.

Carp was recorded in conflict with Cormorants in all Lithuanian aquaculture pond case studies reported. At ten of the 15 farms, a further 6 fish species were sometimes reported (Table 17.4).

Species	Frequency (% of 15 cases)
Carp	100
Pike	53
Northern Whitefish	47
Crucian Carp	27
Goldfish	27
Brown Trout	13
Pikeperch	7

Table 17.4 Fish species reported to be involved in conflicts with Cormorants in 15 cases from Lithuanian aquaculture ponds.

17.2.3 Seasonality

Cormorant conflicts in Lithuania were reported to occur in summer (i.e. Apr-Nov): grey boxes indicate months where few conflict cases were reported.

Month of conflict												
COUNTRY	J	F	M	A	M	J	J	A	S	O	N	D
Lithuania												

17.2.4 Finance

Financial information on the ‘costs’ of Cormorant predation was reported for 13 aquaculture pond conflict 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. It was requested that the values provided be categorised as either ‘actual’ or ‘estimated’. However, this information was not provided for Lithuanian cases. Based on the 13 cases, average turnover for these aquaculture fisheries was 285,500 euro and average loss was 31,754 euro (11% of turnover).

17.2.5 Conflict issues: magnitude of conflict

Cormorant conflicts with aquaculture fisheries stakeholders on ponds were the only ones reported (n = 15 cases) in Lithuania. All stakeholders cited every fishery issue and loss of aquaculture stock (a fish stock issue). A further 7 fish stock and environmental issues were reported from a single farm (Table 17.5).

17.2.6 Conflict issues: status of information used by stakeholders

Overall, stakeholders provided 195 records of the status of the information they used to inform themselves about Cormorant conflict issues in Lithuania. The highest proportion of records (96%) was for ‘popular’ articles, followed by ‘grey literature’ (4%) and no records of ‘scientific literature’.

Conflict issue	Not claimed/not applicable	No impact	Minor effect	Major effect
(1) FISHERIES				
Reduced catch			14	1
Loss of stocked fish			14	1
Reduced value of catch (damage)			14	1
Removal of fish from nets		1	14	
Damage to fishing gear		1	14	
Reduced catchability (stress/behaviour)			15	
Loss of earnings from the fishery			15	
Reduced capital values of fisheries			15	
Reduced fishing tackle sales		15		
Increased recurrent costs			15	
Loss of employment		15		
(2) FISH STOCKS				
Reduced stock - lowered production				1
Effects on popn. dynamics/community structure				1
Vectors of diseases/parasites				1
Loss of juvenile fish - lowered recruitment				1
Loss of aquaculture stock		1	14	
(3) ENVIRONMENTAL				
Interactions with other birds				1
Scaring/shooting disturbance			1	
Damage to vegetation/landscape			1	

Table 17.5 Cormorant conflict issues as recorded by aquaculture stakeholders for Lithuanian pond systems (n = 15 cases). Each figure is the number of times a particular issue was cited by stakeholders.

17.3 Potential Cormorant management tools

Information (summarised in the following tables) was provided on (1) general actions taken against Cormorants in Lithuania, (2) management plans/legal regulations, (3) actions at breeding sites, and (4) at aquaculture sites.

NAME OF RESPONDENT AND YOUR AFFILIATION	**Linas Lozys, Institute of Ecology**
COUNTRY	**Lithuania**
REGION / PROVINCE / etc. (if applicable)	
Period which is concerned [year(s)]	

General information on actions against Cormorants in Lithuania

	Total numbers		Regional
	National numbers	**Count/Estimate?**	**Inland fisheries ponds**
Number of breeding colonies destroyed or disturbed	0		
Number of nests destroyed	0		
Number of nestlings killed	0		
Number of adults killed in the non-breeding season	ca. 1,000	Count	ca. 1,000
Number of breeding adults killed	0		
Number of night roosts destroyed or disturbed	0		

Management plans / legal regulations (Lithuania)

	Total country
Are there any management plans in effect? Please list all national or regional plans and give details	no
Are there any regulations in effect that allow Cormorant culling? Please list all national or regional regulations and give details	no
Are there any coordinated culling programmes in your country?	no
Is it mandatory to obtain single permits for Cormorant killing?	yes
Has a general permit for Cormorant killing been issued?	no
Is there any financial compensation for fish losses?	no
Is there any financial aid for the construction of Cormorant exclosures or for scaring programmes, etc.?	yes

Remarks (on General information & on Management plans /legal regulations):

(1) Is it mandatory to obtain single permits for Cormorant killing? Ministry of Environment issues permits for the inland fisheries pond farms for cormorants shooting in nonbreading season of other bird species.

(2) Is there any financial compensation for fish losses? There isn't financial compensation for fish losses. Position of the Ministry of Environmental protection is to use money for cormorant regulation but not for compensation, since it's too complicated to eveluate fisheries looses and it's more effective use of money would be cormorant regulation.

(3) Is there any financial aid for the construction of Cormorant exclosures or for scaring programmes, etc.? In Lithuania were some small grants for estimation of most effective scaring technology. These grants were financed by Ministry of Agriculture.

(4) Position of the Ministry of Environment is: chaotic shooting of cormorants in the fisheries ponds is not effective; it is necessary to start (for example for three years) co-ordinated shooting (or egg oiling) in all Europe and later to check the effect. I personally agree with this position.

NAME OF RESPONDENT AND YOUR AFFILIATION	**Linas Lozys, Institute of Ecology**							
COUNTRY	**Lithuania**							
REGION / PROVINCE / etc. (if applicable)								
Period which is concerned [year(s)]								
A. Breeding Sites								
Cormorant Damage Control Activities								
1. Avoid foundation of new colonies	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Scaring by use of live ammunition	rarely	months	3	3	4	fisheries ponds		
Shooting some adults to reinforce scaring	rarely	months	3	3	4	As above.		
Pyrotechnics / Fireworks	rarely	months	3	3	3	As above.		
2. Existing colonies: Hinder cormorants from breeding	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Scaring by use of live ammunition	rarely	months	3	3	4	As above.		
Shooting some adults to reinforce scaring	rarely	months	3	3	4	As above.		
Pyrotechnics / Fireworks	rarely	months	3	3	3	As above.		
3. Existing colonies: Reduce breeding success	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Egg oiling	not used	high	2	2	3		It seems it should be most effective technique	
Other (please specify)	egg cooling as result of shooting birds.	medium	3	3	4	As above.	Useful technique at cold, rainy days.	

NAME OF RESPONDENT AND YOUR AFFILIATION	**Linas Lozys, Institute of Ecology**							
COUNTRY	**Lithuania**							
REGION / PROVINCE / etc. (if applicable)								
Period which is concerned [year(s)]								
C. Feeding Sites								
C5. Aquaculture								
Cormorant Damage Control Activities								
2. Bird-proof barriers (overhead barriers and peripheral fencing/netting)	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Coloured streamers to increase visibility of wires and strings	rarely	days	3	3	3	Fisheries ponds	Only experimentally	
3. Wildlife Management								
3.1 Non-lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Audio frightening techniques								
Pyrotechnics / Fireworks (shell crackers, screamers, whistling projectiles, exploding projectiles, bird bangers, flash/detonation cartridges)	rarely	months	3	3	3	As above.		
Live ammunition	rarely	months	3	3	4	As above.		
Visual frightening techniques								
Simple human effigies or scarecrows	rarely	days	3	3	3	As above.	As above.	
Mirrors	rarely	days	3	3	3	As above.	As above.	
3.2 Lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Shooting adults and immatures								
to reduce bird numbers at specific sites	regularly	days	4	3	4	As above.		

17.4 Stakeholders consulted

Fifteen fish farms mentioned earlier (Table 17.1). Relevant State authority in Lithuania: Ministry of Environment, Nature Protection Department, Biological Diversity Division, 4/9 A. Jakšto st., LT-2600 Vilnius, Lithuania.

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18. Netherlands

18.1 National overview
Stef van Rijn & Mennobart van Eerden

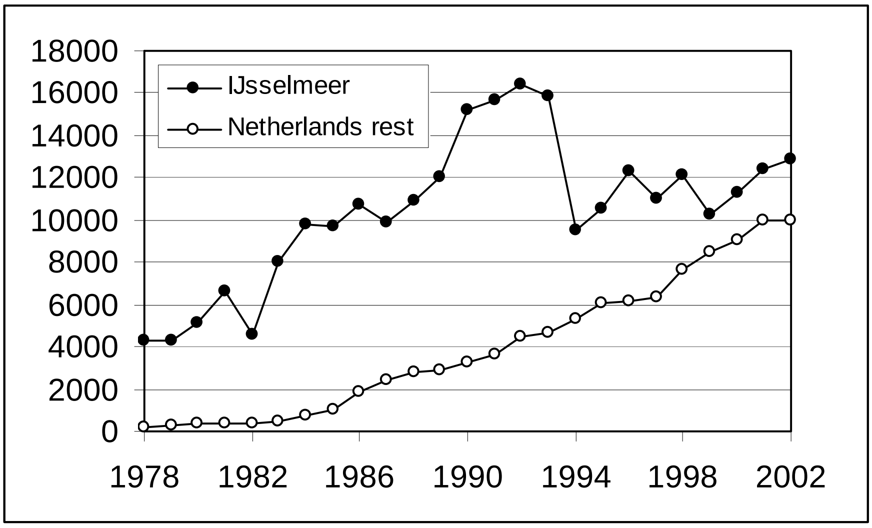
18.1.1 Protection of the species
Cormorants (*P.c. sinensis*) have been fully protected in the Netherlands since 1965. At that time the population was declining and total numbers were less than 1,000 breeding pairs. Pesticide loads in the environment were high, leading to massive losses in populations of terns, raptors and Cormorants. Continuous embankment of new polders in the IJsselmeer area was another reason for legal protection. Since this change in legislation, Cormorants have been protected throughout the season.

18.1.2 Shooting and other measures to reduce Cormorant numbers
Increased Cormorant numbers have led to a debate about the possibilities and necessity to reduce numbers in order to alleviate perceived damage to fisheries. The case of the damage caused by breeding Cormorants to the largest fish farm in Europe in the early 1980s was one of the first complaints in Europe. This was documented extensively in the popular press and put to the High Court. The outcome was the shift of the fish farm to a less vulnerable place, more internally in the Netherlands and compensation was paid by the State. In this, and other cases, local shooting was allowed after extensive use of methods of deterring proved unsuccessful. Generally speaking, however, shooting is by far the least applied measure and is only allowed after all other measures have proven to be unsuccessful.

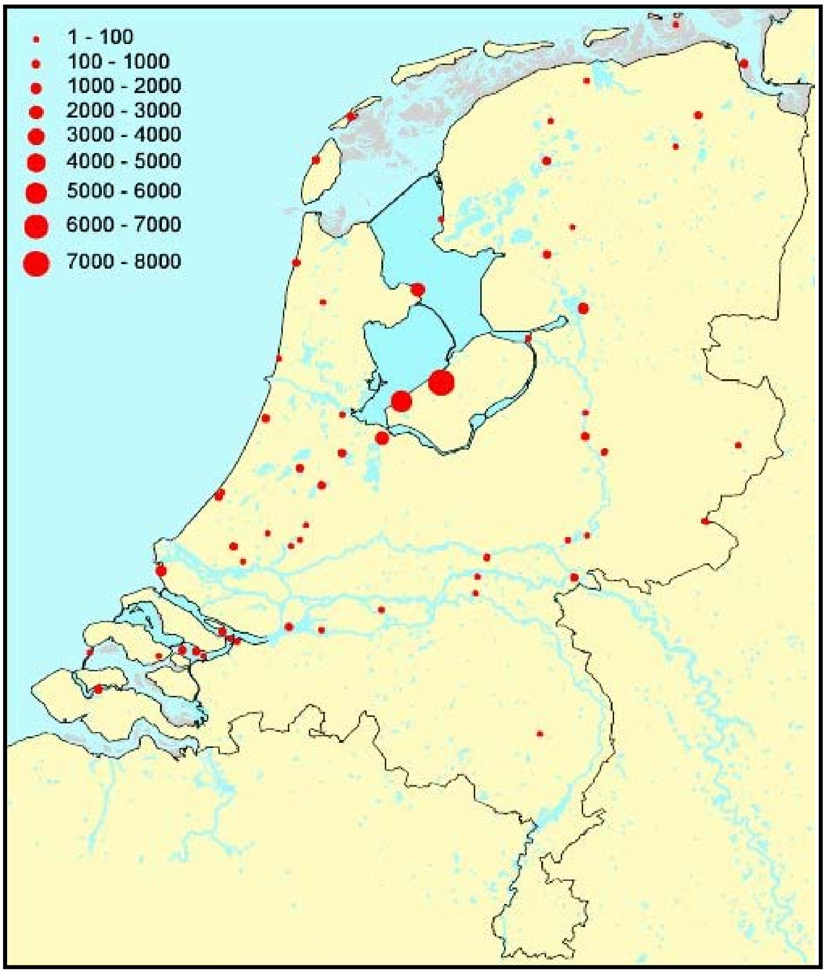
Cormorant numbers in the Netherlands are not regulated by any means, neither by disturbing nor by shooting. Only nature reconstruction measures, which in the Netherlands are carried out extensively (e.g. preventing the growth of young willow [*Salix* spp.]), could affect Cormorants. However, the usefulness of this measure is doubtful as Cormorants can easily breed on the ground and at higher densities than in trees (Van Rijn & Van Eerden 2001).

18.1.3 Breeding numbers
The breeding population of Cormorants in the Netherlands has increased dramatically since the late 1970s. The growth started in the lake IJsselmeer population with the colonization of new colonies in the new polders of Flevoland, reclaimed from the former Zuiderzee in the 1950s and 1960s. These new colonies were settled in nature areas close to the costs of the new lakes of Markermeer and IJsselmeer. The new colonies were situated close to the fishing grounds on the lakes, thus allowing breeding numbers to increase. In the 1980s, numbers of breeding pairs began to grow in other parts of the Netherlands. This growth included the lakes in the northern and western part of the country, the delta in the southwest (in the province of Zeeland, south of Rotterdam), the inland river areas and later also the coastal areas. In the 1990s, the numbers in the IJsselmeer population stabilised after a crash in 1994 (Van Eerden & Zijlstra 1995). After this, the breeding numbers in the rest of the country also stabilised, with the exception of the coastal areas where stabilisation followed later, in the beginning of this century. While nowadays the number of breeding colonies is still increasing somewhat, the total number of breeding pairs seems to have

been stable since the late 1990s. The total Dutch breeding population is 20-22,000 breeding pairs with about 50% breeding in the IJsselmeer area (Van Rijn & Van Eerden 2001).



Breeding numbers of Cormorants in the IJsselmeer area and the rest of the Netherlands in 1978-2002.



Location and size of Great Cormorant colonies in the Netherlands (max. size, 1993-2002).

18.1.4 Wintering numbers

In January of 2003 and 2004 a national mid-winter count of night roosts was carried out. In 2003, coverage of the count was moderate but in 2004 all known roost were checked. The number of birds counted was 25,745 in January 2004. For January 2003 the number was estimated at 16,400 birds (Van Rijn & Nienhuis 2004). The core wintering areas are situated around lake IJsselmeer (40% of the numbers in January 2004) and along the large rivers, mainly IJssel, Rhine and Waal (26%). The largest roosts were all found around lake IJsselmeer (maximum 3,251 on an island near Den Oever). Along the North Sea coast and in the Wadden Sea, which supports important numbers during late summer and autumn, hardly any roosting birds were observed and birds attending roosts close to these regions were reported to originate from feeding areas in freshwater bodies. Differences in wintering numbers are attributed to cold spells, such as in December 2002 and January 2003, with fewer wintering birds as a result, overall though wintering numbers have tended to increase.

Aerial view of a typical ground-breeding colony (Enkhuizen, the Netherlands) (Photograph M. Roos, RIZA).

18.1.5 Consumption by Cormorants

Consumption of fish stocks by Cormorants in the Netherlands has only been studied in the IJsselmeer area and in the lakes in the northwest of the province of Overijssel, northeast of the IJsselmeer area where historically large numbers have bred. In other parts of the country less information is available about the exact diet of Cormorants. The total annual consumption of fish by birds from the IJsselmeer population is estimated to be about 1,500-1,800 tonnes (Van Rijn & Van Eerden 2001). The diet of these birds consists mainly of non-commercial fish species. About 40-60% of the total consumption (fresh mass) is accounting for by Ruffe (see Appendix 2 for scientific names), 20% by Perch and 20% by Roach in the period 1996-2000 (Van Rijn & Van Eerden 2001). In winter Cormorants mainly feed on Roach, Ruffe and Perch. The list of prey species reported is diverse, reflecting local differences in prey composition.

18.1.6 Commercial fisheries

The IJsselmeer and Markermeer lakes (180,000 ha) are heavily exploited by a fishery that catches annually about 5 million euro worth of Eel, Perch, Pikeperch and of the small zooplanktivorous Smelt, the main prey for Perch and Pikeperch and for the piscivorous birds of IJsselmeer (Dekker 2004). The commercial fisheries in the IJsselmeer area are on a steady decline, today practiced by about 55 private companies. These fisheries use mostly fyke nets in summer and gillnets in winter. Active fishing, with special trawl nets, has been forbidden since 1970 (Lammens 1999). In the summer period, mainly Eel fishing is carried out by using temporal and permanent fykes. Additionally long-lines and eel-boxes are used. During a short period in early spring, stocks of spawning Smelt are also exploited. In winter the gillnet fishery switches to Pikeperch and Perch. This fishery is intensive with a reported 400km of netting in the lake (Van Eerden *et al.* 1999). Despite the strong increase in fishing effort from about 15,000 fykes in the 1970s to about 50,000 at the end of the 1980s, the amount of Eel landed has decreased progressively from 5 kg/ha to less than 2 kg/ha in 2000 (Lammens 1999, Lammens unpublished).

In 1992, Dekker *et al.* calculated that for every kilogram of Eel caught, an additional 10 kg of other fish species were taken out of the lake system, which means an annual by-catch of about 2,500 metric tonnes.

In winter the fisheries companies use gillnets to catch Perch and Pikeperch. This method increased from 1,200 nets in the 1970s to over 4,000 nets and the late 1980s (Dekker 1991). The catch of Pikeperch decreased dramatically from 3-6 kg/ha in the 1970s to less than 1 kg/ha in 1999 (Lammens 1999, Lammens unpublished.). The catch of Perch fluctuated a lot in the same period but in recent years this has also decreased (Lammens 1999, Lammens unpublished.)

It is often reported that these lakes are over-fished by commercial fisheries (Van Eerden *et al.* 1999, Van Rijn & Van Eerden 2001, Dekker 2004). The Government and stakeholders' organisations are in a continuous debate over how to arrive at a controllable system for commercial fisheries. There is urgent need for reduction in fishery pressure, reducing the by-catch of young fish and also avoiding the killing of water birds. As many of the inland waters have been placed recently (since March 2000) under the EU Bird and Habitat Directive, the position of commercial fisheries is further debated. Smaller numbers of companies exist in Northwest Overijssel, the Delta area, the Frisian lakes and along the large rivers. Most of these (fyke) fisheries concentrate on Eel in the lake systems with Pikeperch as an important additional catch. All of them have experienced a reduction in Eel catch, mainly attributable to the decline in immigration of elvers (Dekker 2004).

Some specialised fishermen catch large amounts of Bream and Roach with seine nets in winter. These are used to stock other water bodies in the Netherlands and Belgium for sport-fisheries. Put-and-take fisheries for sporting facilities occur in many water bodies, especially in sandpits, small lakes, canals and backwaters in the riverine area. Generally the habit of stocking is on the decline compared to 20 years ago. Sometimes new initiatives emerge such as fishing for trout at fish farms and many new initiatives comprise indoor or well-protected cage activities (Eel, Catfish, Tilapia and others).

18.1.7 Impacts of Cormorant and fisheries on fish

The over-fishing of stocks of Eel, Perch and Pikeperch and the related by-catch of large quantities of young fish has important effects on the available amount of fish for fish-eating birds in the IJsselmeer area.

Mortality of Perch and Pikeperch as a by-catch from the Eel fisheries, predation by Cormorants and other mortality is estimated at respectively 46%, 34% and 8% for Perch and 51%, 15% and 10% for Pikeperch (Van Dam *et al.* 1995). It was concluded that predation by Cormorants possibly affects the amount of Perch that can be taken from the lakes by commercial fisheries in later years. For Pikeperch this effect is supposed to be much lower.

An analyses with a special model, made to indicate the relations between Cormorants, fish and fisheries showed that Cormorants may reduce the commercial fish catch by about 25%, especially for Perch, but it also showed a similar effect due to by-catch mortality of (small) Perch and Pikeperch from Eel fishing (Lammens 1999). The model also suggested that without commercial fisheries, the amount of predatory fish like Perch and Pikeperch would increase strongly and the total amount of fish would decrease by 40-50%. In this situation, the amount of small (prey) fish, such as Smelt, would decrease dramatically and result in a less attractive situation for a lot of fish-eating bird species, including Cormorants. However, it remains very difficult to forecast the different scenarios because a lot of other factors affect the system as well. Young Perch, for example, grow much better in circumstances with lower fish densities (Mous 2000, de Leeuw 2000). This probably means that a lot of density-dependent factors are affecting the fish population and the mortality of fish in these large-scale water systems. The impacts of Cormorants and fisheries on fish in Northwest Overijssel are much less clear (Van Dam 1995). The impact of Cormorants on Eel is supposedly relatively high, compared with the situation in the IJsselmeer area. The impact on Pikeperch is also suggested to be quite high (Veldkamp 1994). The intensive fishing at Lake IJsselmeer also has adverse effects on birds, as an estimated 50,000 water birds are reported to drown there each year (Van Eerden *et al.* 1999). Now that the lake system is under the EU Bird and Habitat Directive, this factor is taken seriously and negotiations between BirdLife NL and the Fisheries' organisations are underway to tackle this issue.

18.2 Cormorant conflicts with fisheries

Care must be taken when interpreting information provided in this section. Please refer to section 2.2.3 (*Methodological limitations and difficulties*).

18.2.1 Conflict site descriptions

Three Cormorant conflicts were reported from the Netherlands, all were on lakes (IJsselmeer, semi-natural, eutrophic, 115,000 ha; Markermeer, semi-natural, eutrophic, 70,000 ha; NW Overijssel, natural, eutrophic, 4,000 ha) and all at < 100m altitude.

18.2.2 Birds and fish

In the Netherlands, Cormorants reported to be involved in conflicts were *P.c. sinensis*. Reported Cormorant densities for each case were 0.3 birds ha^{-1} (IJsselmeer), 0.2 birds ha^{-1} (Markermeer) and 0.5 birds ha^{-1} (NW Overijssel). Eel and Pikeperch were recorded in conflict with Cormorants in all three Dutch lakes and Perch was also recorded for IJsselmeer and Markermeer.

Colour-ringed Cormorant from the Oostvaardersplassen colony, the Netherlands (Photograph J. Herder).

18.2.3 Seasonality

Cormorant conflicts in the Netherlands were reported to occur in summer (i.e. Mar-Sep): grey boxes indicate months where fewer conflict cases were reported.

Month of conflict												
COUNTRY	J	F	M	A	M	J	J	A	S	O	N	D
Netherlands												

18.2.4 Finance

Financial information on the ‘costs’ of Cormorant predation was reported for all 3 lake conflict 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. It was requested that the values provided be categorised as either ‘actual’ or ‘estimated’. Annual financial turnover values were reported as ‘actual’, turnover losses as ‘estimated’. Additional clarification was provided for the financial loss estimates – these represented the marketable value of fish eaten by Cormorants and the values were not equal to turnover loss but were a maximum estimate – assuming no compensatory mechanisms operate within the fish stock.

In addition, a third value was provided for the Dutch lake cases. This value was called the ‘marginal turnover loss due to cormorants’ and, as with estimates of turnover loss, was based on the future market value of fish caught by Cormorants at the younger age classes. Values reported are presented in Table 18.1.

Case study site	Annual turnover (euro): actual	Annual turnover loss to Cormorants (euro): estimate	Turnover loss as % of annual turnover	Annual marginal turnover loss to Cormorants (euro): actual	Marginal turnover loss as % of annual turnover
IJsselmeer	3,200,000	1,000,000	31.2	5,500,000	171.9
Markermeer	1,600,000	530,000	33.1	2,700,000	168.8
NW Overijssel	85,000	99,900	117.5	103,600	121.9

Table 18.1 Financial information on the 'costs' of Cormorant predation for 3 Dutch lake case studies.

18.2.5 Conflict issues: magnitude of conflict

Cormorant conflicts with commercial fisheries stakeholders on lakes were the most frequently reported in the Netherlands, though nature conservationists also cited 3 conflict issues in these cases (Table 18.2)

18.2.6 Conflict issues: status of information used by stakeholders

Overall, stakeholders provided 36 records of the status of the information they used to inform themselves about Cormorant conflict issues in the Netherlands. The highest proportion of records (64%) was for 'popular' articles, followed by 'grey literature' (25%) and 'scientific literature' (4%). Overall, there were differences in the use of popular, grey and scientific literature sources between the 2 stakeholder groups providing information (Table 18.3).

	Stakeholder group			
Status of information	**Recreational**	**Commercial**	**Aquaculture**	**Nature conservation**
Popular	-	85.7%	-	33.3%
Grey literature	-	14.3%	-	40.0%
Scientific literature	-	-	-	26.7%
Total no. records (= 100%)	**None**	**21**	**None**	**15**

Table 18.3 Categorisation of the status of information used by stakeholders to inform themselves about Cormorant conflict issues. Nature conservationists used more scientific literature than expected and commercial fisheries stakeholders used less than expected (Randomisation test, approximating to $X^2 = 11.672$, df = 4, $P < 0.01$).

Conflict issue	Not claimed/not applicable	No impact	Minor effect	Major effect
(1) FISHERIES				
Reduced catch		(3)		3
Removal of fish from nets			3	
Damage to fishing gear		3		
Loss of earnings from the fishery				3
(2) FISH STOCKS				
Reduced stock - lowered production			1	
Effects on popn. dynamics/community structure			2	
Loss of juvenile fish - lowered recruitment			3	
(3) ENVIRONMENTAL				
Eutrophication				(1)
Drowning in fishing gear			2	(3)

Table 18.2 Cormorant conflict issues as recorded by commercial fishery stakeholders (and nature conservationists, round brackets) for three Dutch lakes. Each figure is the number of times a particular issue was cited by stakeholders.

18.3 Potential Cormorant management tools

There is no overall management of Cormorants in The Netherlands. Some habitat management in nature restoration sites in the IJsselmeer area frees them from Willow growth (potential nesting sites). However, in a recent report (van Rijn & van Eerden 2002) it was shown that Cormorant density was highest at ground breeding sites which would argue against this management option. Cormorants have been disturbed on several occasions, sometimes as “experiments” by local fishermen who chase birds away with fast boats on the IJsselmeer. In all colonies (either established or new) interference has been zero up to now. Only in very few cases have illegal actions been taken. Colonies are founded in protected areas belonging to either State or private organisations. Thus any interference, if desired, would have to meet several requirements with regards to management directives and responsibilities. National (Flora en Faunawet) and International laws (EC Bird Directive) are followed closely and the majority of habitat is now under these Directives.

18.4 Stakeholders consulted

In the Netherlands, the Organisation for the Improvement of Inland Fisheries (OVB) is the knowledgeable and advisory body for fisheries, fisheries management and wet nature in inland waters. In the OVB’s newsletter sometimes damage of fish stocks by Cormorants is documented on a very local scale (by local anglers organisations). However, good examples of proved damage by Cormorants are not available.

(1) Organisation for the Improvement of Inland Fisheries (OVB), P.O. Box 433, NL- 3430 AK Nieuwegein, The Netherlands.

The OVB is working together with several partners, like the anglers' organisations, research institutes, industrial circles and governments and the Dutch Society of Anglers Federations (NVVS).

(2) NVVS, P.O. Box 288, NL- 3800 AG Amersfoort, The Netherlands.

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(10) Van Rijn, S. & J. Nienhuis (2004) Aalscholvers op slaapplaatsen in Nederland in januari 2003 en 2004. Limosa 77: 2004.

(11) Veldkamp, R. (1994) Voedselkeus van Aalscholvers *Phalacrocorax carbo sinensis* in Noordwest Overijssel. Rapport Bureau Veldkamp.

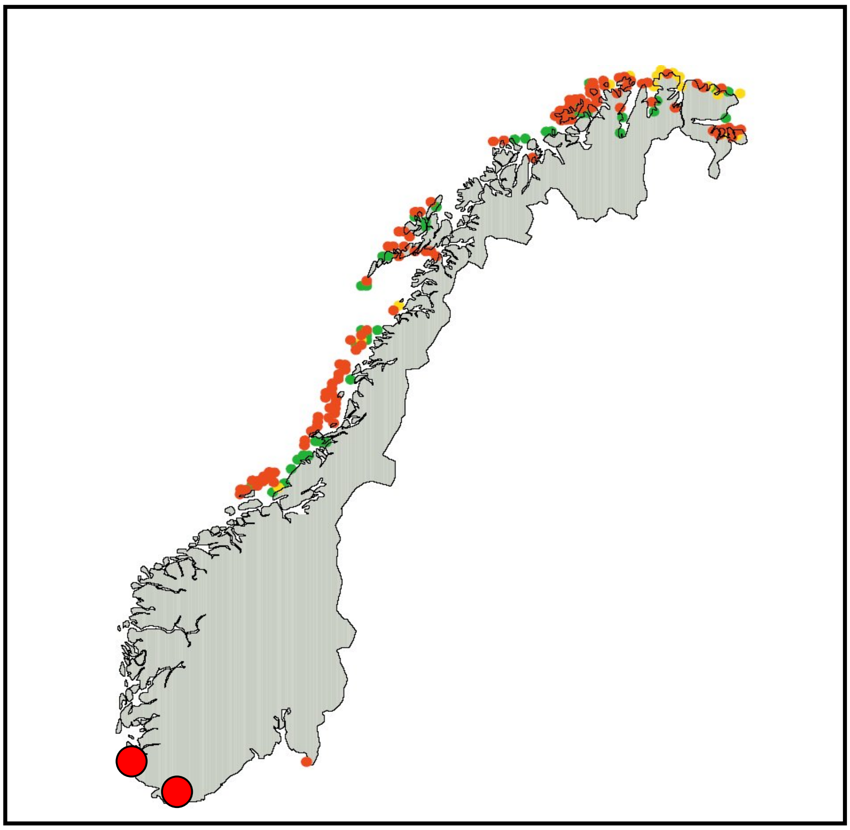
19 Norway

19.1 National overview

By Nils Røv & Svein-Håkon Lorentsen

Background

Around 20-25,000 pairs of Cormorants of the *P. c. carbo* subspecies breed on the outer archipelago in Central and Northern Norway. Of these, 7-8,500 breed north of the Arctic Circle. There has been a general increase in the breeding population of the *carbo* subspecies since the mid-1980s (Røv *et al.* 2002, Lorentsen 2003) but the population probably stabilized after ca. 2000. Parallel with the increase in the breeding population there has also been a significant increase in wintering Cormorant numbers in Norway during the period 1980-2000 (Lorentsen & Nygård 2001). However, the wintering population has also been fairly stable since 2000 (Røv *et al.* 2002). It has been assumed that about 80,000 birds spend their winter on the West Coast of Norway, mostly in the Southern part, while about 25,000 migrate out of the country to the coasts of Northern Europe. Most of them stay in Danish waters, but some go as far as the Mediterranean (Røv in prep., Mogstad & Røv 1997, Bakken *et al.* 2003).



Cormorant breeding distribution in Norway: breeding confirmed (red), probable (yellow), possible (green). *P. c. sinensis* colonies marked with large red dots. Map courtesy of Vidar Bakken/Norwegian ornithological Society.

Since 1987 an increasing number of *sinensis* have bred in the southeastern part of Norway, in a nature reserve at the outlet of the river Glomma outside Fredrikstad in Østfold County . In 2004, 992 active nests were counted in three colonies in this area (Rune Bergstrøm, pers. comm.). These birds winter in Central-Southern Europe (Bakken *et al.* 2003). Also in Vest-Agder county at the Skagerrak coast a colony of *sinensis* established in 2003. This colony grew from 7 pairs in 2003 to 80 pairs in 2004. Also in Rogaland county at the southwestern tip of Norway *sinensis* has been breeding in at least three colonies since 1996. Two of these colonies are probably abandoned due to disturbance so the number of breeding birds in 2004 (compared to at least 100 pairs in 1999) might have been as low as ca. 20 pairs (Lorentsen in prep.).

Within the breeding and wintering range of *carbo*, two kinds of problems have been identified. One is the perception that Cormorant predation reduces stocks of commercially important fish species available to fishermen. The other predicament is better documented: Atlantic Salmon farmers claim that Cormorant around their installations can cause numerous problems.

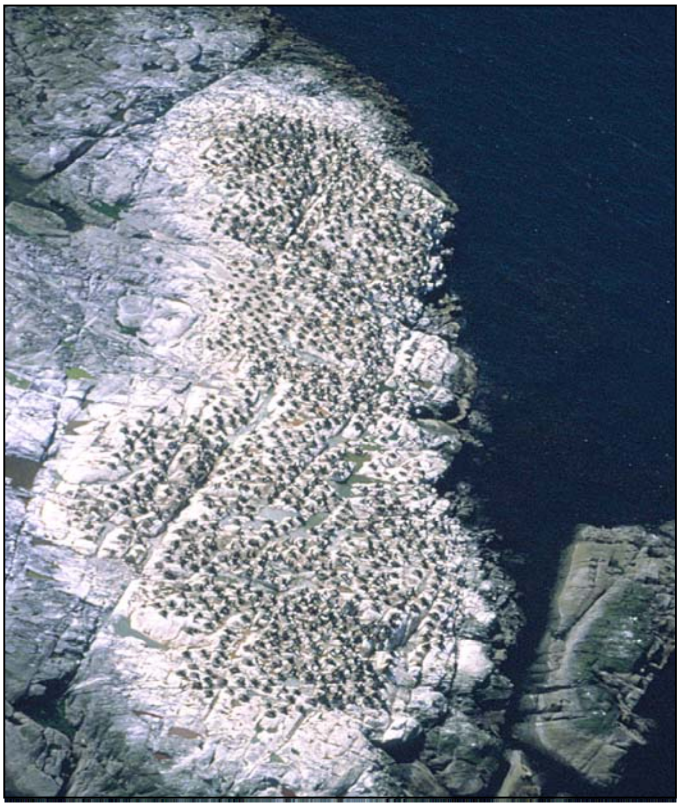
19.1.1 The Conflict

Although fishermen generally claim that Cormorant predation on flatfish (*Pleuronectidae*) and young gadoids (cod-fish) may reduce the fish stocks available to coastal fisheries, this conflict does not seem to be of particular importance. In the large nature reserve of Froan on the coast of Central Norway, some of the local inhabitants claim that dedicated protection of the area has caused an uncontrolled growth of seal and Cormorant populations. Indeed the disappearance of Cod (see Appendix 2 for scientific names) and flatfish across near-shore areas has been blamed on Cormorant and seal predation. Nevertheless, Saithe fisheries are still very good, although restricted by low fish quotas (Sverre Haarstad pers. comm., Arne Gjørrestol pers. comm.). Also, results from the national monitoring programme for seabirds (Lorentsen 2003) demonstrate that the Cormorant populations have been fairly stable in this area.

Predation on wild fish takes place throughout the year. Young Saithe and Cod “settle” in shallow areas along the coast and later recruit to the adult stock living in the open seas. Predation by seabirds is assumed to contribute to the overall mortality of these commercially important gadoid stocks. However some local people living close to Cormorant colonies are also concerned about predation on flatfish in the breeding areas. They claim that because Cormorants can now be found everywhere, there are no flatfish within shallow areas, in contrast to earlier days when there were fewer Cormorants around. These claims have not been verified.

In a recent diet study, undertaken over three years (2001-2003) in an area off the central Norwegian coast, gadoids, mainly Cod and Saithe dominated the diet (75% numerically, 86% by biomass) (Lorentsen *et al*. 2004). During the first year of the study, Cod represented nearly 50% of the diet, but decreased to 13% in 2003. At the same time, the occurrence of Saithe in the diet increased from ca. 23% to 65%. The results indicate that the decrease in Cod in the Great Cormorant diet most probably reflected the decrease in the Norwegian coastal Cod population, and that the increase in Saithe in the diet was related to the relative increase in the abundance of this fish prey as the abundance of Cod decreased.

In Southeastern Norway (Fredrikstad area, Østfold county), where the *sinensis* birds breed, local fishermen believe that they predate on local fish stocks and reduce the catch. In a recent diet study it was found that one-third of the fish consumed consisted of economic important species such as Cod, Eel and Flounder. It was estimated that the Cormorants caught about the same amount of Cod as did the fishermen. However, no conclusion was made about the effect of the bird's predation on fish populations (Skarperud 2003). This potential conflict is, for the time being, not well understood. It is expected that the Cormorant population will continue to increase in the area and will thus cause conflicts of the same kind and magnitude as described in Sweden.



Typical breeding site for Great Cormorants of the *carbo* subspecies along the coast of Central and Northern Norway.

The main problem in fish farms is that Cormorants swim close to the net and grab the fish with their bills from the outside, often inflicting severe damage on the fish. Farms with small fish are most vulnerable. The presence of the fish-eating birds is stressful to the fishes, particularly in severe temperatures conditions. Such stress might increase the sickness among fish. This conflict is fairly well documented in several reports (i.e. Johansen & Eliassen 1999). However, until now, the problems have not been described and evaluated in a scientific way. Fish farmers use several practices to overcome the problems, some of which are not legal. For example, in winter when temperatures are low, Cormorants (and Shags *P. aristotelis*) may congregate around fish farms because of the concentration of wild fish there. There are unverified reports of thousands of birds being illegally shot in some cases.

Sometimes farmers put special nets outside the farms to prevent Cormorants from entering. Many birds get stuck in the nets and drown.

19.1.2 Case Studies

Reduced recruitment of commercially important fish stocks

Barrett *et al.* (1990) studied the diet of Cormorants and Shags based on regurgitated pellets. They suggested that predation by those species could be a factor limiting the recruitment of Cod and Saithe into commercially important stocks in the Norwegian and Barents seas, especially during years with low stock size.

Cormorants as predators in a Cod enhancement area

This study took place in Sørfjorden, an extension of a larger fjord, Ullsfjord in North Norway during 1996-97. Based on otolith analyses of pellets regurgitated by 30 Cormorants roosting in the fjord during winter, the authors (Johansen *et al.* 1999) found that 98% of the food (both by biomass and number) consisted of Gadoids. Cod dominated the diet while Saithe were the second most important prey. The Cormorants selected Cod from a large range of sizes and age-classes, and more than 80% were from 10cm (1 year) to 40cm (4 years). The Cod had a mean length of 22cm and mean mass of 177g. Total Cormorant predation during the winter of 1996-97 was estimated to be at least 17,100 individuals weighing about 3 tonnes. This predation seemed to be an important cause of Cod mortality at age 0.5 to 4 years. It was concluded that serious long-term predation effects would probably arise only after several years of poor recruitment into the Cod stock. Cormorant predation was small compared to, for example, Cod cannibalism, such that any form of reduction of the Cormorant population in an attempt to enhance the local Cod population, would have little effect.

Cormorant diet outside Central Norway

Lorentsen *et al*. (2004) studied Cormorant diet outside Central Norway. Gadoids, mainly Cod and Saithe dominated the diet (75% numerically, 86% by biomass) (see above).

***Cormorant feeding behaviour and habitat use*.**

Lorentsen (in prep.) has studied Cormorant feeding behaviour and habitat use in an area outside Central Norway. The area consists of a fragmented kelp (*Laminaria hyperborean*) and soft-bottom habitat. Cormorant food loads were measured using electronic balances and habitat use was studied by means of cross-triangulation of individuals fitted with radio transmitters. Kelp was experimentally removed and the effects on fish populations and Cormorants were studied.

19.2 Cormorant conflicts with fisheries

Care must be taken when interpreting information provided in this section. Please refer to section 2.2.3 (*Methodological limitations and difficulties*).

19.2.1 Conflict site descriptions

One Cormorant conflict was reported from Norway: from a coastal fjord (Sørfjord: 6,000ha, Troms, north Norway). This conflict involved commercial fishermen.

19.2.2 Birds and fish

In Norway, Cormorants reported to be involved in conflicts were *P.c.carbo*. Maximum recorded Cormorant density at Sørfjord was 0.005 birds ha^{-1}. Two fish species were recorded in conflict with Cormorants in the single Norwegian coastal case reported: Cod and Saithe.

Breeding Cormorants (subspecies *carbo*) in Kongsfjorden, North Norway.

19.2.3 Seasonality

Cormorant conflicts in Norway were reported to occur throughout the year.

19.2.4 Finance

Financial information on the 'costs' of Cormorant predation was reported for a single conflict case. 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. It was requested that the values provided be categorised as either 'actual' or 'estimated'. The information provided for the Norwegian case was estimated. For the single case, estimated turnover for the commercial fishery was 20,000 euro and estimated loss was 1,500 euro (7.5% of turnover).

19.2.5 Conflict issues: magnitude of conflict

The single coastal commercial fishery stakeholder cited 5 conflict issues relating to either fisheries or fish stocks. Loss of stocked fish, loss of juvenile fish through lowered recruitment and loss of spawning fish were each reported to be minor issues. Reduced stock through lowered production and effects on fish population dynamics/community structure were considered but cited as not applicable.

19.2.6 Conflict issues: status of information used by stakeholders

Overall, the single stakeholder provided 5 records of the status of the information they used to inform themselves about Cormorant conflict issues in

Norway, one record for each conflict issue. All 5 records were for a single scientific paper.

19.3 Potential Cormorant management tools

The Management Authority in Norway consider Cormorants and Shags as valuable game species that should be managed in such a way that sustainable populations are maintained in all parts of their distribution area. Both species are included in the national monitoring programme for seabirds (Lorentsen 2003). The most important breeding colonies and a number of wintering areas are counted annually (Røv *et al*., 2003, Lorentsen & Nygård 2001, Lorentsen 2003). From 2002, the hunting seasons are regulated at five-year intervals (previously three-years). The hunting regulations are based on the results from the monitoring programme.

During the present hunting period, the regulations are as follows. In Central Norway north of Trondheimsfjorden and Northern Norway: Both species of all ages are hunted during 1 October - 30 November, without any bag limit. On the islands outside Trondheimsfjorden (Hitra and Frøya) and all part of Norway south of Trondheimsfjorden: Young Cormorants (with white underparts) are hunted during 1 October - 30 November, no bag limit. Adult Cormorants and Shags are protected.

Cormorants and Shags that cause damage to economic activity (mostly Atlantic Salmon farms) can be killed, after permission has been given from the local management authority.

According to the most recent hunting statistics, around 10,000 Cormorants and Shags are shot annually during regular hunting. A number of birds are supposed to be killed irregularly, mostly around fish farms. During the breeding season there is a general prohibition to disturb colonies of breeding seabirds. Many colonies are situated within special protected areas (mostly nature reserves). A number of new areas will be protected in near future. However, until now no management action has been carried out to reduce the conflicts involving *sinensis* birds. No financial compensation is being paid and the supposed damage has not been estimated.

19.4 Stakeholders consulted

(1) (Professional coastal fisherman), N-7318 Mølnbukt, Norway.
(2) (Prefessional coastal fisherman, living in Froan protected area), N-7286 Sørburøya, Norway.
(3) SalMar AS (Salmon fish farm company), N-7266 Kverva, Norway.

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20. Poland

20.1 National overview

By Robert Gwiazda & Szymon Bzoma

Background

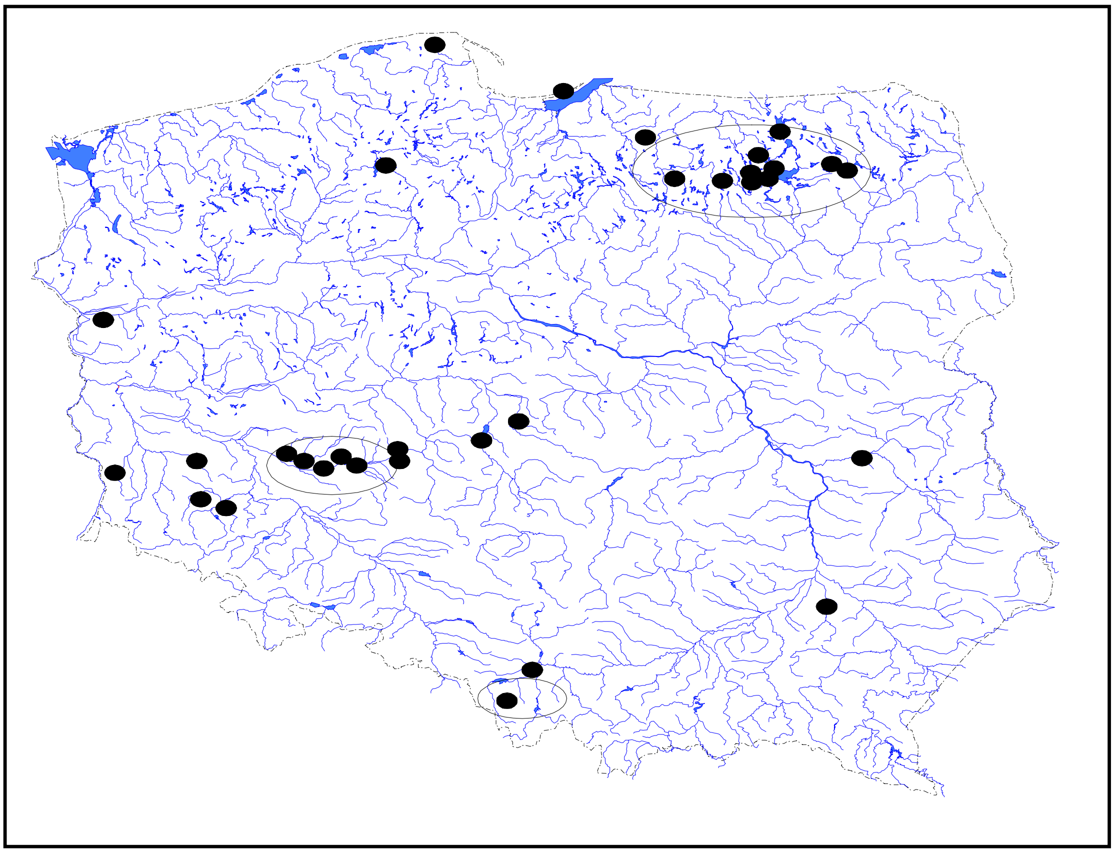
A conflict between fishermen and Cormorants emerged in Poland in the mid-1980s, following increases in the abundance of birds and the number of new breeding colonies (Dobrowolski 1995, Dobrowolski & Deitrowski 1997). Northeast Poland is the region where the densest population of Cormorants occur. During the last two decades the number of breeding Cormorants in Poland has increased from 1,470 in 1981 to 8,200 in 1992 (Lindell *et al*. 1995). At present there are ca. 15,000 breeding pairs (Tomiałojć & Stawarczyk 2003) that have come into conflict with fish farms in Southern Poland as well as with fisheries in Northeast Poland. The Olsztyn (N.E. Poland), Zielona Góra (S.W. Poland) and Bielsko-Biała (S. Poland) provinces are the regions of greatest conflict (Dobrowolski 1995). The clash between Cormorants and fish farmers raises many problems, particularly as it often results in real financial losses. For example, damage to trees in the Kąty Rybackie colony (covering ca. 100 ha of Pine forest) has caused a conflict between Cormorants and foresters while fishermen consider Cormorants to be the main cause of reduced catches and losses of Pikeperch (see Appendix 2 for scientific names) and Eel in the Vistula Lagoon or in the Mazurian Lakes.

Generally the impact of Cormorants on the fish stocks in natural freshwater habitats (lagoon, lakes, dam reservoirs) is not high. The main conflicts between Cormorants and stakeholders occur at inland aquaculture facilities located in southern Poland where breeding and migrating birds regularly feed at fishponds.

20.1.1 Cormorants in Poland

The Cormorant (*P. c. sinensis*) was an abundant and common breeding species in Poland in the first part of the nineteenth century (Tomiałojć 1990, Lindell *et al*. 1995). However, relentless persecution of the Cormorant during the second half of the nineteenth century led to a steep decline in the species by the beginning of the twentieth century. In the 1920s and 1930s only one colony was documented and the total number of breeding pairs was estimated to be between 100-150. A slow increase was recorded in the next few years, encouraged by Government protection. Around 1,800 breeding pairs were recorded in 1959 but numbers had started to decrease slowly by the early 1980s. By 1981, Cormorants were breeding at a minimum of 10 sites in Poland; in 1992 this increased to 32 sites, fifteen of which were found in the Northeast (Lindell *et al*. 1995). Only a few of the breeding colonies were located in South and Southeast Poland (Przybysz 1994).

At present, there are more than 40 breeding Cormorant colonies in Poland (Tomiałojć & Stawarczyk 2003). More than 50% of them are located in protected areas such as Reserves and National Parks (Przybysz 1994). The biggest Cormorant colony, containing ca. 50% of the total breeding population in Poland, is at Kąty Rybackie, between the Baltic coast and Vistula Lagoon (Northeast Poland) (Przybysz *et al*. 1997, Goc *et al*. 2003). The other 40 or so colonies are much smaller.



Location of Cormorant-fisheries conflicts in Poland. The main areas of conflict are shown by elipses (map provided by IMGW Wroclaw).

Cormorants stay in Poland from spring (February-March) to late autumn (November-December) at inland sites. During the winter, Cormorants are observed regularly at coastal sites (mainly in the Gulf of Gdańsk and Szczecin Lagoon) and sporadically at inland sites (Tomiałojć & Stawarczyk 2003, S. Bzoma pers. comm.). The number of birds has been connected to weather conditions.

20.1.2 Case Study: Gdańsk Bay
Gulf of Gdańsk site

The Gulf of Gdańsk is located in the southern part of the Baltic Sea (Polish and Russia coast). The shallowest part is at Puck Bay, west of the Gulf near Hel Peninsula. The maximum depth is 118 m. Vistula Split in the south of the Gulf of Gdańsk separates the Vistula Lagoon from this Gulf.

Cormorants in the Gulf of Gdańsk

The Gulf of Gdańsk is a very important area for Cormorants and increasing numbers of birds were documented during the period 1984 -1993 (Kozakiewicz *et al.* 1997). This area is occupied by up to 5,000 Cormorants in the non-breeding season and throughout winter. During the breeding season, Cormorants from the breeding colony in Kąty Rybackie use the Gulf of Gdańsk as one of their feeding grounds (Bzoma *et al.* 2003).

Diet and food consumption

Pellet analyses of non-breeding Cormorants in an annual cycle showed that the Round Goby (see Appendix 2 for scientific names) was the dominant species, comprising up 59% of the Cormorant diet, followed by the Three-spined Stickleback

(18%) and Eelpout (6%) (Bzoma 1999). The amount and frequency of Round Goby in Cormorant diets increases at the beginning of April when these fish begin spawning. A little later in the year the Round Goby constitutes 90% of the fish caught by Cormorants (Bzoma 1998). Three-spined Sticklebacks make up a large part of the Cormorant diet between October and November (Bzoma 1999).

The impact

The impact on fish was generally positive. The fact that Cormorants feed mainly on Round Goby contradicts the general opinion that they are dangerous pests to the fishing industry (Bzoma 1998).

The conflict

Generally the conflict of interests seems to be low. Birds feed mainly on the most abundant, low-value fish.

Gaps to be filled

Four areas require further research: (1) further diet studies and counting of Cormorants at coastal sites (mainly in the Gulf of Gdańsk area), (2) seasonal estimation of the number of Cormorants from the breeding colony in Kąty Rybackie that feed in the Gulf of Gdańsk, (3) studies of Cormorant impact on fish population dynamics in the Gulf, (4) socio-economic aspects of the impact of Cormorants on fisheries.

Great Cormorant day roost in the Gulf of Gdańsk (Photograph Szymon Bzoma).

20.1.3 Case Study: Vistula Lagoon

The Lagoon site

The Vistula Lagoon, a eutrophic water body, is situated in the southern part of the Baltic Sea. A narrow sand spit, the Vistula Strait separates the Lagoon from the Baltic. The Lagoon stretches over 838 km^2, is ca. 90 km long with a mean depth of less than 3m.

Cormorants in the Lagoon

The Cormorant population in the breeding colony at Kąty Rybackie on the Vistula Split has significantly increased during the last two decades. The population grew from more than 3,500 pairs in 1990 (Przybył 1994) to almost 6,000 pairs in 1996, and more than 11,500 pairs in 2004. Cormorants breed in a mixed colony with Grey Herons (*Ardea cinerea)*, located in a forest formed mainly by Pine trees *Pinus silvestris* (M. Goc pers. comm.).

The fish structure

The Vistula Lagoon is a highly productive water body. Cyprinid fishes, mainly Roach and Bream, are the dominant species in the ichthyofauna. Ruffe, also abundant in the Lagoon, is not a commercial species here. The most important fish are Pikeperch, Atlantic Salmon, Sea Trout, and Eel, the latter species having the highest economical value.

Diet and food consumption

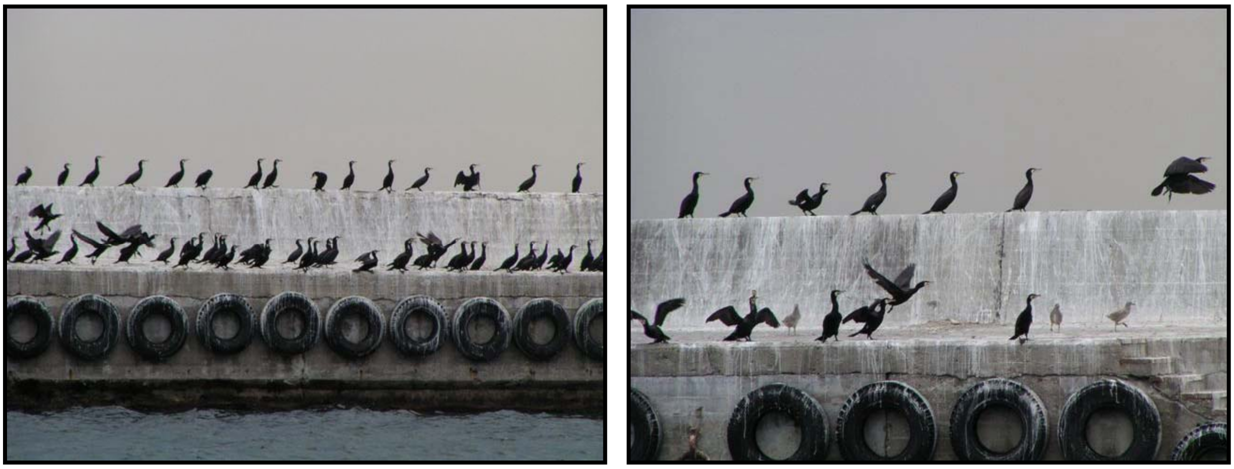
Stempniewicz *et al*. (2001) studied the diet of Cormorants from nestling regurgitations and pellets, during the breeding period since the mid 1990s. Cormorants in the Vistula Lagoon mostly fed on Ruffe (58-75% in diet by numbers), followed by Roach (5-12%). According to Martyniak *et al*. (1997b, 2000) who used data based on pellets analyses, the main prey of Cormorants from the colony in Kąty Rybackie was Ruffe (ca. n70% of diet) and Round Goby. Pikeperch made up only 2.9% and Eel 1.2% of Cormorant diet during the breeding season. The average length of fish ranged from 5.7cm-48.9 cm.

The impact

Stempniewicz *et al*. (2001) estimated that 2,200-3,100 tonnes of small fish were removed from the Lagoon (commercial landings ca. 1,484-2,267 tonnes, and Cormorant prey ca. 712-816 tonnes) during one season. Commercial catches have decreased considerably in the past 25 years, except for Herring. However, Cormorants selected smaller fish than were caught by fishermen. Indeed, due to the small size and species composition, fish taken by Cormorants have negligible economic value (Stempniewicz *et al*. 2001). Martyniak *et al*. (1997b, 2000) believe that Cormorants have a positive impact on fish by eliminating Ruffe and removing biogens from the water ecosystem. Cormorants can also have a positive impact by reducing intraspecific and interspecific competition in fish communities within the highly productive Lagoon. The negative impact of Cormorants is largely related to predation on young Pikeperch, Salmon and Sea Trout, as well as to pressure on Eel stocks.

The conflict

Local fishermen generally consider Cormorants to be the main cause of reducing landings. They believe that Cormorants can decrease yields of valuable commercial fish species. However, some local fishermen have indicated that over-fishing is the main cause of a reduction in the sustainability of fisheries. Thus, a conflict between fishermen and Cormorants should be considered within a wider socio-economic and ecological context. For example, trees in the colony die as a result of the Cormorant guano. Moreover, as the colony expands the area of destroyed forest in the Reserve increases annually.



Cormorants at Gdynia harbour (Photograph Szymon Bzoma).

Gaps to be filled

Five areas require further research: (1) further diet studies and counts of Cormorants in the Vistula Lagoon area, (2) seasonal estimation of the number of Cormorants from the breeding colony in Kąty Rybackie feeding in the Vistula Lagoon, (3) estimation of reproductive success in the Kąty Rybackie colony, (4) studies of Cormorant impacts on fish population dynamics in the Lagoon, (5) socio-economic impact of Cormorants on fisheries.

20.1.4 Case Study: The Lakes

The lakes sites

Lakes in Poland cover approximately 317,000 ha, ca. 80% of which are found in Northern Poland (Szczerbowski 1993). Most of the Cormorant colonies are located in the Mazurian Lakeland area (Northeast Poland), the majority of lakes here are highly productive and eutrophic.

The Cormorants on lakes

On average, 80% of the Polish Cormorant population bred in this region between 1988-1992 (Przybysz 1994, Przybysz *et al*. 1997). According to Przybysz *et al*. (1997), in 1992 the largest colonies existed at Lake Dobskie (680 pairs), in Słońsk (550 pairs), at Lake Morąg (430 pairs) and at Lake Rydzówka (310 pairs). At Włocławek dam reservoir, the breeding population reached 1,300 nests in 1998 (Tomiałojć & Stawarczyk 2003).

The fish structure

The lacustrine fish fauna in Poland consists of about 20 species, dominated by cyprinid and percid fishes. In most cases the major fish species are Roach, Bream and Perch (Brylińska 1986, Szczerbowski 1993). The species of highest economic value are Pike, Pikeperch, Eel, Vendace and another whitefish, the Powan.

Diet and food consumption

The most frequent species in the diet of Cormorants shot at Mazurian Lakeland in spring was Roach (Mellin 1990). Based on analysis from stomachs, Roach comprised 72% by number and 41% by mass, and based on analysis of undigested fish

- 54% and 23% respectively. The proportion of Eel was relatively high based on mass (more than 20%) (Mellin 1990). Thus, Roach dominated the diet of Cormorants at two studied colonies in Mazurian Lakeland (Rydzówka Lake, Morąg Lake) but Perch and Eel were also important. The most frequently eaten prey were 10-15 cm long. (Martyniak *et al.*,1997a).

The main prey of Cormorants at the lakes of two National Parks in Northeast Poland after the breeding season was Roach, following by Perch. The fraction of Eel in their diet was very small (Martyniak *et al*. 1997c). Roach and Perch were also dominant in the diet of breeding Cormorants at Wielimie Lake (Pomeranian Lakeland), although the occurrence of Pikeperch was very small (less than 3%) (Gwiazda 2002).

The impact

The Cormorant is considered an important agent in reducing the overcrowded whitefish stock in eutrophic lakes (Mellin & Mirowska-Ibron 1997). The reduction of young planctivorous fish is positive for fisheries. However, negative impacts include the presence of Eel in the Cormorant diet. It was also found that 82% of fish caught by Cormorants from lake colonies contained tapeworms (Mellin 1990, Mellin & Mirowska-Ibron 1997), so there may be, as yet unrealised, parasitic affects.

The conflict

Financial losses based on studies at Olsztyn and Ełk Fish Farms in Northeast Poland were calculated to be between 2,200,000- 3,200,000 zł (ca. 580,000-850,000 euro), (Andrzejewski & Łakomy 1998). Nevertheless, this calculation was made on the assumption that every fish consumed by Cormorants was commercial and valuable. The fishermen considered Cormorants to be the main factor in reduction of Eel and Pikeperch stocks in lakes.

Gaps to be filled

Four areas require further research: (1) counts of breeding and non-breeding birds, location of unknown and newly established colonies and roosting sites, (2) estimation of reproduction success in the breeding colonies, (3) further diet studies of Cormorants at lakes, (4) studies of Cormorant impact on fish population dynamics in lakes.

20.1.5 Case study: aquaculture fishponds

The fishponds sites

Aquaculture fish farms in Poland cover a total area of ca. 70,000 ha (ca. 50,000 ha of surface area) (Szczerbowski 1993, Dobrowolski 1995) although the distribution of ponds in Poland is uneven. Southern Poland has the most ponds and can be divided into three main areas: the Wrocław and Legnica Provinces in Southwest Poland, the Bielsko-Biała and Katowice Provinces in Southern Poland and the Tarnobrzeg, Lublin and Chełm Provinces in Southeast Poland (Dobrowolski 1995). State-owned fishponds cover more than 40,000 ha, which is ca. 75% of the total surface area of fishponds in Poland. However, privatization has contributed to a change in ownership over the past few years.

The Cormorants at aquaculture fishponds

The ponds at Milicz Fish Farm are protected as a Natural Birds Reserve. In 1981 Cormorants tried to breed at the Milicz complex (Southeast Poland). Within this complex, 46 Cormorant nests were recorded in 1984 and 251 in 1986. Almost 100 Cormorants bred in this complex in 1991. Since 1986, Cormorants have started to breed at the Goczałkowice Reservoir near the fishponds (Southern Poland). In 1989, 135 pairs bred there but after the destruction of nesting trees in 1991 and 1992, Cormorants did not breed at all. At present, between 40-50 pairs have bred at this reservoir and forage at the fishponds (Gwiazda 2002).

At Łężczak pond (Southern Poland), Cormorants started to breed in 1990 (63 nests). The next year, 104 nests were recorded. Some small colonies were recorded at fishponds in the central part of country. Non-breeding Cormorants feed at a number of larger fishponds and contribute to losses of fish. Although breeding Cormorants from more than 10 colonies in Poland are not located near fishponds, they do forage there. After the breeding season, and during migration, Cormorants often visit fishponds to forage. Approximately 2,300 birds were legally shot at Polish fishponds in 2001.

The fish community structure

The main fish species in Polish aquaculture is the common Carp, making up more than 95% of the whole production. The remaining farms mostly stock Rainbow Trout (Szczerbowski 1993). Populations of some non-commercial fish species such as Perch and Roach also inhabit fishponds.

Fish farm production

Between 1986-1995, the production of Carp in an area ca. 70,000 ha ranged from 16,700 tonnes to 25,000 tonnes (Butz 1997, cited after Mastyński 1998). Average production was 286 kg/ha with a maximum of ca. 3,200 kg/ha. Carp is sold for direct consumption.

Diet and food consumption

The diet of Cormorants is largely related to the fish stock structure at farms, consisting mainly of Carp. The remains of Carp were found in over 90% of the stomachs of birds feeding in Warlity Fish Farm (Mellin & Mirowska-Ibron 1997). The most frequently eaten prey were 8.0-10.9 cm in body length and weighed 10-20 g (Mellin *et al*. 1997). Carp was also the most common fish in the diet of Cormorants (ca. 70% in number) feeding in fishponds at the Milicz complex (Witkowski & Orłowska unpubl. data). Carp was predominant in the diet of Cormorants from the breeding colony in Goczałkowice Reservoir, feeding at the fishponds of the Upper Vistula River. Carp (almost 70% in number) ranged from 13-31 cm with an average of 21.0 cm (Gwiazda 2002). At the Sorkwity site (Northeast Poland), whitefish was the subdominant food item, in some fish farms this species is reared as stocking material (Mellin *et al*. 1997).

The impact

In 1992, six colonies existed on fishponds with a further 15 located within foraging distance (Andrzejewski & Łakomy 1998). The financial losses caused by Cormorants were given by Dobrowolski & Deitrowski (1997). The Breeding colony at Potasznia fishponds comprised 250 nests, and the estimated annual losses reached about over $15,000. In 1990 the fish farm at Psary requested compensation of more than $12,500 for losses caused by Cormorants from a nearby colony. The Charzykowy Fish Farm estimated losses of about $4,700. In 1992 and 1993 the Fish Farm at Parowa estimated losses of approx. $30,000 caused by 300-500 cormorants foraging on the fishponds from mid-July until the winter migration. Witkowski & Orłowska (unpubl. data) calculated losses at the Milicz fishpond complex. Cormorants consumed almost 70 tonnes of fish in 2000 and ca. 62 tonnes in 2001 from February until October. The losses ammounted to less than 3% of an annual turnover: ca. 360,000 zł in 2,000 and 330,000 zł in 2001 (95,000 and 87,000 euro, respectively) (Witkowski & Orłowska unpubl. data). Andrzejewski & Łakomy (1998) estimated that financial losses from Cormorant predation in ponds across Poland were about 800,000-1000,000 zł (ca. 210,000-260,000 euro).

The conflict

Foraging Cormorants at fish farms are serious pests. The conflict between fishermen and Cormorants occurs mainly in summer (breeding season) and in autumn (post-breeding and migrating periods), starting in February-March and ending in October-November (Witkowski & Orłowska unpubl. data). The essence of the conflict is that Cormorants feed mostly on reared Carp. Additional conflicts arise because Cormorants are believed to damage fish, increasing the chance of disease and predation by other bird species as well as reducing the marketable value of the fish. Fish, living in habitats within the Cormorants foraging area are found to have slower growth because of stress. The use of expensive scaring devices increases the costs of production in fish farms but most farm owners believe that without any scaring techniques their financial losses would be much higher and they would lose their business. Thus, disturbing by using gas cannons and shooting of birds at fishponds is the most common scaring technique in Poland. Illegal damage of nests has also been recorded.

Cormorant colony at Goczalkowice Reservoir (Photograph Robert Gwiazda).

Gaps to be filled

Four areas require further research: (1) counts of breeding and non-breeding birds counting, location of unknown and new established colonies, (2) rigorous studies of Cormorant predation and impact on aquaculture farming, (3) development of existing scaring techniques or introduction of new but effective ones, (4) consideration of new legal regulations (e.g. shooting Cormorants all year on fish ponds).

20.2 Cormorant conflicts with fisheries

Care must be taken when interpreting information provided in this section. Please refer to section 2.2.3 (*Methodological limitations and difficulties*).

20.2.1 Conflict site descriptions

Thirty-eight Cormorant conflicts were reported from Poland: at 22 aquaculture (50% State owned, 50% privately owned) pond sites (Potasznia, Psary, Charzykowy, Parowa, Ośno Lubuskie, Buda Stalowska, Przemków, Zator, Krośnice, Stawno, Ruda Sułowska, Radziądz, Gołysz/Mnich/Dębowiec/Ochaby, Mała Raszowa, Antonin, Dzikie Nowe Brzeziny, Przygodzice, Niedźwiedzice, Rybin, Pęczniew-Jeziorsko, ponds near Lublin and in NE Poland), 14 lakes (Morąg, Rydzówka, Ełk, Orle, Głębokie, Jorzec, Jeziorsko Reservoir, Tałty Ryńskie, Mazurian Lakes, Bełdany, Żarnowieckie, Łętowo, Tuchlin, Inulec) and 2 coastal sites (Gdańsk Bay, Vistula Lagoon) (Table 20.1).

Habitat	**Feature**	**Category**		
	Altitude (m)	**< 100m**	**100-500m**	**500+m**
Aq. Ponds	N = 16 cases	11	5	
Lakes	N = 7 cases	7		
Coasts	N = 2 cases	2		
	Trophic status	**Oligotrophic**	**Mesotrophic**	**Eutrophic**
Aq. Ponds	N = 22 cases			22
Lakes	N = 14 cases		1	13
Coasts	N = 2 cases			2
	Anthropogenic Influence	**Natural**	**Semi-natural**	**Artificial**
Aq. Ponds	N = 22 cases			22
Lakes	N = 14 cases	11	1	2
Coasts	N = 2 cases		2	

Table 20.1 The number of Cormorant conflict cases reported from Poland in relation to habitat and habitat features.

20.2.2 Birds and fish

In Poland, Cormorants reported to be involved in conflicts were *P.c. sinensis*. Reported Cormorant densities are given in Table 20.2

Habitat	**No. cases**	**Cormorant density (maximum no. ha^{-1})**			
		Mean	**SE**	**Minimum**	**Maximum**
Lakes	13	0.8	0.33	0.06	4.57
Aq. ponds	13	1.6	0.8	0.21	11.10

Table 20.2 Cormorant density (mean, standard error [SE], minimum and maximum) for Polish cases in relation to 2 habitat types.

Carp was recorded in conflict with Cormorants at all but one of the 19 Polish aquaculture case studies, Eel was recorded at the remaining site. These two species were also recorded for lake cases: Carp in 6 (75%) cases, Eel in 2 (25%) cases. Eel, Flounder, Pikeperch, Sea Trout and Atlantic Salmon were each recorded in conflicts in one of the 2 coastal cases.

20.2.3 Seasonality

Cormorant conflicts in Poland were reported to occur in summer (i.e. Mar-Oct): grey boxes indicate months where fewer conflict cases were reported.

Month of conflict												
COUNTRY	J	F	M	A	M	J	J	A	S	O	N	D
Poland												

20.2.4 Finance

Financial information on the ‘costs’ of Cormorant predation was reported for 17 pond aquaculture conflict cases, 13 lakes ones and a single coastal case. 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. It was requested that the values provided be categorised as either ‘actual’ or ‘estimated’. All values provided for Poland were estimated. Based on the 17 cases, average estimated turnover for 17 aquaculture pond fisheries was 592,408 euro and average estimated loss was 19,001 euro (3% of turnover) and average estimated turnover for 13 commercial lake fisheries was 607,781 euro and average estimated loss was 73,899 euro (12% of turnover). Estimated turnover for the single coastal fishery was 30,000,000 euro and estimated loss was 261,100 euro (0.9% of turnover).

20.2.5 Conflict issues: magnitude of conflict

Cormorant conflicts with pond aquaculture fisheries stakeholders (n = 22 cases) and with commercial fisheries stakeholders (n = 14) on lakes were the most frequently reported in Poland. Aquaculture stakeholders (information from 22 cases) identified 12 conflict issues relating to fisheries, fish stocks and environment while commercial fishery stakeholders (information from 11 cases) identified 10 conflict issues relating to these three categories. The most commonly cited major conflicts in the fisheries and fish stocks categories were loss of stocked fish and reduced stock through lowered production, respectively, while no major conflicts were identified in the environment category (Table 20.3).

20.2.6 Conflict issues: status of information used by stakeholders

Overall, stakeholders provided 200 records of the status of the information they used to inform themselves about Cormorant conflict issues in Poland. The highest proportion of records (52%) was for ‘grey literature’ articles, followed by ‘popular’ articles (24%) and ‘scientific literature’ (23%). Overall, there were no differences in the use of popular, grey and scientific literature sources between the 2 stakeholder groups providing information (Table 20.4).

Conflict issue	Not claimed/not applicable	No impact	Minor effect	Major effect
(1) FISHERIES				
Reduced catch			9 (8)	2 (2)
Loss of stocked fish			16	4 (1)
Reduced value of catch (damage)			7	
Reduced catchability (stress/behaviour)			7	
Loss of earnings from the fishery			8 (8	2 (2)
Reduced capital values of fisheries			1 (1)	2
Increased recurrent costs			(1)	
(2) FISH STOCKS				
Reduced stock - lowered production			16 (8	4 (2)
Effects on popn. dynamics/community structure			7 (2)	3
Vectors of diseases/parasites			(2)	
Loss of juvenile fish - lowered recruitment			7	2
Loss of aquaculture stock			8	3
(3) ENVIRONMENTAL				
Eutrophication			(1)	
Scaring/shooting disturbance			1	
Damage to vegetation/landscape			1 (1)	

Table 20.3 Cormorant conflict issues as recorded by pond aquaculture fishery stakeholders (and commercial lake fisheries stakeholders, round brackets) for 22 and 11 conflict cases, respectively. Each figure is the number of times a particular issue was cited by stakeholders.

Status of information	Stakeholder group			
	Recreational	**Commercial**	**Aquaculture**	**Nature conservation**
Popular	-	23.8%	24.8%	-
Grey literature	-	46.0%	55.5%	-
Scientific literature	-	30.2%	19.7%	-
Total no. records (= 100%)	**None**	**63**	**137**	**None**

Table 20.4 Categorisation of the status of information used by stakeholders to inform themselves about Cormorant conflict issues.

20.3 Potential Cormorant management tools

Information (summarised in the following tables) was provided on (1) general actions taken against Cormorants in Poland, (2) management plans/legal regulations, (3) actions at stillwaters, and (4) at aquaculture sites.

20.4 Stakeholders consulted

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NAME OF RESPONDENT AND YOUR AFFILIATION	Robert Gwiazda, Institute of Freshwater Biology, Polish Academy of Sciences
COUNTRY	Poland
REGION / PROVINCE / etc. (if applicable)	
Period which is concerned [year(s)]	2001

A. General Information

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

	Total numbers		**Regional numbers**				
	National numbers	**Count/Estimate?**	**Mazury and Warmia Voivodship (NE)**	**Lubuski Voivodship (W)**	**Wielkopolska Voivodshiop (W)**	**Lower Silesia Voivodship (SW)**	**Upper Silesia Voivodship (S)**
Number of breeding colonies destroyed or disturbed							
Number of nests destroyed							
Number of nestlings killed							
Number of adults killed in the non-breeding season	ca. 2,100-2,300		ca. 200-300	40	ca. 100	1,531	ca. 200-300
Number of breeding adults killed							
Number of night roosts destroyed or disturbed							

Management plans / legal regulations (Poland 2001)						
	Total country	Mazury and Warmia Voivodship (NE)	Lubuski Voivodship (W)	Wielkopolska Voivodshiop (W)	Lower Silesia Voivodship (SW)	Upper Silesia Voivodship (S)
Are there any management plans in effect? Please list all national or regional plans and give details	No					
Are there any regulations in effect that allow Cormorant culling? Please list all national or regional regulations and give details	No					
Is it mandatory to obtain single permits for Cormorant killing?	No					
Has a general permit for Cormorant killing been issued?	No					
Is there any financial compensation for fish losses?	No					
Is there any financial aid for the construction of Cormorant exclosures or for scaring programmes, etc.?	No					

NAME OF RESPONDENT AND YOUR AFFILIATION	**Robert Gwiazda, Institute of Freshwater Biology, Polish Academy of Sciences**
COUNTRY	**Poland**
REGION / PROVINCE / etc. (if applicable)	
Period which is concerned [year(s)]	
C. Still Waters	

Cormorant Damage Control Activities								
1. Resource Management	**Technique is used?**	**Efficiency?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Habitat management								
Eliminating bird nesting sites (nest/tree removal)	rarely	months	3	5	1		illegal	
Fish management								
Locating most susceptible fish species and size close to the centre of human activity or near buildings	unknown							
3. Wildlife Management								
3.1 Non-lethal techniques	**Technique is used?**	**Efficiency?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Human harassment								
Human patrol with pyrotechnics (fireworks) on foot or in vehic	rarely	days	3	2	2			
Simple human presence	regularly	not efficient	1	1	5			
Audio frightening techniques								
Gas bangers / cannons (propane gas exploders)	regularly	days	2	3	3		Disturbance to other animals.	
Pyrotechnics / Fireworks (shell crackers, screamers, whistling projectiles, exploding projectiles, bird bangers, flash/detonation cartridges)	rarely	days	2	3	3		As above.	
Visual frightening techniques								
Eye spot balloons	rarely	days	2	1	5			
Laser light	unknown							
Prevention of colony establishment (non-lethally)								
local	rarely	months	1	1	1			
3.2 Lethal techniques	**Technique is used?**	**Efficiency?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Egg and nestling destruction								
Egg oiling	unknown							
Nest or egg destruction	rarely	weeks	3	4	1		illegal	
Killing of nestlings	rarely	months	3	5	1		illegal	
Shooting adults								
to reinforce non-lethal harassment	rarely	days	1	1	1			
to reduce bird densities at specific sites	regularly	months	4	4	1			
coordinated culling programmes	unknown							
not coordinated culling	unknown							

NAME OF RESPONDENT AND YOUR AFFILIATION	**Robert Gwiazda, Institute of Freshwater Biology Polish Academy of Sciences**							
COUNTRY	**Poland**							
REGION / PROVINCE / etc. (if applicable)								
Period which is concerned [year(s)]								
E. Aquaculture								
Cormorant Damage Control Activities								
1. Resource Management	**Technique is used?**	**Efficiency?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**Reference**
Habitat management								
Eliminating bird nesting sites (nest/tree removal)	rarely	months	3	5	2		illegal	
Fish management								
Locating most susceptible fish species and size close to the centre of human activity or near buildings	unknown							
3. Wildlife Management								
3.1 Non-lethal techniques	**Technique is used?**	**Efficiency?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**Reference**
Human harassment								
Human patrol with pyrotechnics (fireworks) on foot or in vehicles	rarely	days	3	3	2			
Simple human presence	regularly	not efficient	1	1	5			
Audio frightening techniques								
Gas bangers / cannons (propane gas exploders)	regularly	days	2	3	3		Disturbance to other animals.	
Pyrotechnics / Fireworks (shell crackers, screamers, whistling projectiles, exploding projectiles, bird bangers, flash/detonation cartridges)	rarely	days	2	3	3		As above.	
Visual frightening techniques								
Eye spot balloons	rarely	days	2	1	5			
Laser light	unknown							
Prevention of colony establishment (non-lethally)								
local	rarely	months	1	1	1			
3.2 Lethal techniques	**Technique is used?**	**Efficiency?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**Reference**
Egg and nestling destruction								
Egg oiling	unknown							
Nest or egg destruction	rarely	weeks	3	5	1		Illegal	
Killing of nestlings	rarely	months	3	5	1		As above.	
Shooting adults								
to reinforce non-lethal harassment	rarely	days	1	1	1			
to reduce bird densities at specific sites	regularly	months	4	4	1			
coordinated culling programmes	unknown							
not coordinated culling	unknown							

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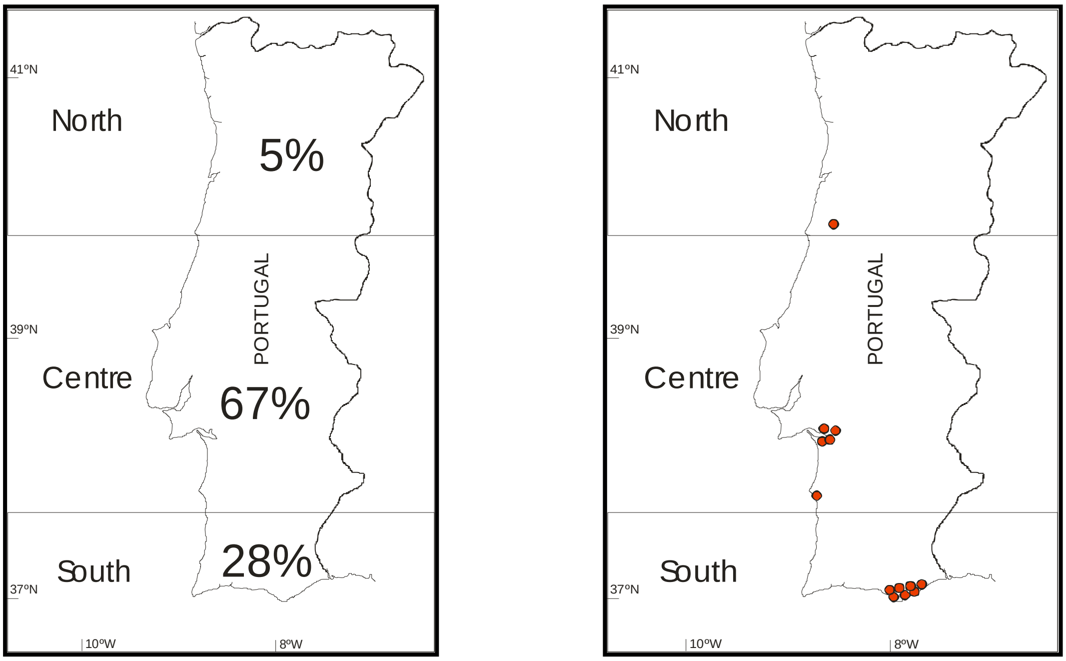
21. Portugal

21.1 National overview

By Catarina Vinagre & Susana França

Background

Two subspecies of Cormorants occur in Portugal, *P. c. carbo* and *P. c. sinensis*. They are wintering birds and no breeding colonies are known. Analysing data from the midwinter census (1984 to 1997), Costa & Granadeiro (1997) concluded that Cormorant populations have increased in Portugal. In 1984 the estimated number of wintering Cormorants in Portugal was 1,000 individuals, this rose to 10,000 by 1997 but has since stabilised. Cormorants are usually found in estuaries, such as those of Minho, Tagus, Sado and Ria Formosa, with the largest concentrations in the Tejo and Sado estuaries (*ibid*).



(Left) distribution of fish farms in Portugal (proportional distribution of farms according to region) and (Right) location of case study sites (see sections 21.2.1 and 21.4).

21.1.1 Case Studies

There are almost no conflicts between Cormorants and fish farmers in Portugal. Preliminary studies on Cormorant diet in the Sado Estuary (Costa & Granadeiro, unpublished) show that this species feeds mainly on Thin-lipped Grey Mullet (see Appendix 2 for scientific names) a non-commercial species in Portugal. The occurrence of commercially important species in the diet of Cormorant, such has Sole, Sea Bass and Gilthead Sea Bream was very low. Grade (1996) also conducted a study on the diet ecology of Cormorants and examined the conflicts between this species and fisheries in the Ria Formosa. He concluded that there were around 2,000 Cormorants in this area and that they fed mainly on Sand-smelt, a non-commercial species. The incidence of commercial species in Cormorant diet was lower than 1%. Grade's study covered seven aquaculture sites in the Ria Formosa region and only two sites reported losses of more than 5% from Cormorant predation. To discourage Cormorants, these aquacultures facilities used physical barriers such as grid and parallel lines but it was found that such preventative measures were not correctly installed in six of the aquaculture sites (*ibid*).

Aquaculture

We thus undertook a series of interviews with aquaculture managers, focusing on aquaculture interests as the main fishery stakeholder in Portugal. Angling is not an important activity in Portugal (anglers are few in number and there are no Associations). There are also no important fishing communities on rivers, since freshwater fish are not valued in Portugal and therefore are not commercially important. However, there has been a considerable investment in aquaculture in the last 15 years. Generally, both traditional and modern aquaculture takes place in estuaries, in salt marshes where old salt works have been transformed into fish farms.

Brown Trout fish farm located in the estuarine system of Aveiro in the North of Portugal.

Information from the interviews led to the following conclusions. In north Portugal aquaculture is not an important activity. There are some trout farms but conflicts with Cormorants have never been reported. In central Portugal there is an important tradition in aquaculture and also recent investments. Fish farmers reported losses from Cormorant predation that ranged from 5% to 85% per tank. In the south there has been a lot of recent investment in aquaculture. Grade (1996) reported complaints from fish farmers and also fishermen that were targeted against Cormorants. Most fish farmers reported losses of less than 5%, but one aquaculture site reported a 9% loss and another 100% loss due to Cormorants. However, there are some doubts about reports of serious losses from Cormorant predation. For example, some fish farmers may be driven to emphasise their losses in the hope of getting some financial aid such as government or European subsidies. These kinds of subsidies became quite common in Portugal during the 1990s, being widespread in agriculture but were never applied to aquaculture.

Many of the aquaculture sites use some kind of scaring or preventative device to deter Cormorants and reduce predation. The most common methods were parallel and grid strings (coloured) which people considered quite effective. Some fish farmers use explosions but concluded that after some time they became ineffective. Human scarecrows were also traditionally used, although people knew they were ineffective. Human presence is quite effective but only works in small facilities where people are always around working. One of the farms invested in an ultra sound device but found it to be ineffective. Conflicts between Cormorants and fisheries are not very serious in Portugal. The use of parallel and grid strings should be enough to control losses from Cormorants and other birds.

21.2 Cormorant conflicts with fisheries

Care must be taken when interpreting information provided in this section. Please refer to section 2.2.3 (*Methodological limitations and difficulties*).

21.2.1 Conflict site descriptions

Twelve Cormorant conflicts were reported from Portugal: at 12 coastal aquaculture sites (Nova, Apostolos, Bocage, Herdade do Zambujal in the Sado Estuary and Aquamarim and 7 in the Ria Formosa estuarine system (in the Algarve) (Table 21.1). Most conflicts were reported from semi-natural, nutrient poor waters.

Habitat	**Feature**	**Category**		
	Altitude (m)	**< 100m**	**100-500m**	**500+m**
Aq. sites	N = 12 cases	12		
	Trophic status	**Oligotrophic**	**Mesotrophic**	**Eutrophic**
Aq. sites	N = 12 cases	9		3
	Anthropogenic Influence	**Natural**	**Semi-natural**	**Artificial**
Aq. sites	N = 12 cases		8	4

Table 21.1 The number of Cormorant conflict cases reported from Portugal in relation to habitat and habitat features.

21.2.2 Birds and fish

In Portugal, Cormorants reported to be involved in conflicts were both *P. c. carbo* and *P.c. sinensis*. However no density values were reported for any of the 12 coastal aquaculture sites. Five fish species were recorded in conflict with Cormorants in the 12 Portuguese coastal aquaculture cases reported (Table 21.2).

21.2.3 Seasonality

Cormorant conflicts in Portugal were reported to occur in winter (i.e. Nov-Mar): grey boxes indicate months where few conflict cases were reported.

Month of conflict												
COUNTRY	J	F	M	A	M	J	J	A	S	O	N	D
Portugal												

Species	Frequency (% of 12 cases)
Gilthead Sea Bream	100%
Sea Bass	67%
Senegal Sole	33%
Eel	25%
Thin-lipped Grey Mullet	2%

Table 21.2 Fish species reported to be involved in conflicts with Cormorants in 12 cases from Portuguese coastal aquaculture sites.

21.2.4 Finance

Financial information on the 'costs' of Cormorant predation was reported for several estuarine aquaculture conflict 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. It was requested that the values provided be categorised as either 'actual' or 'estimated'. However, turnover information was not provided for Portuguese cases and only 6 estimates of loss were provided. These loss estimates were highly variable being 0.5%, <5%, 7%, 9%, 83% and 100% of turnover.

21.2.5 Conflict issues: magnitude of conflict

Cormorant conflicts with coastal aquaculture fisheries stakeholders were the only ones reported (n = 12 cases) in Portugal. Aquaculture stakeholders reported 12 conflict cases and nature conservationist stakeholders also reported on 7 of these cases. Aquaculture stakeholders identified 14 conflict issues relating to either fish stocks or environment, nature conservationist stakeholders identified 3 issues relating to environment. The most commonly cited major conflicts for aquaculture stakeholders related to fish stocks: reduced stock through lowered production, effects on population dynamics/community structure, loss of spawners and loss of aquaculture stock. Nature conservationist stakeholders reported no major conflict issues (Table 21.3)

21.2.6 Conflict issues: status of information used by stakeholders

Overall, stakeholders provided 177 records of the status of the information they used to inform themselves about Cormorant conflict issues in Portugal. The highest proportion of records (60%) was 'scientific literature', followed by 'popular' articles (40%). There were no records for 'grey literature'. Overall, sample sizes were too small to investigate possible differences in the use of popular, grey and scientific literature sources between the 2 stakeholder groups providing information (Table 21.4).

Status of information	Stakeholder group			
	Recreational	Commercial	Aquaculture	Nature conservation
Popular	-	-	41.7%	-
Grey literature	-	-	-	-
Scientific literature	-	-	58.3%	100.0%
Total no. records (= 100%)	**None**	**None**	**168**	**9**

Table 21.4 Categorisation of the status of information used by stakeholders to inform themselves about Cormorant conflict issues.

Conflict issue	Not claimed/not applicable	No impact	Minor effect	Major effect
(2) FISH STOCKS				
Reduced stock - lowered production		9	1	2
Effects on popn. dynamics/community structure		9	1	2
Threats to endangered fishes	11	1		
Vectors of diseases/parasites	11	1		
Loss of juvenile fish - lowered recruitment	1	8	2	1
Loss of spawners		9	1	2
Loss of aquaculture stock		9	1	2
(3) ENVIRONMENTAL				
Eutrophication	11	1 (2)		
Interactions with other birds	12	(5)		
Scaring/shooting disturbance	9	3 (2)		
Lead contamination (birds/environment)	9	3		
Landscape alteration	12			
Drowning in fishing gear	12			
Damage to vegetation/landscape	12			

Table 21.3 Cormorant conflict issues as recorded by aquaculture stakeholders (n = 12 cases) on Portuguese coasts (figures for nature conservationist stakeholders at 7 of these sites in round brackets). Each figure is the number of times a particular issue was cited by stakeholders.

21.3 Potential Cormorant management tools

Cormorant management issues in Portugal are covered in Grade (1996), Costa & Granadeiro (1997), and in section 21.1.1.

21.4 Stakeholders consulted

The following aquaculture stakeholders were consulted.

Aquaculture facility	Location
Truturão	North
Apostolos	Sado Estuary (Centre)
Nova	Sado Estuary (Centre)
Bocage	Sado Estuary (Centre)
Aquamarim	South
Herdade do Zambujal	Sado Estuary (Centre)
*Ria Formosa 1	Ria Formosa (South)
*Ria Formosa 2	Ria Formosa (South)
*Ria Formosa 3	Ria Formosa (South)
*Ria Formosa 4	Ria Formosa (South)
*Ria Formosa 5	Ria Formosa (South)
*Ria Formosa 6	Ria Formosa (South)
*Ria Formosa 7	Ria Formosa (South)

* This was the case study referred to in the scientific report (Grade, 1996). The name of the manager and the aquaculture facility was not mentioned, only the region.

21.5 Bibliography

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22. Romania

22.1 National overview
By Botond Kiss

Background

There are approximately 16,000 pairs of Cormorants (*P. c. sinensis*) in Romania. Almost all Cormorants in Romania nest in the Danube Delta and the Razim–Sinoe lagoon complex. The rest of the nesting population, located in wetlands in other parts of the country, only make up 1 -2 % of the overall Cormorant population in the Delta although they do have some socio-economic impact on the areas where they reside. In some areas, along the lower Danube, the presence and impact of the nesting Cormorants on both the Bulgarian and Serb side needs consideration. For example, the birds in the Plavnii Reserve, especially those sited in the colonies in the Limba zone move regularly, sometimes several times a day, into Romania to feed in the fish farms.

Today, after the latest observations in the lower Danube (working in the Green Danube Corridor project), more Cormorants appear to be living in the lower Danube and in the west part of Romania, together possibly 2,000 pairs. The last census of the Delta in 2002 recorded 16,000 pairs. Best estimates place the total Romanian population at over 18,000 breeding pairs. Some of the observed birds possibly come from Ukraine and Bulgaria.

Great Cormorant colony in the Romanian sector of the Danube Delta (Photograph Maarten Platteeuw).

22.1.1 Conflicts within the Danube Delta

The Danube Delta, the largest delta in Europe, is made up of two major channels (Sulina and Gherghe) which stem from the Danube, as well as a network of freshwater lakes and interconnecting waterways (Bell *et al*. 2001). The Danube Delta Biosphere

Reserve was established by the Romanian government in 1990 to manage 580,000 ha of wetlands and is a site of major significance for ornithologists, lying at the intersection of a main European migration route for 325 species of birds (Bell *et al*. 2001).

The freshwater lakes and channels of the delta contain seventy-six species of fish; the most important commercial species are Carp (see Appendix 2 for scientific names), Bream, Perch, Sturgeon and Shad. Fishing is an important livelihood strategy amongst the delta's population and the fisheries mainly comprise three components: freshwater, migratory and marine fisheries. These exist within the Biosphere Reserve and include open water lakes, channels, canals, flooded reed beds and part of the Black Sea Coast (Navodaru *et al*. 2001). Fish catches have declined over the past 40 years. According to Navodaru *et al*., fishing was maintained at a constant level until 1989. After the revolution, old State companies were joined by new private enterprises and fishing effort increased sharply. Bell *et al.* (2001) also list a rise in polluting discharges, increased nutrient loading in the river and sections of the Delta, and the effects of polarization for aquaculture facilities as contributing to the decline in fish catches. However, one of the main conflicts in this region occurs between fishermen and fish-eating birds such as Cormorants because of the perceived impact on predation on fish stocks (Navodaru *et al.* 2003, Bell 2004, see also http://www.dur.ac.uk/imew.ecproject/). Further conflicts exist between fishermen and the Danube Delta Biosphere Reserve Authority. The function of this Authority is to implement and influence a range of conservation policies, which may clash with local interests such as upholding the ban on fishing in protected areas (Bell *et al*. 2001). Another source of conflict exists between Delta fishermen and those whom they describe as the "ecologists", particularly over the protection given to fish-eating birds such as the migratory Pelicans (*Pelecanus crispus*) that breed in the delta during the summer months and the non-migratory Cormorants (*ibid*).

Seine net fishing in the Danube Delta (Photograph Ion Navodaru).

22.1.2 Cormorants in Romania

In Romania, the Cormorant is not usually protected. However, this species is not usually sought after by amateur hunters as it is not edible, Cormorants are shot as a preventative measure to protect fish in the ponds, especially fingerling farms. Spontaneous shooting is also carried out within the colonies, even though this destroys other species such as Pelicans, Spoonbills (*Platalea leucorodia*) and Little Egrets (*Egretta garzetta*). For example, on 20th May 1999 the entire mixed colony on the Bisericuta Island in Razim Lagoon, designated a protected area, was completely wiped out by unknown persons. Later inspection revealed the existence of around 150 Cormorant nests, 9 Pelican nests (declared as 'monuments of nature') and over 150 Herring Gull (*Larus argentats*) nests. On the Island, only around 30 Herring Gull nests have returned and there are still eight Shelduck (*Tadorna tadorna*) nests, which survived as they were hidden from view in the cliffs. This aggressive act still remains unpunished. Until recently, the DDBRA had not installed protective measures and this omission led to the destruction, on 11th July 2000, of a Cormorant colony on Ceaplacele (on Canal 5 and from Istria) where 184 juveniles were killed.

The diet of Cormorants was assessed using sample material collected by shooting between 1959-1962 in the Danube Delta. Out of the sampled birds, 15% had empty stomachs, presumably due to the time of day when they were shot. For the rest of the birds, diet was diverse and comprised 18 species. The size of the identified fishes ranged between several grams (Deep-snouted Pipefish, Bleak) to 240g (Pike), 300 g (Pikeperch), 700 g (Carp). The average weight of fish species of economical importance has been calculated at 60g and 10g for those of low economically value. It is important to note that a large part of the biomass consumed by Cormorants has no economical value, as the fish are caught in areas of the sea which are unreachable by fishermen. Large numbers of breeding Cormorants may be proof that sizeable quantities of fish exist in the Danube Delta and the sea.

22.1.3 Gaps to be filled

Six areas require further research: (1) the monitoring of colonies in the Danube Delta Biosphere Reserve helped by general monitoring within the delta, (2) research on the ecology and diet of Cormorants based on regurgitated material collected from colonies and also examining the stomach contents collected when Cormorants are shot around the fingerling basins and ponds, (3) assessment of species impact on a trophic basis and the impact on fish fauna, (4) identify ways to minimize animosity of local people towards fish-eating birds, through education and public awareness, (5) identify ways in which it may be possible to offer financial compensation for Cormorant damage in order to encourage local people to adopt a more tolerant attitude towards the birds (such compensation does appear unlikely however), (6) identify some economical and humanitarian methods of controlling the Cormorant population if this action is necessary.

22.2 Cormorant conflicts with fisheries

Care must be taken when interpreting information provided in this section. Please refer to section 2.2.3 (*Methodological limitations and difficulties*).

22.2.1 Conflict site descriptions

One Cormorant conflict was reported from Romania: in the Danube Delta (a mixture of fresh, brackish and coastal water, much of it eutrophic and semi-natural).

22.2.2 Birds and fish

In Romania, Cormorants reported to be involved in conflicts were *P.c. sinensis*. Densities of birds in the Romanian sector of the Danube Delta were reported to be 0.05 birds ha^{-1} in 2002 (Bell 2004). Gibel Carp, Roach, Silver Bream and Bleak were recorded in conflict with Cormorants in the Romanian sector of the Danube Delta (Table 22.1, data from Martinca colony 2001-03) although a further 22 fish species were reported to be consumed (see Bell 2004).

Species	Frequency in regurgitations	
	% by number	% by biomass
Gibel Carp	26.2	42.7
Roach	17.3	8.4
Silver Bream	17.3	30.8
Bleak	24.8	2.1
Other species	14.4	16.0

Table 22.1 Fish species reported to be involved in conflicts with Cormorants in the Romanian sector of the Danube Delta.

22.2.3 Seasonality

Cormorant conflicts in Romania were reported to occur throughout the year.

22.2.4 Finance

Financial information on the 'costs' of Cormorant predation was not provided for the Romanian case.

Fish diversity in the Danube Delta (Photograph Ion Navodaru).

22.2.5 Conflict issues: magnitude of conflict

Cormorant conflicts with commercial fisheries stakeholders in the Danube Delta were reported for the single case in Romania, although conflicts with recreational fisheries stakeholders and nature conservationists are also reported (see Bell 2004). Commercial fisheries stakeholders identified 13 conflict issues relating to fisheries, fish stocks or environment. Recreational fisheries stakeholders and nature conservationists identified 2 and 3 conflict issues, respectively, relating to either fisheries or fish stocks. The only major conflicts cited, for commercial fisheries stakeholders, were reduced catches, loss of employment and lowered production (Table 22.2)

22.2.6 Conflict issues: status of information used by stakeholders

Overall, stakeholders provided 36 records of the status of the information they used to inform themselves about Cormorant conflict issues in Romania. The highest proportion of records (80%) was for 'scientific literature' followed by 'popular' articles (20%). There were no records for 'grey literature' (Table 22.3).

	Stakeholder group			
Status of information	**Recreational**	**Commercial**	**Aquaculture**	**Nature conservation**
Popular	-	17.2%	50.0%	-
Grey literature	-	-	-	-
Scientific literature	100.0%	82.8%	50.0%	-
Total no. records (= 100%)	**3**	**29**	**4**	**None**

Table 22.3 Categorisation of the status of information used by stakeholders to inform themselves about Cormorant conflict issues.

22.3 Potential Cormorant management tools

There is no Cormorant management in Romania but birds may be shot during the duck-hunting season from August 15 to March 15. Shooting occurs especially at private fishponds. There is no shooting of Cormorants in the Danube delta by locals as ammunition is far too expensive but there may be some hunting by Italian visitors. However, the shooting of some hundred Cormorants (probably less than 200 adults in the non-breeding season) is unlikely to affect the overall population. There is some illegal destruction of nests: in 1991 fishermen killed about 180 young chicks in a colony in the lagoons. Similar illegal activities can occur at roosts.

22.4 Stakeholders consulted

The most important are the Danube Delta National Institute for Research-Development, the Danube Delta Biosphere Authority, the district Association for Hunting and Angling sport, local authorities of mayoralties, peoples of villages Chilia Veche, Crişan, Maliuc, Mahmudia, Mila 23, Murighiol, concessionaires of fishing resources in the central and north part of the Delta.

Conflict issue	Not claimed/not applicable	No impact	Minor effect	Major effect
(1) FISHERIES				
Reduced catch			(1)	1
Loss of stocked fish			1 [1]	
Reduced value of catch (damage)			1	
Removal of fish from nets	1			
Reduced catchability (stress/behaviour)			1	
Loss of earnings from the fishery			[1]	
Reduced fishing tackle sales			1	
Loss of employment				1
(2) FISH STOCKS				
Reduced stock - lowered production				1
Effects on popn. dynamics/community structure	1		(1)	
Vectors of diseases/parasites			1	
Loss of juvenile fish - lowered recruitment			1	
Loss of aquaculture stock			[1]	
(3) ENVIRONMENTAL				
Eutrophication			1	
Scaring/shooting disturbance			1	

Table 22.2 Cormorant conflict issues as recorded by a commercial fishery stakeholder, a recreational fishery stakeholder (round brackets) and a nature conservationist stakeholder [square brackets] for the Romanian sector of the Danube Delta. Each figure is the number of times a particular issue was cited by stakeholders.

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23. Slovenia

23.1 National overview

By Miha Janc & Marijan Govedic

Background

In 1977 Great Cormorants (*P. c. sinensis*) were rare visitors in Slovenia. They were still uncommon in 1983 but the first flocks appeared in 1984. It was estimated that in 1993-1994 about 1,000 Cormorants wintered on large rivers in Slovenia and a few thousand in more recent years (Table 23.1). On the basis of ringed Cormorants, these birds breed in Dennmark, Sweden, Poland, Estonia, The Netherlands, Germany and Croatia (Govedič 2001). Great Cormorant night roost counts in Slovenia are shown in Figure 23.1.

Year	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Month	**Feb**	**Feb**	**Feb**	**Jan**	**Jan**	**Jan**	**Jan**	**Jan**	**Jan**
No. Cormorants	*1,734	*1,637	*2,979	*3,246 3,391	*2,579 2,839	*3,656 3,942	3,044	2,441	2,952

Table 23.1 Number of wintering Great Cormorants (*P. c. sinensis*) in Slovenia: (data from Geister 1997 and Stumberger 1997-2002, *numbers for inland areas (i.e. coast excluded).

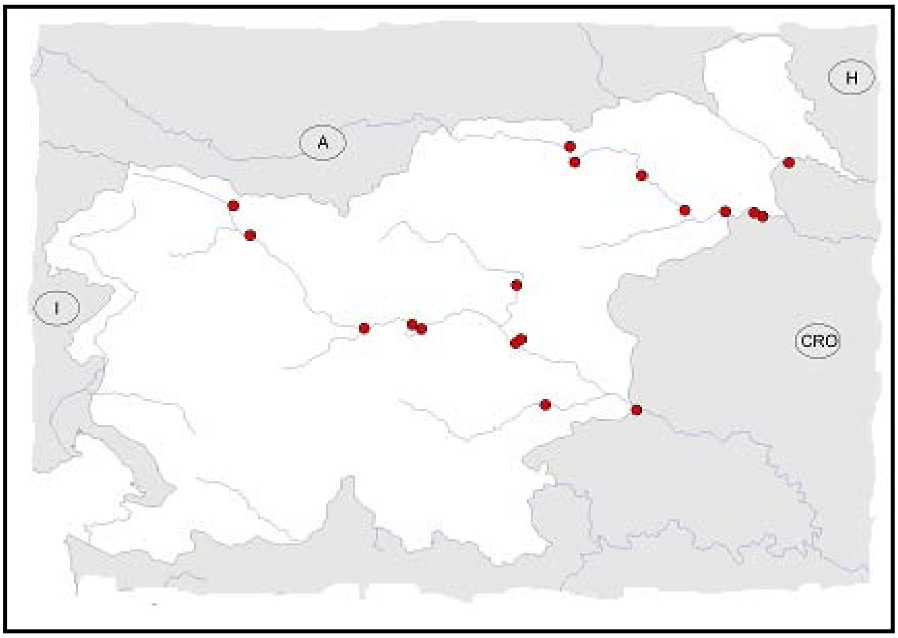

Figure 23.1 Distribution of Great Cormorant night roots in Slovenia.

23.1.1 Case Study: Sava River

This case study is based on Govedic *et al.* (2002). The diet of Cormorants wintering on the Sava River between Ljubljana and Zagorje in the winter of 1998-1999 was analysed (see Figure 23.2) using regurgitated pellets collected at the night roost at Hotic. These birds primarily fed on fish in the Sava River and its tributary, Ljubljanica. This particular stretch of water with a surface of 279 ha is in the Barbel-zone (i.e. slow flowing with increasing amounts of silt, mud and considerable aquatic vegetation) in which 24 fish species were found (Brown Trout [see Appendix 2 for scientific names], Rainbow Trout, Huchen, Grayling, Chub, Nase, Danube Roach, Roach, Blageon/Soufie, Prussian/Gibel Carp, Barbel, Bream, Pike, Perch, Rudd, Carp, Tench, Schneider, Zährte, Streber, Bullhead, Burbot, Weather Fish, Vimba). In Ljubljanica, 27 fish species were documented, including 8 not recorded in the Sava (Crucian Carp, Gudgeon, Minnow, the Cyprinid *Barbus petenyi*, Pikeperch, Wels, Bleak, Golden Loach).

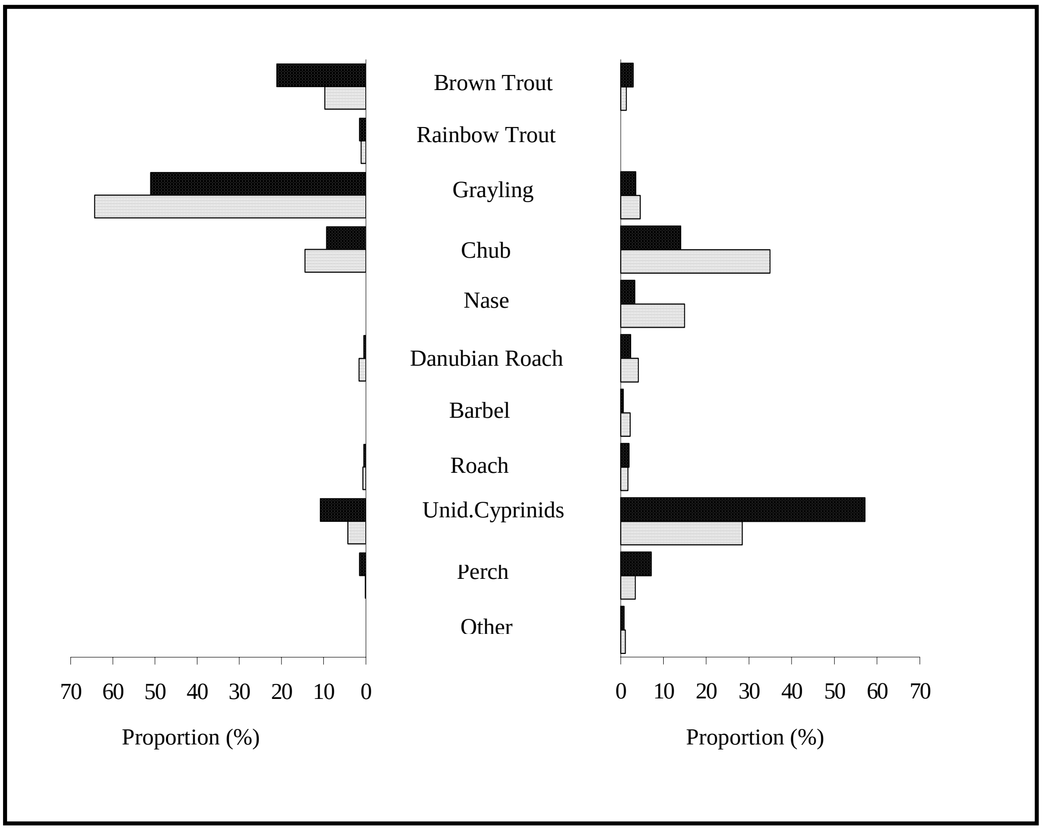

Figure 23.2 Comparison of the Great Cormorant diet between upper (left) and central (right) Sava river (Slovenia) in the winter of 1998/99. Proportion by number (black), proportion by mass (grey) (from Govedič 2002).

At the roost site near Hotic, 185 to 594 birds were recorded during 9 counts between October 1998 and March 1999. The highest density was 2.13 individuals/ha in January and more than 1 bird/ha was recorded throughout this period. It was estimated that these birds had 64,287 feeding days. Assuming that a Cormorant consumes between 250 and 500 g of fish daily, Cormorants from the night roost at

Hotic consumed between 16,071 and 32,143 kg of fish or between 44.8 and 89.6 kg/hectare in winter (1998/99). From the same section of water 8,812 kg of fish (31.6 kg/ha) were taken by anglers in 1998. However, since the productivity of this stretch of river was not known it was impossible to evaluate the effect of Cormorant predation on fish stocks there.

Among 473 pellets, 70 % contained the remains of fish but they also contained Nematode worms and tapeworms, the remains of caddis flies, snails and a single frog. In individual pellets, the remains of between 1-69 fish (median = 2, average = 3.9) were found: most (93.6 %) contained the remains of up to 10 fish. Altogether, the remains of 1,279 fish were found. The total weight of these fish was estimated at 57 kg. The diet consisted of 12 fish species: Brown Trout, Grayling, Chub, Nase, Danube Roach, Roach, Barbel, Bream, Bleak, Pike, Perch, and Ruffe. Most of the diet consisted of cyprinids (88% by number, 90% by biomass) although Grayling and Brown Trout represented 6% by number and 4% by mass and Pike, Perch and Ruffe represented 7% by number and 4% by mass. Among cyprinids Chub (16% by number and 39% by mass) and Nase (4% by number and 16% by mass) were most common. The proportion of unidentified cprinidswas 57% by number and 28% by mass.

Prey size ranged from 23 to 345 mm. The most frequent length class was 70-170 mm (50% by number and 19% by mass), but large individuals (>170 mm) were common (25% by number and 80% by mass) in the diet of Cormorants. The respective numbers of cyprinids, percids, and salmonids varied significantly between months while the numbers of specimens did not. It was concluded that the differences in fish species caught by Cormorants in the study area depended on random detection of a particular fish species. Chub and Nase are shoaling fishes and are probably more easily detected by Cormorants than the non-shoaling species.

Sava Bohinja: a case study river (Photograph Jože Ocvirk).

23.1.2 Case study: Sava Bohinjka River

This case study is based on a report of the Fisheries Research Institute "Estimate of the effect of Cormorants on Grayling population in the river Sava Bohinjka and proposal of fish management" (Ljubljana, 1998, p9). Almost 600 wintering Cormorants could have caused the practical disappearance of Grayling, including spawners, in the 5 km long fish preserve, in three years. This interpretation is supported by Govedic's (2002) data where, according to remains in regurgitated pellets Grayling was the predominant prey (51% by number, 64.3% by biomas and 69.9% by occurrence).

The Sava Bohinjka River is one of the two uppermost tributaries of the river Sava. The study stretch was typical alpine salmonid water and some 5km of its course has been closed for angling for more then 30 years and was the source of Grayling spawners for eggs/fry to be reared in a hatchery. Young Grayling were subsequently stocked in various streams in Slovenia and abroad. Cormorants first appeared on Sava Bohinjka River in winter 1993/1994. According to different reports the number of wintering birds varied from 64 and 580 between 1993 and 1998.

In 1974 and in 1981, an electrofishing survey was carried out in the section of the river where angling is permitted. Twenty five to 30 kg of Grayling (41 - 137 individuals/ha) were recorded. In the fish preserve section, 200 adult Grayling/ha, weighing an average of 500 g, were estimated to be present before Cormorants appeared. In September 1997 and in March 1998, the study was repeated. Four stretches of the river (>100m) were electrofished three times during a particular day. Two study sites were in the fish preserve and two in sections where angling is permitted. In September 1997, 75 Grayling/ha (3.4 kg/ ha) were recorded in the sections where fishing is allowed, corresponding figures in the fish preserve were 71 Grayling/ ha (3.2 kg/ ha). In March 1998 the population of Grayling was estimated to be 9 individuals/ha (1.3 kg/ha) in the fish preserve while in stretches of river open for angling, Grayling density was estimated to be 43 individuals/ha (10.7 kg/ha).

This discrepancy could be explained by the fact that the preserve is far from settlements and from main roads, thus allowing Cormorants undisturbed access to fish predation. Older Grayling that survived Cormorant predation may have moved closer to the settlements/roads. Age structure was also affected as in 1997 Grayling aged more than 2 years were missing. This radical reduction of the Grayling population is further illustrated by the fact that the number of spawners caught for stock enhancement dropped from 320 in 1996 to 12 in 1997, and in 1998 no spawners were caught on spawning sites. These results (see also Table 23.2) suggest strongly that

Stretch of Sava Bohinjka river	**Inventory made in**					
	1974 and 1981		**September 1997**		**March 1998**	
	No./ha	**Weight (kg/ ha)**	**No./ha**	**Weight (kg/ ha)**	**No./ha**	**Weight (kg/ ha)**
Open for angling	41-137	25-30	75	3.4	43	10.7
Fish preserve	200 estimate	100 estimate	71	3.2	9	1.3

Table 23.2 Number and weight of Grayling in Sava Bohinjka river from 1974 to 1998.

Cormorants may depredate a stretch of salmonid stream and threaten the existence of a previously healthy Grayling population: Cormorants apparently almost eliminated a dense population of spawners in the fish preserve where it remained stable for decades before the arrival of the birds.

Similar effects of Cormorant predation were demonstrated by the Fisheries Research Institute on the Unica River (Fisheries Research Institute of Slovenia unpublished data: 2004). Median weight of Grayling electrofished on four locations was 266g, 234g, 273g, and 271g in 1997 and has diminished to 57g, 78g, 82g, and 29g in 2004. These data suggest that older age-classes of Grayling have been predated. It should be mentioned that the Unica is one of the finest commercial salmonid fisheries in Slovenia where poaching control is strict and stocking is not necessary because the fishery is self-sustainable.

23.1.3 Concluding remarks

Although most Slovenian case studies do not demonstrate a negative Cormorant effect on either fish stocks or angling catches, there are serious concerns over these birds. The consequences of total protection of a top predator or the reintroduction of one in an environment where almost everything has been changed (i.e. damaged/altered by human activities, including self-regulatory mechanisms) are clearly unpredictable. When such actions are planned, all possible effects on all possible parts of the ecosystem, including man, should be taken into consideration and management plans prepared beforehand. From the standpoint of biodiversity, threatened or endangered fish species (e.g. Atlantic Salmon, Marble Trout, Grayling, Nase, etc.) deserve at least as much protection as do fish-eating birds. There are also serious concerns that big flocks of Cormorants breeding on large water bodies with an apparently ample food supply could depredate small streams in days or weeks. How Cormorants (first arriving in the winter of 1997/98) apparently affect angling catches of Grayling in the Soča River can be seen (Table 23.3) from records of FC Tolmin.

Year	Number caught	Weight (kg)
1997	2,064	1,029
1998	1,247	657
1999	1,072	558
2000	775	445
2001	287	158
2002	226	126
2003	94	65

Table 23.3 Catches of Grayling in FC Tolmin.

This evidence is alarming for two reasons. First Grayling in the Soča belong to the genetically different Adriatic line (Susnik *et al*. 2001) and thus deserve particular attention, and (2) it has been estimated that angling tourism contributes 2.3 million euro to the local economy (Sullivan *et al*. 2002).

FC Novo Mesto presented strong evidence showing how Cormorants apparently affect angling catches even for a species like Nase, which has a very dense population (Table 23.4). The table shows a textbook example of how the predator first diminishes the prey population and is subsequently affected by the lack of prey – it is reasonable to assume that the decline in fish catches reflects the decline of the fish population.

Year	Catches of Nase		Number of Cormorants
	Number	kg	
1996	3109	2153	500
1997	2550	2139	500
1998	1589	1091	400
1999	793	517	350
2000	771	546	250
2001	699	468	150

Table 23.4 Catch of Nase related to numbers of cormorants in FC Novo Mesto, 1996 - 2001 (Cormorants first seen in winter 1992-1993).

23.2 Cormorant conflicts with fisheries

Care must be taken when interpreting information provided in this section. Please refer to section 2.2.3 (*Methodological limitations and difficulties*).

23.2.1 Conflict site descriptions

Twenty-two Cormorant conflicts were reported from Slovenia (Figure 23.3): on 19 rivers/sections of rivers; Savinja[13,14,15,16 on Figure 23.3] (3 sections and the tributaries Lava/Loznica/Hudinja), Sava[9,10,11,12] (4 sections), Sava Dolinka[8], Sava Bohinjka[7], Dravinja[18], Drava[19] (2 sections), Idrijca[2], Mirna[6], Vipava[1], Ljubljanica[3], Mura[20], Velunja[17], Krka[5] (and tributaries), and three lakes (Velenje, Šmartinsko, Blagovna) (Table 23.5). No conflicts were reported from the Fisheries Society covering the Gradaščica[4]. Most conflicts were reported from the middle reaches of rivers and at widths of 10-50m and altitudes of 100-500m. Most of these rivers were natural and of low nutrient status.

23.2.2 Birds and fish

In Slovenia, Cormorants reported to be involved in conflicts were *P.c. sinensis*. Reported Cormorant densities are given in Table 23.6.

Habitat	No. cases	Cormorant density (maximum no. ha^{-1})			
		Mean	SE	Minimum	Maximum
Lakes	3	5.2	3.10	0.86	11.11
Rivers	19	5.3	0.88	1.08	12.81

Table 23.6 Cormorant density (mean, standard error [SE], minimum and maximum) for Slovenian cases in relation to 2 habitat types.

Habitat	Feature	Category		
	Reach	**Upper**	**Middle**	**Lower**
Rivers	N =18 cases	4	12	2
	Width (m)	**< 10m**	**10-50m**	**50-100m**
Rivers	N = 19 cases	3	13	3
	Altitude (m)	**< 100m**	**100-500m**	**500+m**
Rivers	N = 19 cases	1	16	2
Lakes	N = 3 cases		3	
	Trophic status	**Oligotrophic**	**Mesotrophic**	**Eutrophic**
Rivers	N = 19 cases	6	12	1
Lakes	N = 3 cases		1	2
	Anthropogenic Influence	**Natural**	**Semi-natural**	**Artificial**
Rivers	N = 19 cases	13	6	
Lakes	N = 3 cases		1	2

Table 23.5 The number of Cormorant conflict cases reported from Slovenia in relation to habitat and habitat features.

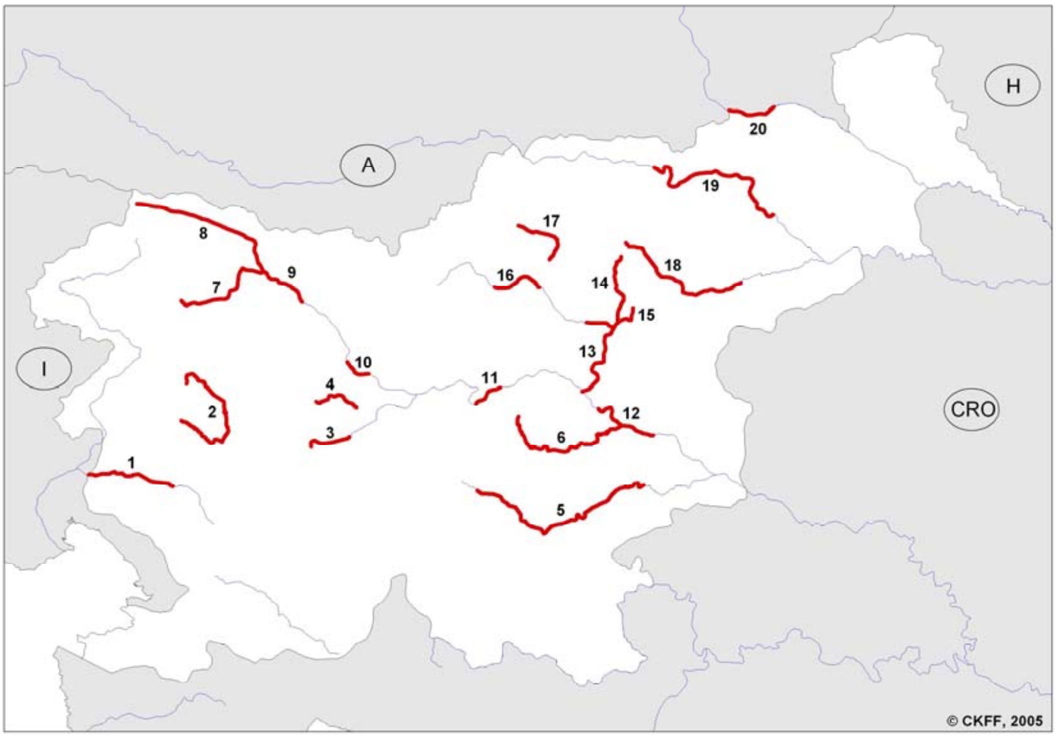

Figure 23.3 Location of the 19 river sections, where Cormorant conflicts were reported. Numbers refer to locations given in 23.2.1

Twenty-one fish species were recorded in conflict with Cormorants in the 19 Slovenian river case studies reported and a further 2 species were recorded in 2 lake cases (Table 23.7).

23.2.3 Seasonality

Cormorant conflicts in Slovenia were reported to occur in winter (i.e. Sept-Mar): grey boxes indicate months where fewer conflict cases were reported.

Month of conflict												
COUNTRY	J	F	M	A	M	J	J	A	S	O	N	D
Slovenia												

23.2.4 Finance

Financial information on the 'costs' of Cormorant predation was reported for 19 river conflict 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. It was requested that the values provided be categorised as either 'actual' or 'estimated'. For these Slovenian cases, turnover information was 'actual' and most loss information 'estimated'. Based on these cases, average turnover for 19 recreational fisheries was 55,897 euro and average loss was 34,288 euro (61% of turnover). Turnover for a single recreational lake fishery was 53,000 euro and loss was 530 euro (10% of turnover), corresponding figures for a single aquaculture stillwater were 2,750 euro and 1,300 euro (47% of turnover).

	Frequency	
Species	**River (% of 19 cases)**	**Lakes (% of 2 cases)**
Brown Trout	74	-
Grayling	53	-
Huchen	26	-
Rainbow Trout	16	-
Marble Trout	10	-
Brook Trout	5	-
Nase	79	-
Chub	79	-
Barbel	47	-
Danube Roach	42	-
Bleak	37	50
Roach	32	50
Minnow	16	-
Pike	16	100
Rudd	10	-
Carp	10	100
Schneider	5	-
Vimba	5	-
Pikeperch	1	100
Dace	1	-
Orfe	1	-
Tench	-	50
Bream	-	50

Table 23.7 Fish species reported to be involved in conflicts with Cormorants in 19 cases from Slovenian rivers and 2 cases from lakes.

23.2.5 Conflict issues: magnitude of conflict

Cormorant conflicts with recreational fisheries stakeholders on rivers were the most frequently reported (n = 19 cases) in Slovenia. Recreational fisheries stakeholders on rivers identified 19 conflict issues relating to fisheries, fish stocks or environment. The most commonly cited major conflicts in each of these categories were loss of stocked fish, effects on fish population dynamics/community structure and scaring/shooting disturbance (Table 23.8).

23.2.6 Conflict issues: status of information used by stakeholders

Overall, stakeholders provided 619 records of the status of the information they used to inform themselves about Cormorant conflict issues in Slovenia. The highest proportion of records (62%) was for 'grey literature', followed by 'popular' articles (37%) and 'scientific literature' (7%). Overall, there were differences in the use of popular, grey and scientific literature sources between the 3 stakeholder groups providing information (Table 23.9).

	Stakeholder group			
Status of information	**Recreational**	**Commercial**	**Aquaculture**	**Nature conservation**
Popular	37.2%	-	10.5%	41.7%
Grey literature	61.9%	-	84.2%	55.6%
Scientific literature	0.9%	-	5.3%	2.8%
Total no. records (= 100%)	**564**	**None**	**19**	**36**

Table 23.9 Categorisation of the status of information used by stakeholders to inform themselves about Cormorant conflict issues. Aquaculture stakeholders used less popular literature and more grey literature than expected (randomisation test approximating to $X^2 = 9.61$, df = 4, $P < 0.05$).

Krka: a case study river (Photograph Jože Ocvirk).

23.3 Potential Cormorant management tools

From 2000 onwards, the Ministry for Agriculture, Forestry and Food has issued an annual Cormorant management ordinance and Management plan. In winters

2001/02 and 2002/03, DOPPS-Bird Life Slovenia delayed their implementation by about 3 months by taking the ordinance to the Court of Justice. According to official reports, 4 Cormorants were shot during the first winter, 151 during the second, 470 during the third, and 504 during the fourth, i.e. 2003/04 but according to oral communications last winter, many more Cormorants were shot. Shooting is going on all over the country (except on sites protected under IBA and the Ramsar convention) because neither bureaucracy nor anglers were willing to protect the most vulnerable waters with threatened fish species at “the expense” of larger water bodies. This winter (2004/05), the Ordinance will allow scaring/ shooting only on salmonid rivers and on some upper stretches in ‘Barbel districts’ where Nase predominates. Its effect is questionable since at the end of November it has not yet been passed. Ammunition for shooting Cormorants goes at the expense of fishing clubs (no compensation from the Government) but, in spite of this, hunters are reluctant to shoot these birds because by law they are not game birds.

23.4 Stakeholders consulted

Stakeholders in the Anglers Association of Slovenia (National level) and 22 regional or provincial Angling Clubs were consulted.

Club	Region/Province
Anglers Association of Slovenia	National
FC Vrhnika	Central (of Ljubljana)
FC Dolomiti	Ljubljana
FC Medvode	Ljubljana
FC Sevnica	Lower Carniola
FC Jesenice	Upper Carniola
FC Cerknica	Inner Carniola
FC Radovljica	Upper Carniola
FC Novo Mesto	Lower Carniola
FC Bled	Upper Carniola
FC Celje	Slovenian Styria
FC Mozirje	Slovenian Styria
FC Maribor	Slovenian Styria
FC Mura Paloma	Slovenian Styria
FC Paka	Slovenian Styria
FC Ruse	Slovenian Styria
FC Lasko	Slovenian Styria
FC Velenje	Slovenian Styria
FC Slovenska Bistrica	Slovenian Styria
FC Rence	Primorska
FC Sevnica	Zasavje
FC Litja	Zasavje
FC Idrija	Primorska

Conflict issue	Not claimed/not applicable	No impact	Minor effect	Major effect
(1) FISHERIES				
Reduced catch	1		3	15
Loss of stocked fish			1	18
Reduced value of catch (damage)			6	11
Reduced catchability (stress/behaviour)		1	10	15
Loss of earnings from the fishery		1	6	8
Reduced capital values of fisheries	1		4	7
Increased recurrent costs			9	7
(2) FISH STOCKS				
Reduced stock - lowered production			3	10
Effects on popn. dynamics/community structure			1	16
Threats to endangered fishes			2	14
Vectors of diseases/parasites			2	1
Loss of juvenile fish - lowered recruitment		1	2	13
Loss of spawners			10	6
Loss of aquaculture stock			2	3
(3) ENVIRONMENTAL				
Eutrophication			2	
Interactions with other birds		1	3	1
Scaring/shooting disturbance		3	5	2
Landscape alteration			5	1
Damage to vegetation/landscape		1	10	

Table 23.8 Cormorant conflict issues as recorded by recreational angling stakeholders for Slovenian rivers (n = 19 cases). Each figure is the number of times a particular issue was cited by stakeholders.

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24. Spain

24.1 National overview

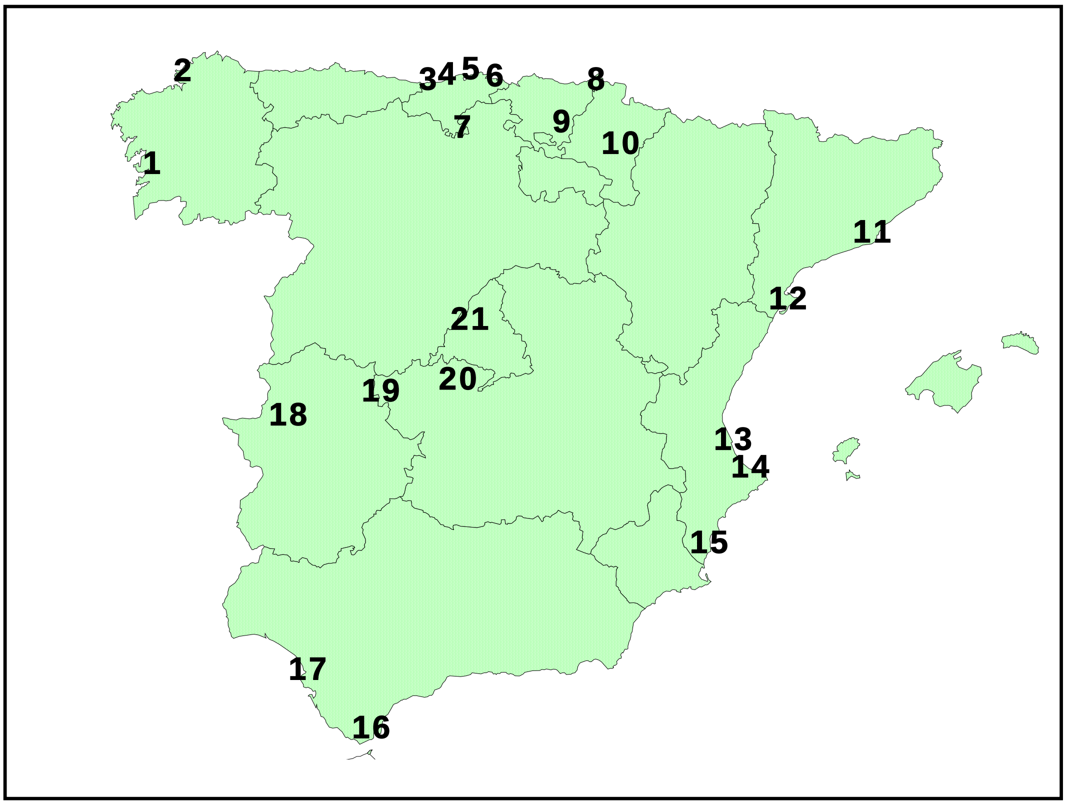
By Angel Serdio, Carlos García de Leániz & Sofía Consuegra

24.1.1 Great Cormorants in Spain

The number of wintering Great Cormorants (*P. carbo*) has increased in Spain in recent years (Blanco *et al*. 1994, Campos & Lekuona 1994, Pérez-Tris 2000), apparently due to an increase in the breeding population of central Europe. However, the two subspecies of Great Cormorant (*carbo* and *sinensis*) have not increased at the same rate. In Spain, the subspecies *sinensis* is mostly distributed in inland areas and its numbers have increased at a faster rate than the subspecies *carbo,* which is dispersed along the Atlantic and Cantabrian coasts. *Sinensis* has even succeeded in breeding in some Spanish reservoirs (Ibarra & Martín 1996). Results from the 1998 wintering census (Hidalgo 1998) indicate that there were ca. 43,000 Great Cormorants in Spain, located mainly in inland areas (62%), especially in the large interior reservoirs of central Spain. Atlantic and Cantabrian coasts hold only 17 % of the total wintering population, though they support the great majority (91%) of individuals belonging to the *carbo* subspecies.

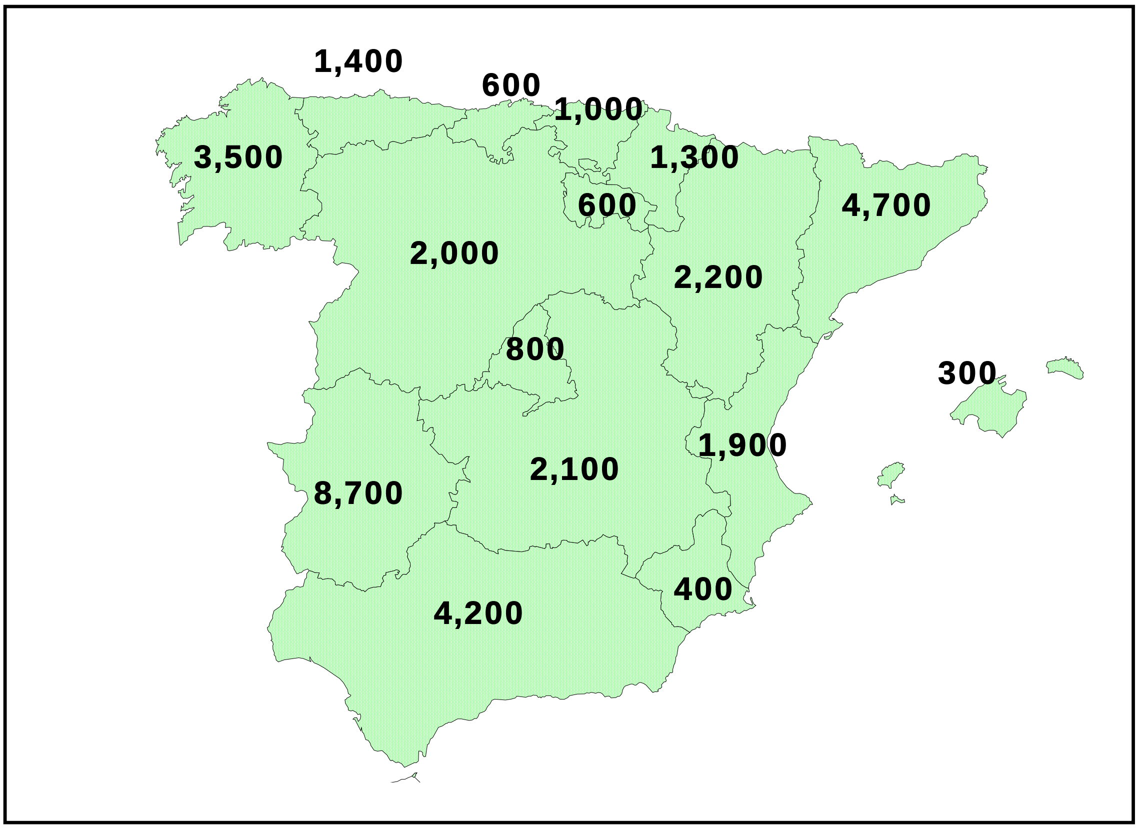
Great Cormorants rarely breed in Spain, though the number of breeding pairs seems to have increased in recent years. In every case, it was the subspecies *sinensis* that has been observed breeding successfully in inland areas of central and southern Spain (de Juana 1991, Ibarra & Martín 1996). At the end of the winter season, the number of Cormorants in Spain decreases significantly. Mature birds migrate to the breeding areas of the British Isles and central Europe and only immature Cormorants remain in Spain (Del Hoyo *et al*. 1992). Thus, the scope for conflict between Cormorants and fisheries in Spain is not as high as in some other European countries. Fish farming is not an important activity in inland reservoirs, and the impact of Cormorants on the aquaculture industry does not seem to be high (Pizarro *et al*. 1997, Lekuona 1998, Olmos *et al*. 2000). However, there is some conflict between Cormorants and freshwater fisheries, especially along the salmonid rivers of northern Spain where angling is very popular and has a relatively high recreational profile.

River Deva, Cantabria.



Location of Spanish REDCAFE sites.

1. Umia-O´Grove Saltmarsh (Galicia)
2. Ortigueira estuary (Galicia)
3. River Deva and estuary (Asturias - Cantabria)
4. River Nansa and estuary (Cantabria)
5. River Pas and estuary (Cantabria)
6. River Asón and estuary (Cantabria)
7. Ebro reservoir (Cantabria- Castilla León)
8. River Bidasoa and estuary (Basque Country - Navarra)
9. Ullibarri reservoir (Basque Country)
10. Yesa reservoir (Navarra)
11. Llobregat Delta (Cataluña)
12. Ebro Delta (Cataluña)
13. Marjal del Moro Saltmarsh (Valencia)
14. Albufera de Valencia (Valencia)
15. Santa Pola Saltmarsh (Valencia)
16. Cádiz Bay (Andalucía)
17. Doñana National Park (Andalucía)
18. Valdecañas reservoir (Extremadura)
19. Navalcán reservoir (Extremadura)
20. River Tajo (Castilla La Mancha)
21. River Jarama (Madrid)



Wintering Cormorant numbers in Spain (figures from Hidalgo 1998).

24.1.2 Case Study: the northern Atlantic Salmon rivers

The rivers

The rivers of northern Spain are generally short and steep, quick to rise and fall and prone to droughts from July to September. Average annual rainfall (mm) ranges from 1,029 to 1,769. Average pH values range from 6.3 to 8.3, depending on the rivers. Mean water temperatures can reach up to 20 ºC during the summer, and the rivers never freeze during the winter.

The Great Cormorant in northern Spain

Until a few decades ago, Great Cormorants migrating south seldom stopped in northern Spain, and when they did it was mostly for short periods of time. Consequently, few, if any, wintering roosts were commonly found (Bernis 1969). However, there has been a dramatic increase in the number of Cormorants wintering in northern Spain in recent years. Nowadays, some 8,000 Great Cormorants (mainly belonging to the *carbo* subspecies) winter in this region (Hidalgo 1998), Most of these are found in the region of Galicia (3,600 birds), followed by Asturias (1,400 birds), Navarra (1,300 birds), the Basque Country (1,100 birds) and Cantabria (600 birds).

The fish

At least 26 species of freshwater fish have been recorded in the rivers of northern Spain. Of these, the most valued species include the Brown Trout (see Appendix 2 for scientific names) and especially the Atlantic Salmon which has become the subject of various enhancement and restoration programmes in different regions. Other fish species present in these rivers include various resident cyprinids, as well as migratory species such as Eel, Shad and Sea Lamprey (Doadrio 2002).

River Pas, Cantabria.

The anglers

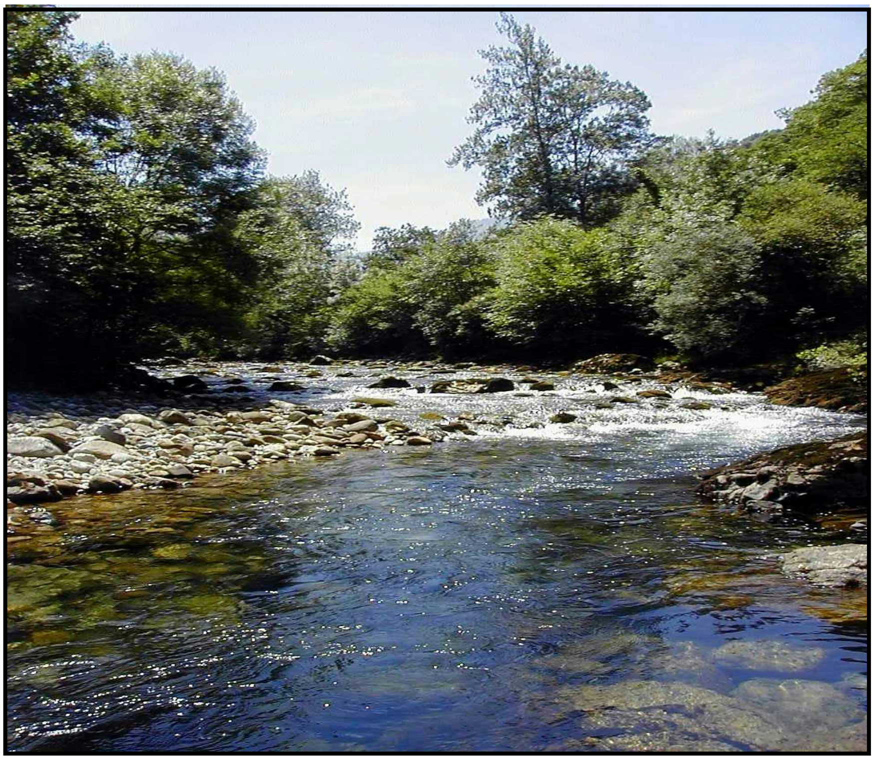
Salmonid anglers make up an estimated 4% of the population in the northern provinces (ca. 100,000 anglers). Angling generally takes place from early spring until mid-summer. The target fish species is generally Brown Trout. Angling for Atlantic Salmon has decreased as annual catches have diminished to less than 2,000 fish in recent years.

The impact

There are only a few studies on the diet of the Great Cormorant in northern Spanish rivers, and consequently any conclusions must necessarily be considered as preliminary. Nevertheless, the available data suggest that Cormorants are opportunistic predators in Spanish rivers and that the fish they eat are generally those that are most abundant and vulnerable (Lekuona & Campos 1996, Viñuales 2002). Thus, in the lower reach of the River Bidasoa the diet of Cormorants is made up mostly of Eel (37% in biomass) and Flounder (31% biomass), whereas salmonids only make up 10% (Lekuona & Campos 1996). However, in the headwaters of the River Narcea (where there were only Brown Trout and Minnow), Cormorants can eat as much as 20% of the total production of Brown Trout (Viñuales 2002). In the River Asón, Cormorants seem to take advantage of the presence of numerous disused weirs, that may render some migratory fish species particularly vulnerable (Serdio *et al*. 2001).

The conflict

Many anglers believe that predation by cormorants (and by other fish-eating birds such as the Grey Heron *Ardea cinerea*) constitute one of the main reasons behind the decline in salmonid catches. However, there is little evidence to support such a claim. In the case of the Brown Trout, there are simply no data to suggest that catch per unit effort (or any other measure of abundance) has decreased in most rivers. However, in the case of Atlantic Salmon the decline in angling catches started before the increase in Cormorant numbers (García de Leániz *et al*. 2001). Also, it is important to realize that few Cormorants remain in Spanish rivers during the spring, when migratory salmonids appear to be most vulnerable to bird predation (Kennedy & Greer 1988). In any event, it is clear that more diet studies, to be carried out throughout the season and in rivers with varying fish communities, are urgently needed.



River Asón, Cantabria.

24.2 Cormorant conflicts with fisheries

Care must be taken when interpreting information provided in this section. Please refer to section 2.2.3 (*Methodological limitations and difficulties*).

24.2.1 Conflict site descriptions

Seventeen Cormorant conflicts were reported from Spain: on 5 rivers/sections of rivers (Asón, Pas, Nansa, Deva, Bidasoa), 10 coasts (Ebro Delta, Asón, Pas, Nansa, Deva, Bidasoa estuaries, Marjal del Moro, Cádiz Bay, Santa Pola saltmarshes, Albufera de Valencia) and two standing waters (Doñana National Park, Yeas Reservoir) (Table 24.1).

Habitat	Feature	Category		
	Reach	**Upper/Middle**		**Middle/Lower**
Rivers	N = 5 cases	4		1
	Width (m)	**< 10m-50m**		**50-100m**
Rivers	N = 5 cases	5		
	Altitude (m)	**< 100m-500m**		**500+m**
Rivers	N = 5 cases	5		
Lakes	N = 2 cases	2		
	Trophic status	**Oligotrophic**	**Mesotrophic**	**Eutrophic**
Rivers	N = 5 cases	5		
Lakes	N = 2 cases			2
Coasts	N = 10 cases		1	9
	Anthropogenic Influence	**Natural**	**Semi-natural**	**Artificial**
Rivers	N = 5 cases	5		
Lakes	N = 2 cases	1		1

Table 24.1 The number of Cormorant conflict cases reported from Spain in relation to habitat and habitat features.

24.2.2 Birds and fish

In Spain, Cormorants reported to be involved in conflicts were both *P.c. sinensis* and *P.c. carbo*. Reported Cormorant densities are given in Table 24.2

Habitat	No. cases	Cormorant density (maximum no. ha^{-1})			
		Mean	**SE**	**Minimum**	**Maximum**
Lakes	2	0.2	0.06	0.11	0.23
Rivers	4	0.0006	0.7×10^{-4}	0.0004	0.0007
Coasts	9	0.4	0.11	0.12	0.96

Table 24.2 Cormorant density (mean, standard error [SE], minimum and maximum) for Spanish cases in relation to 3 habitat types.

Nine fish species were recorded in conflict with Cormorants in the 17 Spanish case studies reported (Table 24.3).

24.2.3 Seasonality

Cormorant conflicts in Spain were reported to occur in winter (i.e. Sept-Apr): grey boxes indicate months where fewer conflict cases were reported.

Month of conflict												
COUNTRY	J	F	M	A	M	J	J	A	S	O	N	D
Spain												

Species	Frequency (% of cases)				
	R (n = 5)	L (n = 1)	Laq (n = 1)	C (n = 8)	Caq (n = 2)
Atlantic Salmon	100			62	
Brown Trout	80				
Rainbow Trout			100		
Spanish Toothcarp		100		38	
Valencia Toothcarp				38	
Gilthead Sea Bream					100
Senegal Sole					50
Sea Bass					50
Jarabugo		100			

Table 24.3 Fish species reported to be involved in conflicts with Cormorants in 17 cases from Spain (R = rivers, L = lakes, C = coasts, aq = aquaculture sites).

24.2.4 Finance

Financial information on the 'costs' of Cormorant predation was reported for only 3 conflict 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. It was requested that the values provided be categorised as either 'actual' or 'estimated'. All values for Spanish cases were estimated. Estimated losses at the two coastal aquaculture sites were 8-12% of turnover and 66% of turnover. Estimated turnover at the single stillwater aquaculture site was 500,000 euro and estimated loss was 30,000 euro (6% of turnover).

24.2.5 Conflict issues: magnitude of conflict

Cormorant conflicts on coasts were the most frequently reported (n = 10 cases) in Spain. Recreational fisheries stakeholders, aquaculturists and nature conservationist stakeholders each reported 5, 2 and 3 conflict cases on coasts. Recreational fisheries stakeholders identified 5 conflict issues, aquaculturists 8 conflict issues and nature conservationist stakeholders 6 issues relating to either fisheries or fish stocks (Table 24.4).

24.2.6 Conflict issues: status of information used by stakeholders

Overall, stakeholders provided 199 records of the status of the information they used to inform themselves about Cormorant conflict issues in Spain. The highest proportion of records (53%) was for 'popular' articles, followed by 'grey literature' (28%) and 'scientific literature' (19%). Overall, there were differences in the use of popular, grey and scientific literature sources between the 3 stakeholder groups providing information (Table 24.5).

Status of information	Stakeholder group			
	Recreational	**Commercial**	**Aquaculture**	**Nature conservation**
Popular	61.1%	-	-	72.0%
Grey literature	27.8%	-	26.7%	28.0%
Scientific literature	11.1%	-	73.3%	-
Total no. records (= 100%)	**144**	**None**	**30**	**25**

Table 24.5 Categorisation of the status of information used by stakeholders to inform themselves about Cormorant conflict issues. Aquaculturists used more scientific literature and less popular literature than expected ($X^2 = 75.101$, df = 4, $P < 0.001$).

Conflict issue	Not claimed/not applicable	No impact	Minor effect	Major effect
(1) FISHERIES				
Reduced catch	4	[1]		[1]
Loss of stocked fish		5 [1]		[1]
Removal of fish from nets		[1]	[1]	
Damage to fishing gear		[1]	[1]	
Loss of earnings from the fishery			[1]	[1]
Reduced capital values of fisheries			[1]	[1]
Increased recurrent costs			[2]	
(2) FISH STOCKS				
Reduced stock - lowered production		5		
Effects on popn. dynamics/community structure		5 (3)		
Threats to endangered fishes			(3)	
Vectors of diseases/parasites		(3) [2]		
Loss of juvenile fish - lowered recruitment		5 (3)		
Loss of spawners		(3)		
Loss of aquaculture stock			(3)	

Table 24.4 Cormorant conflict issues as recorded by recreational angling stakeholders (n = 5 cases), (nature conservationists, 3 cases in round brackets), and [aquaculture stakeholders, 2 cases in square brackets] for Spanish coasts. Each figure is the number of times a particular issue was cited by stakeholders.

24.3 *Potential Cormorant management tools*

Information (summarised in the following tables) was provided on (1) general actions taken against Cormorants in Spain, (2) management plans/legal regulations, (3) actions at small rivers, and (4) at aquaculture sites.

NAME OF RESPONDENT AND YOUR AFFILIATION	**Angel Serdio, Carlos García de Leániz, Sofía Consuegra (Centro Ictiológico de Arredondo, Spain)**
COUNTRY	**Spain**
REGION / PROVINCE / etc. (if applicable)	
Period which is concerned [year(s)]	

General information on actions against Cormorants in Spain (annual numbers)

	Total numbers		**Regional numbers**															
	National numbers	**Count/Estimate?**	**Galicia**	**Asturias**	**Cantabria**	**País Vasco**	**Navarra**	**Aragón**	**Cataluña**	**Castilla León**	**La Rioja**	**Castilla La Mancha**	**Madrid**	**Valencia**	**Murcia**	**Andalucia**	**Extremadura**	**Baleares**	**Canarias**
Number of breeding colonies destroyed or disturbed	No data: hunting and disturbing are illegal																		
Number of nests destroyed																			
Number of nestlings killed																			
Number of adults killed in the non-breeding season																			
Number of breeding adults killed																			
Number of night roosts destroyed or disturbed																			

Management plans / legal regulations (Spain)	Total country	Galicia	Asturias	Cantabria	País Vasco	Navarra	Aragón	Cataluña	Castilla León	La Rioja	Castilla La Mancha	Madrid	Valencia	Murcia	Andalucia	Extremadura	Baleares	Canarias
Are there any management plans in effect? Please list all national or regional plans and give details		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Are there any regulations in effect that allow Cormorant culling? Please list all national or regional regulations and give details		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Are there any coordinated culling programmes in your country?		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Is it mandatory to obtain single permits for Cormorant killing?		YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Has a general permit for Cormorant killing been issued?		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Is there any financial compensation for fish losses?		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Is there any financial aid for the construction of Cormorant exclosures or for scaring programmes, etc.?		YES 50%	YES 50%	YES 70%	YES	YES	YES 40%	YES	YES	YES 40%	YES	YES 40%	YES	YES 60%	YES 50%	YES 60%	YES	YES 60%
Remarks (on General information & on Management plans /legal regulations):																		

NAME OF RESPONDENT AND YOUR AFFILIATION **Angel Serdio, Carlos García de Leániz, Sofía Consuegra (Centro Ictiológico de Arredondo, SPAIN)**
COUNTRY **Spain**
REGION / PROVINCE / etc. (if applicable)
Period which is concerned [year(s)]
<u>C. Feeding Sites</u>
C1. Small Rivers (Width < 100 m)

Cormorant Damage Control Activities								
1. Resource Management	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Habitat management								
Improve habitat quality for fishes	Unknown							
Altering fish stocking regimes. Please give details!!!	Rarely	Not known	2	2	3	Cantabria	Cantabria stocking programmes	
(c) density	X							
(d) stocked fish sizes	X							
3.2 Lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Shooting adults and immatures	llegal							

NAME OF RESPONDENT AND YOUR AFFILIATION	**Angel Serdio, Carlos García de Leániz, Sofía Consuegra (Centro Ictiológico de Arredondo, SPAIN)**							
COUNTRY	**Spain**							
REGION / PROVINCE / etc. (if applicable)								
Period which is concerned [year(s)]								
C. Feeding Sites								
C5. Aquaculture								
Cormorant Damage Control Activities								
2. Bird-proof barriers (overhead barriers and peripheral fencing/netting)	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Physical exclosures with narrow meshed systems (mesh sizes < 20 cm) using wire, lines or string in parallel or grid patterns	Regularly	Years	2	2	4	Very common		Pérez-Hurtado et al, 1997
Coloured streamers to increase visibility of wires and strings	Rarely	Years	2	2	4	36.32N / 6.18W		As above.
3. Wildlife Management								
3.1 Non-lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Human harassment								
Human patrol on foot or in vehicles	Regularly	Not efficient	1	1	5	Very common		
Gas bangers / cannons (propane gas exploders)	Rarely	Not efficient	1	1	4	42.35N / 1.17W		Lekuona, 1998
Pyrotechnics / Fireworks (shell crackers, screamers, whistling projectiles, exploding projectiles, bird bangers, flash/detonation cartridges)	Rarely	Not efficient	1	1	4	42.35N / 1.17W		Lekuona, 1998
3.2 Lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Shooting adults and immatures	Ilegal							

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Lekuona (1998) Impacto del Cormorán grande, la Gaviota reidora y la Garza real en una piscifactoría de Navarra durante la época invernal. *Ardeola,* 45(2). 171-182

24.4 Stakeholders consulted

Aquaculture

(1) Organización de Productores de Acuicultura Continental, Travesera de Gracia, 441 1º, 08025 Barcelona.

(2) Organización de Productores Piscicultores, General Moscardó, 3 5º F, 28020 Madrid.

Government

(3) Ministerio de Agricultura, Pesca y Alimentación, Corazon de María, 8, 28002 Madrid.
(4) Gobierno de Cantabria, Dirección General de Montes y Conservación de la Naturaleza, Rodríguez 5 1º, 39071 Santander, Cantabria.
(5) Gobierno de Cantabria, Centro Ictiológico de Arredondo, 39813 Arredondo, Cantabria.
(6) Gobierno de La Rioja, Direccion General de Medio Natural, Prado Viejo 62 bis. Edificio SOS Rioja, 26071 Logroño, La Rioja.
(7) Junta de Extremadura, Dirección General de Medio Ambiente, Avda. de Portugal, s/n, 06800 Mérida, Badajoz.
(8) Junta de Andalucia, Dirección General de Gestión del Medio Natural, Avda. Manuel Siurot, 50. Casa Sundheim, 41071 Sevilla.
(9) Región de Murcia. Dirección General de Medio Natural, Luis Fontes Pagán s/n, 30071 Murcia.
(10) Gobierno de Aragón. Dirección General de Medio Natural, Paseo Mª Agustín, 36. Edificio Pignatelli, 50004 Zaragoza.
(11) Junta de Castilla y León, Dirección General de Medio Natural, Rigoberto Cortejoso, 14, 47071 Valladolid.
(12) Junta de Castilla La Mancha, Consejería de Agricultura y Medio Ambiente, Pintor Matías Moreno, 4, 45071 Toledo.
(13) Generalitat de Catalunya, Dirección General de Bosques y Biodiversidad, 08017 Barcelona.
(14) Xunta de Galicia, Dirección Xeral de Conservacion da Natureza, Edificio Administrativo San Lázaro, 15781 - Santiago de Compostela, La Coruña.
(15) Gobierno de Navarra. Dirección, General de Medio Ambiente, Yanguas y Miranda 27, 1º, 31002 Pamplona, Navarra.
(16) Gobierno Vasco, Departamento de Ordenación del Territorio y Medio Ambiente, C/Donostia-San Sebastián, 1, 01010 Vitoria, Alava.
(17) Principado de Asturias, Coronel Aranda 2, 33005 Oviedo, Asturias.

Nature Conservation

(18) SEO. Sociedad Española de Ornitología, c/ Melquíades Biencinto, 34, 28053 Madrid.
(19) AEMS. Ríos con Vida, Rodríguez San Pedro 13, Of. 2, 28015 Madrid, Madrid.

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25. Sweden

25.1 National overview

By Henri Engström

Background

Conflicts with Cormorants exist throughout most of Sweden although they seem generally to be larger in southern Sweden in areas with high Cormorant densities. In the Bothnian Gulf, Cormorants also exist but most fisheries-conflicts appear to be related to gull and seal predation. The conflicts are most intense along the coast in the provinces of Småland and Östergötland and across several medium to large size lakes. Major fish species of concern are Eel (see Appendix 2 for scientific names), Pikeperch, Pike, Perch, salmonides (several lakes and the Baltic Sea), and Cod (Swedish Westcoast). Most problems occur in summer and to some extent in the spring although, occasionally, there are conflicts in early winter. It is important to note that disputes are not always most prevalent in areas where Cormorant predation is most severe.

Great Cormorant at breeding colony.

25.1.1 The Conflict

The primary concern amongst commercial fishermen in Sweden today is that Cormorants consume or injure fish (Engström 1998). Further problems fuelling the conflict between Cormorants and fisheries are guided both by perception and practical experience. For example, some fishermen believe that large Cormorant colonies lead to greater quantities of fish being consumed and an overall reduction in fish stocks. The causes of fluctuations in fish stocks, however, are difficult to establish and the quantity of fish removed from fishing nets is unknown. Nevertheless, it is likely that smaller species, which are not so economically valuable to the fishermen, are being taken (ibid:154). Fishermen also point out that Cormorants hunting near to fyke nets can scare the fish, which then become trapped and die. Large numbers of Cormorants drown in fyke nets every year in Sweden (ca. 10,000) and it can become time-consuming for fishermen to remove them. Cormorants can also damage fishing gear with their sharp claws and beaks although this is more likely with gill nets than with fyke nets.

Various responses to the conflict questionnaire confirmed the conflict between the fishing industry and Cormorants. Comments by fishermen included:

"The Cormorant is increasing in number at coasts around the island of Öland. There is no breeding colony around but there are high numbers. I fish from the harbour of Böda at northern Öland. About 100-200 Cormorants are seen here sitting on the rocks near the shore. I fish at 3-4m depth up to a distance of 10-12 nautical miles from the coast. We always see Cormorants nowadays, regardless where we are. It is not merely fishermen who catch fish but also Cormorants, which, however, no quotas exist for."

"The number of Cormorants has increased by 66% between 1999 and 2002 (source: county admin board)*…the increase and spread of Cormorants must be stopped immediately."*

(Left) beak marks on an Eel from Lake Ringsjön, (Aåne) caused by Cormorant attacks (Right) Whitefish caught in fyke-nets also showing beak marks.

"Besides damage caused by Cormorants, seals also cause considerable damage to the fishery.".

"According to Kalmar county administrative board, the area around Kalmar Sound holds about 50,000 Cormorants during a period of 8 months. According to ornithologists, Cormorants eat 0.5kg fish a day (minimum), which means that all Cormorants consume about 6,000 tonnes per year. How large a part of that consists of commercially important species is unknown. It is obvious that Cormorants affect also juvenile fish. Moreover Cormorants may compete for "coarse" fish which is food for predatory fish. We have observed that fish do not exist any longer in shallow and other areas where Cormorants are stationary. The Cormorant is opportunistic and easily found in areas where fish are present. Hunting, which is allowed to protect fish,

seems rewarding and Cormorant attacks has somewhat declined. However, present measures are not enough and more egg pricking and fewer protected islands are necessary to make the whole population decline to an acceptable level."

25.1.2 Case Studies
Swedish West Coast

In 1995, Cormorants started breeding along the Swedish West Coast. Three small colonies existed in 1999 but even though numbers have increased, the population is still small in relation to potential foraging areas. Fishery-related conflicts are a growing problem along the West Coast and this is mainly due to increasing concentrations of non-breeding birds during summer and over-wintering birds, all of which are held responsible for consuming large amounts of fish. The precise numbers of over-wintering Cormorants in this area is unknown but could be several thousand individuals. However, it is known that several species of fish have declined to almost non-existent levels along the West Coast in recent years. Several hypotheses behind this decline has been put forward including Cormorant predation, but over-fishing and environmental factors (mainly eutrophication) are the most likely causes. Nevertheless, Cormorant colonies have been subject to human persecution.

Northern Kalmar Sound, Baltic Sea

The Cormorant re-established itself as a breeding species on the island of Svartö in Southern Kalmarsund in the late 1940s, after having been absent for more than 40 years. The exact year is unknown but breeding has been documented since 1948. Currently, in terms of the number of breeding pairs, the coastal area of Småland is the most important breeding area for Cormorants in Sweden. In 1999, three colonies exceeded 1,900 pairs and the total number of pairs attempting to breed reached 8,400 (34% of the total Swedish population). During this year a total of 14 colonies were found on the coast and five in freshwater. The freshwater colonies are all very small, consisting of only 100 pairs.

The colony of Svartö in the province of Småland, Baltic Sea. The largest and oldest colony in Sweden, established in 1948. In the late 1990s the colony, including neigbouring colonies held 3,000 pairs. The island to the left with almost no trees left is Svartö and the island to the right Törnhomen.

Human disturbance is a major problem at many of colonies around Småland, influencing the size of some of them. Moreover, disturbances have also contributed to the extinction of colonies and the dispersal of individuals over the area. For example, during the last 15 years, no less than 17 colonies have been subject to human disturbance. Ten colonies have vanished due to illegal persecution. The most well known colony that was destroyed illegally by people was on the island of Gåsö in northern Kalmar Sound. The whole colony, consisting of ca. 3,000 pairs, was exterminated during the peak breeding season in 1993 by some local people who cut down all the nesting-trees at the island. Despite extensive human disturbance the population in Småland as a whole appears to have remained strong and the population size has been fairly constant since 1992. The apparent stability in the population size may partly be explained by the fact that two colonies with large numbers of Cormorants have developed on islands where colonies have been largely undisturbed.

Currently, management actions such as egg pricking are allowed at all colonies except for protected sites at Kungsholmen, Norra Sandholmen-Svartö-Törnholmen and Svartingskär. During 1994-2000, a mean of 2,065 Cormorants have been shot every year (reported). Conflicts between fisheries and Cormorants in the area are severe. However, a study in one of the core areas with large numbers of Cormorants showed that Cormorant attacks on fish in fyke-nets, in terms of documented bite-marks, were rather small (Engström 1998).

Island of Öland, Baltic Sea

The first documented breeding at Öland occurred in 1989. Until 1999, there were colonies in four sites at least. The largest colony developed on the small island of Marskär (Löt) and reached 510 pairs in 1996. However, during the same year the nesting trees at Marskär were felled by the landowner and since then only a few pairs have bred on the island. An accurate figure of the current population at Öland is not available but there are probably no more than a hundred pairs of Cormorants. The low population density at Öland is a bit surprising considering the large areas of shallow water on the Eastern side of the island, which are suitable for feeding. One explanation for the small number may be the lack of appropriate breeding islands. Cormorants, however, may still use this region, although they will normally breed on the nearby Swedish mainland. To some extent the area is also within reach of the large mainland breeding colonies in the province of Småland.

There have been intense complaints from fishermen. The conflict is not well documented but probably resembles that of Gotland. Coastal fisheries, especially small-scale ones, are declining due to unfavourable economic conditions.

Island of Gotland, Baltic Sea

Cormorants started to breed on Lilla Karlsö, off Southwestern Gotland, in 1992. A second colony was founded in 1995 at Laus Holmar, Southeast Gotland. Several, mainly small, colonies here were also established during the late 1990s. No inland breeding on Gotland exists. However, at the two main colonies, population increase has been strong in recent years although the colony at Lilla Karlsö now shows signs of levelling off. In 2000, Lilla Karlsö colony contained 2,268 pairs and Laus Holmar 1,120 pairs. Both colonies are located within protected bird areas. Cormorant populations may still increase for some time, particularly on the East coast where extensive shallow waters occur.

Conflicts in relation to Cormorants and fisheries are not well documented in Gotland. Most coastal-based fisheries are small and few in number. Presumably most fishermen have diversified their livelihoods and are not dependent solely upon fishing. Cormorant damage is probably caused when birds attack fish in pound/fyke nets. However, it more likely that damage caused by Cormorants is a rather small problem compared to other factors affecting present-day fisheries in the areas.

Swedish East Coast, Baltic Sea

Along the coast, in the province of Södermanland, the Cormorant population has increased considerably in size in recent years. For example, between 1995-1999 the number of breeding pairs increased annually by 74%. In 1999, the total number of Cormorants along the coast comprised 3,000 pairs distributed over 18 colonies. Most colonies are of medium size and none exceeds 500 pairs.

(Left) inland colonies at Lake Ellestadsjön, Sksne ca 800 pairs in 1995-96 and (Right) small colony, ca 10 pairs, in typical oligotrophic system, Lake Sommen, Östergötland.

Following discussions with officials from local administrations (during 2000 and 2001), it seems that conflicts with the fisheries appear to be minimal, largely because coastal fisheries are less important to the region. Disturbance (legal) is known to occur in only one colony.

Lake Hjälmaren and Lake Mälaren, Inland fisheries

Cormorants settled in Lake Hjälmaren in 1996. Population increase has been rapid and in 1999 the population consisted of 388 pairs distributed over nine colonies. All colonies except one contain less than one hundred pairs.

At the moment, conflicts between Cormorants and the fisheries are severe. Damage to fish caught in fishing gear is the most common problem. Five colonies have been subjected to human persecution (two of the colonies illegally). Lake Hjälmaren has an important and viable fishery with Pikeperch, Eel, Perch, Pike and crayfish (*Astacidea*) being the most important species. There are around 30 full-time or part-time fishermen at the Lake. In the autumn of 1999, fishermen and hunters, with permission from local authorities, organised communal hunting with the aim of reducing the overall number of Cormorants. Hunters were spread out over large parts of the Lake including islets and popular roosts; altogether 554 cormorants were shot. This large-scale hunting practice was repeated on three occasions in 2000 and involved more than 100 hunters each time. Fishermen were allowed to shoot 750 birds. However, in 2002, 242 Cormorants were shot on 21 August, 80 cormorants on 28 August and 61 on 1 September. The hunters noted that the Cormorants behaved differently during the three hunting occasions. For example, some Cormorants were very shy whilst others were not, indicating birds of different origin, an observation also later confirmed also by ringing recoveries. So far the effect of hunting has not been evaluated but data on breeding numbers indicate an on-going increase. Despite the presumed, limited impact of hunting on bird numbers, fishermen in the area are still happy with the present management method of shooting.

Lake Mälaren holds an important small-scale fishery similar to that of Lake Hjälmaren. Cormorants started breeding here in 1994 and the population reached 379 pairs in 1999. The colonies here show many similarities with those of Lake Hjälmaren. Legally organised hunting (cf. Lake Hjälmaren) was carried out on six occasions during late August to early October (2000) with a total of 33 birds shot although hunters had permission to shoot 300 birds. Conflicts are intense in the area, as Cormorants are held responsible for small fish catches, and injuries to fish in nets. Many fishermen complain that present day hunting is not efficient. A possible reason is that Cormorants can easily avoid hunters by keeping to the many reserves around the Lake. Furthermore, the Lake consists of many elongated bays which makes co-ordinated hunting difficult. The population is presumed to have at least doubled during the last 2-3 years.

Ground breeding colony at Lacka Trutbsda in the province of Södermanland.

Coasts of Västernorrland County, Bottnian Bay

The area of Västernorrland includes the provinces of Medelpad, Ångermanland and Västerbotten. Between 1994-1999, breeding was known to have occurred in about 10 sites. The two largest colonies at Gnäggen (282 pairs) and Långskärsklubb (301 pairs) are found on rocky islets surrounded by mostly deep water. Ice-cover is present in winter which prevents Cormorants from over-wintering. Little is known about the Cormorant-fishery conflicts in the area. However, because Cormorant populations are small in relation to the huge area of water, problems are likely to be mostly local. Nevertheless, the growing Grey Seal (*Halichoerus grypus*) population has had a considerable impact on fisheries.

25.2 Cormorant conflicts with fisheries

Care must be taken when interpreting information provided in this section. Please refer to section 2.2.3 (*Methodological limitations and difficulties*).

25.2.1 Conflict site descriptions

Nine Cormorant conflicts were reported from Sweden: on 7 coasts (east coast of Gotland between När and Slite, northern Kalmar Sound – Baltic Sea, west coast SW of Göteborg, east coast of N Öland, west coast Tjörn – Hisingen, east coast Sjösaviken, coasts of Västernorrland county – Bothnian Bay) and two lakes (Mälaren and Hjälmaren). Little, if any, information was available on the habitat features of these sites: 3 coastal sites and 2 lake ones were semi-natural.

25.2.2 Birds and fish

In Sweden, Cormorants reported to be involved in conflicts were both *P.c. carbo* and *P.c. sinensis*. Reported Cormorant densities at two coastal sites were 0.03 birds ha^{-1} and 0.05 birds ha^{-1}, respectively. Eel, Whitefish, Perch and Pikeperch were the most commonly recorded fish in conflict with Cormorants in Sweden (Table 25.1).

	Frequency (% cases)	
Species	**Coast (n = 7)**	**Lake (n = 2)**
Eel	100	100
Whitefish	71	100
Brown Trout	57	-
Perch	57	100
Pike	57	-
Atlantic Salmon	43	-
Cod	43	-
Herring	43	-
Flatfish	29	-
Pikeperch	14	100
Turbot	14	-
Flounder	14	-

Table 25.1 Fish species reported to be involved in conflicts with Cormorants in 9 cases from Swedish coasts and lakes.

25.2.3 Seasonality

Cormorant conflicts in Sweden were reported to occur in summer and autumn (i.e. Apr-Nov): grey boxes indicate months where fewer conflict cases were reported.

Month of conflict												
COUNTRY	J	F	M	A	M	J	J	A	S	O	N	D
Sweden												

25.2.4 Finance

Financial information on the 'costs' of Cormorant predation was reported for only 4 coastal conflict 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. It was requested that the values provided be categorised as either 'actual' or 'estimated'. Two turnover vales were 'actual', the remainder, and all 4 loss values were 'estimates'. Based on the 4 cases, average turnover for 4 commercial fisheries was 19,575 euro and average loss was 10,375 euro (53% of turnover).

25.2.5 Conflict issues: magnitude of conflict

Cormorant conflicts with commercial fisheries stakeholders on coasts and lakes were the most frequently reported (n = 7 and 2 cases, respectively) in Sweden. Commercial fisheries stakeholders identified 25 conflict issues relating to fisheries, fish stocks and environment at coastal sites and 23 issues at lake sites. The most commonly cited major conflicts in each of these categories were reduced catch and loss of earnings from the fishery, loss of juvenile fish through lowered recruitment, and damage to vegetation/landscape (Table 25.2)

25.2.6 Conflict issues: status of information used by stakeholders

Overall, stakeholders provided 129 records of the status of the information they used to inform themselves about Cormorant conflict issues in Sweden. All records were for 'popular' articles.

25.3 Potential Cormorant management tools

Information (summarised in the following tables) was provided on (1) general actions taken against Cormorants in Sweden, (2) management plans/legal regulations, (3) actions at breeding sites, and (4) at very large waterbodies.

Conflict issue	Not claimed/not applicable	No impact	Minor effect	Major effect
(1) FISHERIES				
Reduced catch			3 (1)	3 (1)
Loss of stocked fish			1 (1)	2
Reduced value of catch (damage)			6 (1)	1 (1)
Removal of fish from nets			5 (1)	1
Damage to fishing gear			3 (1)	2
Reduced catchability (stress/behaviour)			2 (2)	2
Loss of earnings from the fishery			4 (1)	3 (1)
Reduced capital values of fisheries			2 (2)	3
Reduced fishing tackle sales		2	(1)	1
Increased recurrent costs			4 (2)	1
Loss of employment		1	(1)	1
(2) FISH STOCKS				
Reduced stock - lowered production			2 (1)	1
Effects on popn. dynamics/community structure			1 (2)	2
Threats to endangered fishes			3 (2)	2
Vectors of diseases/parasites				1
Loss of juvenile fish - lowered recruitment			1 (1)	4 (1)
Loss of spawners			1 (1)	2
Loss of aquaculture stock			1	(1)
(3) ENVIRONMENTAL				
Eutrophication			2 (1)	1
Interactions with other birds			1 (1)	
Scaring/shooting disturbance			2	1 (1)
Lead contamination (birds/environment)		1	(1)	
Landscape alteration			1	2
Drowning in fishing gear			5 (1)	
Damage to vegetation/landscape				5 (1)

Table 25.2 Cormorant conflict issues as recorded by commercial fisheries stakeholders for Swedish coasts (n = 7 cases) and lakes (n = 2 cases, round brackets). Each figure is the number of times a particular issue was cited by stakeholders.

NAME OF RESPONDENT AND YOUR AFFILIATION	Henri Engström, Uppsala University
COUNTRY	Sweden
REGION / PROVINCE / etc. (if applicable)	per county (=län)
Period which is concerned [year(s)]	usually year 2000, but see below

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

	Total numbers		**Regional numbers** (includes all areas in Sweden where cormorants presently breed or occur in large numbers)																	
	National numbers	Count/Estimate?	Blekinge län	Gotlands län	Gävleborgs län	Hallands län	Jönköpings län	Kalmar län	Kronobergs län	Västra Götalands län	Skåne län	Stockholm län	Södermanlands län	Uppsala län	Värmlands län	Västerbottens län	Västernorrlands län	Västmanland län	Örebro län	Östergötlands län
Number of breeding colonies destroyed or disturbed* (1985-2000)	**21+42 (legal+illegal)****		1+3	0		0		7+10			2									
Number of nests destroyed (year 2000)	**?**		0	0	0	0	0	See (1)	0	38 (1999)	0	0	Coast: 0, for L. Hjälmaren see Örebro län	0	0	0	0	For L. Hjälmaren see Örebro county	Few	Coast: 511, L. Roxen: 400
Number of nestlings killed (occure rarely, illegal)	**few**																			
Number of adults killed in the non-breeding season	**not reported separately, ca. 50% of no. below**																			
Numbers of breeding adults killed (see 2)	**3,864**		<10	No figure available but probably few	0	As for Gotlands län	0	Coast: 2,430	0	Coast: 82, L. Vänern: 0	L. Ivösjön: <50	Coast: 112, for L. Mälaren see Uppsala län	Coast: 0, for L. Hjälmaren and L. Mälaren see Uppsala & Örebro län	L. Mälaren: 33, coast: 0	0	0	0	See Uppsala & Örebro län	123 at standing fishing gears, 388 at "common" hunting	Coast: 471, L. Roxen: 300, L. Glan: < 20

(1) 9000 eggs pricked, number of nests destroyed unknown

(**2) National number includes both adults shot during the breeding season to protect fish in standing fishing gears. It also includes adults and juveniles shot during the summer after breeding has ceased.

* The amount of disturbance differ widely between colononies. Sometimes disturbance takes place year after year and colonies are finaly abondoned, in other cases only single years and no long term effects are observed.

Management plans / legal regulations (usually year 2000)	Total country	Blekinge län	Gotlands län	Gävleborgs län	Hallands län	Jönköpings län	Kalmar län	Kronobergs län	Västra Götalands län	Skåne län
Are there any management plans in effect? Please list all national or regional plans and give details	see (1)	see below	see below	see below	see below	see below	see below	see below	see below	see below
Are there any regulations in effect that allow Cormorant culling? Please list all national or regional regulations and give details. (Hunting regulations: 1=special licence needed, 2=hunting permits provided only to licenced fishermen, usually shooting is allowed within 200-300m from standing fishing gears, 3=hunting allowed by fishermen, hunters, landowners and "hunting friends"). Hunting (1-3) usually allowed year around.		hunting: 1, egg pricking: not allowed	hunting: 2, egg pricking: not allowed	hunting: not allowed, egg pricking: not allowed	hunting: 1, egg pricking: not allowed	hunting: not allowed, egg pricking: not allowed	hunting: 3, egg pricking: allowed in many colonies	hunting: 1, egg pricking: not allowed	coast: hunting 1 L. Vänern: hunting (3). L. Ymsen: (2000) max 10	hunting: 1, egg pricking: not allowed
Are there any coordinated culling programmes in your country?		No	No	No	No	No	No	No	No	No
Is it mandatory to obtain single permits for Cormorant killing?		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Has a general permit for Cormorant killing been issued?		No	No	No	No	No	No	No	No	No
Is there any financial compensation for fish losses?		No	No	No	No	No	No	No	No	No
Is there any financial aid for the construction of Cormorant exclosures or for scaring programmes, etc.?		No	No	No	No	No	No	No	No	No

	Total country	Stockholm län	Södermanlands län	Uppsala län	Värmlands län	Västerbottens län	Västernorrlands län	Västmanland län	Örebro län	Östergötlands län
Are there any management plans in effect? Please list all national or regional plans and give details	see (1)	see below	see below	see below	see below	see below	see below	see below	see below	see below
Are there any regulations in effect that allow Cormorant culling? Please list all national or regional regulations and give details. (Hunting regulations: 1=special licence needed, 2=hunting permits provided only to licenced fishermen, usually shooting is allowed within 200-300m from standing fishing gears, 3=hunting allowed by fishermen, hunters, landowners and "hunting friends"). Hunting (1-3) usually allowed year around.		coast: hunting 2, L. Mälaren: hunting 3 , egg pricking: not allowed	coast: hunting 2, egg pricking: not allowed	hunting: 2 (max: 600 in L. Mälaren), egg pricking: not allowed	hunting: 3, egg pricking: not allowed	hunting: not allowed, egg pricking: not allowed	hunting: not allowed, egg pricking: not allowed	hunting: 3, for Lakes Mälaren and Hjälmaren see Örebro and Uppsala län	hunting: 3 (max: 750), egg pricking allowed in several colonies (L. Hjälmaren)	coast: hunting 2, L Roxen & L. Glan: hunting 3, eggpricking allowed in several colonies (L. Roxen)
Are there any coordinated culling programmes in your country?		No	No	No	No	No	No	No	No/Yes*	No
Is it mandatory to obtain single permits for Cormorant killing?		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Has a general permit for Cormorant killing been issued?		No	No	No	No	No	No	No	No	No
Is there any financial compensation for fish losses?		No	No	No	No	No	No	No	No	No
Is there any financial aid for the construction of Cormorant exclosures or for scaring programmes, etc.?		No	No	No	No	No	No	No	No	No

Remarks (on General information & on Management plans /legal regulations):

All information given above is based on figures reported to county administration boards. The actual number of shot adults or juveniles may be slightly higher for some areas, while disturbances at colonies at some areas may be much higher than reported (s

(1) A national managment plan is under preparation. Will be finished probably by 2002. This plan suggest protective hunting to be allowed at standing fishing gears (<300m). Alternative non-letal methods to reduce cormorant predation should be developed at standing fishing gears. It also suggest disturbance at colonies to be used carefully due to the risk of spreading of birds to new unwanted sites. The plan also suggest Sweden to work, within EU, for an open hunting season on cormorants, this mainly because of psychological reasons.

*In Lake Hjälmaren hunting of 750 cormorants was issued in 2000. During early autumn about 100 fishermen and hunters organised hunting on three occations and about 500 cormorants were shot. Similar hunting also took place in 1999 & 2001.

NAME OF RESPONDENT AND YOUR AFFILIATION	**Henri Engström, Uppsala University**							
COUNTRY	**Sweden**							
REGION / PROVINCE / etc. (if applicable)	**whole country**							
Period which is concerned [year(s)]	**1985-2000**							
A. Breeding Sites								
Cormorant Damage Control Activities								
1. Avoid foundation of new colonies (In Sweden disturbance takes place mostly within already established colonies, see below)	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Scaring by use of live ammunition	regularly	days-years (depending on intensity)	1	1 (fishermen) 3 (public)	4	Several (most common in Småland, Östergötland)		Pers. comm. with fishermen, ornithologists, data from county adm. boards etc.
Shooting some adults to reinforce scaring	regularly	probably not efficient*	3	As above.	4	As above.		As above.
Scaring by human presence	regularly	years (if carried out regularly)	3	As above.	4	As above.		As above.
Removal of nests	regularly	probably efficient*	1(ground) 5 (trees)	1(fishermen) 4 (public)	4	few (usually illegal)		As above.
Egg oiling	rarely	month-years (if done repetedly)*	As above.	1 (fishermen) 3 (public)	4	only one site in L. Vänern		Report: county adm. board, 2000
Egg pricking	regularly	As above.	As above.	As above.	4	many		Pers. comm. with fishermen, ornithologists, data from county adm. boards etc.
Egg destruction/removal	regularly (illegal)	As above.	As above.	1(fishermen) 5 (public)	4	Several (most common in Småland, Östergötland)		As above.
Introduction of mammalian predators	rarely	probably not efficient	4	As above.	4	Uppland, Småland (iilegal)		As above.
Human disturbance affecting predation	regularly	not efficient	4	1(fishermen) 4 (public)	4	many		As above.
Killing of young	rarely	month-years*	As above.	1(fishermen) 5 (public)	4	several, illegal (most common in Småland, Östergötland, Uppland)		Pers. Comm. with fishermen, ornithologists etc. + newspapers
2. Existing colonies: Hinder cormorants from breeding	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Removal of trees	rarely (5 times)	usually not efficient**	As above.	4	1	Småland, Blekinge, Öland, Uppland		Pers. comm. with fishermen, ornithologists, data from county adm. boards etc.
Other modification of habitat	rarely, sheep grazing	As above.	3	1	3	Blekinge		As above.
Scaring by use of live ammunition	regularly	days	2	4	4	several		As above.
Shooting some adults to reinforce scaring	regularly	days	4	1(fishermen) 4 (public)	4	several		As above.
Simple scarecrows	rarely	low	4	1	3	Östergötland, L. Roxen		As above.
Scaring by human presence	regularly	low	4	3	5	Many		As above.
3. Existing colonies: Reduce breeding success	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Removal of nests	regularly	usually not efficient**	As above.	1(fishermen) 4 (public)	4	several		As above.
Egg pricking	regularly	temporarily***	As above.	1(fishermen) 3 (public)	4	many		As above.
Egg destruction/removal	regularly	temporarily***	As above.	1(fishermen) 5 (public)	4	several		As above.

* probably not efficient because cormorants move elsewhere

** efficient to avoid breeding at a certain site but cormorants will, with high certainty, move to other nearby sites and start to breed.

*** when done repetedly reproduction is affected, however cormorants seem to leave the site within a few years and start to breed elsewhere.

NAME OF RESPONDENT AND YOUR AFFILIATION **Henri Engström**
COUNTRY **Sweden**
REGION / PROVINCE / etc. (if applicable)
Period which is concerned [year(s)] **1985-2000**
C. Feeding Sites
C4. Very Large Waterbodies (Still Waters and Coastal Waters)

Cormorant Damage Control Activities								
1. Resource Management	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Fish management								
Altering fish stocking regimes. Please give details.								
(a) timing	rarely	unknown	1?	1	probably low	Östergötland, Småland, Skåne	Avoiding eel stocking these are most susceptible to cormorant predation.	Pers. Comm. with fishermen, fishery officials at county adm boards
(c) density	rarely	unknown	1	1	5	Östergötland, Småland, Skåne	Reduction of stocked eels because it is believe that cormorants will consume the fish.	As above.
3. Wildlife Management								
3.1 Non-lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Human harassment								
Human patrol on foot or in vehicles	probably only rarely							
Audio frightening techniques								
Gas bangers / cannons (propane gas exploders)	rarely	days-weeks	3	1(fishermen) 4 (public)	3	L. Roxen, Östergötland		
Live ammunition	probably regularly	probably low						
Visual frightening techniques								
3.2 Lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Shooting adults and immatures								
to reinforce non-lethal harassment	regularly	days	4	As above.	3	many		Pers. Comm. with fishermen, ornithologists and officials at county adm boards
to reduce bird numbers at specific sites	regularly	days*	4	As above.	3	many		As above.
to reduce regional population levels	rarely	probably low**	4***	As above.	3	L. Hjälmaren		As above.

* birds will usually quickly return when shooting has ceased

** Been practised on a large scale only at one site, L. Hjälmaren, now for tree years. Killing involved about 20% per year of the local breeding population (late summer numbers). Effectivness seem to be low probably because shooting also involves migrating birds. Breeding population has continued to increase.

*** Labour demanding, about 100 hunters involved at each shooting occasion

25.4 Stakeholders consulted

Five fishermen, one official at the county administration board (south central Sweden) and one nature conservation organisation answered requests for information. Acknowledgment was also received from the Ministry of Agriculture, Food and Fisheries.

(1) Swedish Ornithological Society, Dörby 3656, 38696 Färjestaden.
(2) Professional Fisherman, PI 9818 Svärta Sand, 61193 Nyköping.
(3) KalmarIän Fishery Association, Hallströmsgatan 23, 593 50 Västervik.
(4) Professional Eel Fishery/SVC, Horsikavägen 8, 430 82 Donsö.
(5) Västernorrlands Fishery Association, Dehlinvägen 37, 865 92 Ainö.
(6) Professional Fisherman, Chairman of Öland Fishery Association, Mellböda 2192, 380 74 Löttorp.
(7) Professional Coastal Fisherman, Gotland Fishery Association, Gutenvik, Östergarn, 620 16 Ljugarn.
(8) Lake Mälaren Fishery Association, Hagbyholm 6, 725 97 Västerås.
(9) County Admin Board, Västmanland, 721 86 Västerås.
(10) Professional Fisherman, Gillholmen 110, 442 71 Kärna.

25.5 Bibliography

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(2) Dekker, W. (1997) The impact of cormorants and fykenet discards on the fish yield from Lake Ijsselmeer, the Netherlands. Cormorant and human interests, Lelystad, the Netherlands.
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(9) Lindell, L. (1989) Breeding Cormorants in Sweden. Workshop on Cormorants *Phalacrocorax carbo*.
(10) Lindell, L. and T. Jansson (1994) "Skarvarna i Kalmarsund."

26. United Kingdom

26.1 National Overview

By Ian Russell, Bruno Broughton & Julian Hughes
With input from Ian Winfield, Ian Cowx & Dave Carss

Background

For the purposes of this review, it has only been possible to collate information for Great Britain (i.e. England, Wales and Scotland), although a case study from Northern Ireland is also reported. There are about 7,500 pairs of *P. c. carbo* breeding in England, Wales and Scotland and about 1,650 pairs of *P. c. sinensis* (almost exclusively at inland colonies in England). The population of Great Cormorants wintering in Britain has increased around four-fold over the last 25 to 30 years and there are now about 25,000 individuals (of which about 10,000 individuals are inland) in winter.

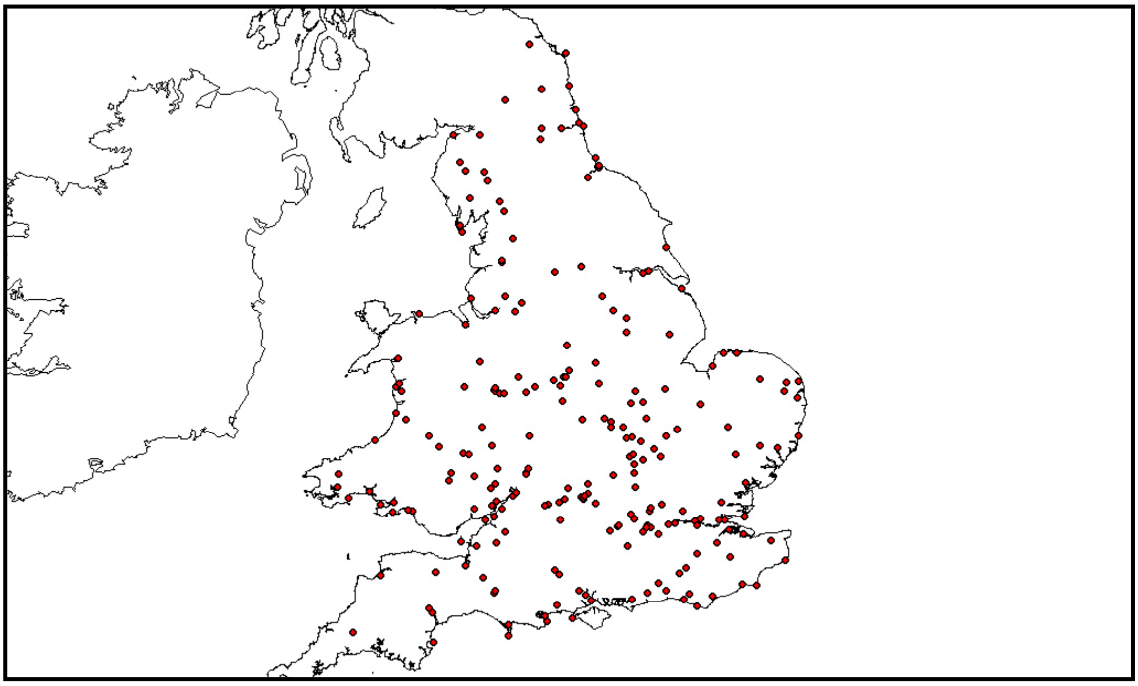


Figure 26.1 Roosts used by Cormorants in England and Wales in at least one winter between 1985 and 2000 – note that not all coastal roost sites are included. (Map based on data from Wildfowl & Wetland Trust).

In England and Wales, Cormorants have extended their range from coastal areas and now over-winter and feed in many inland areas, taking advantage of new wetland habitats, many created as a result of mineral extraction and water-supply reservoirs. In addition, over the last 20 years Cormorants have started to develop inland breeding colonies, probably due, at least in part, to colonisation from the continent by the sub-species *P. c. sinensis*. While *P. c. carbo* remains the predominant sub-species in England and Wales, the proportion of *P. c. sinensis* in the population has increased and there is evidence of the two sub-species interbreeding (Goostrey *et al*. 1998, Newson 2000). The proportion of *P. c. sinensis* varies regionally and is higher in south and east England than elsewhere. The increase in inland colonies has meant that some birds are present at inland sites throughout the year, although peak numbers occur over winter with many birds returning to coastal breeding sites in the spring. Figure 26.1 illustrates the distribution of inland roost sites in England and Wales over recent years.

The range extension and increase in numbers of birds has increasingly brought Cormorants into conflict with inland fisheries. The vast majority of Cormorant ‘conflicts’ in the UK are concerned with impacts on recreational fisheries. Such fisheries can conveniently be grouped into ‘game’ (salmonid) and ‘coarse’ (non-salmonid) fisheries. Almost all coarse fisheries in England and Wales operate on a catch and release basis; increasingly, many wild Atlantic Salmon (see Appendix 2 for scientific names) and trout fisheries also now practice catch and release. There are relatively few reported Cormorant conflicts with aquaculture (though some in Scotland) and very few, if any, with commercial (net) fisheries or at coastal sites. Conflicts with endangered fish species have also been noted.

It is estimated that there are 2,404 km^2 of freshwater habitat in Britain of which ca. 80% is stillwater and ca. 20% rivers; the majority of this is in Scotland (Smith & Lyle, 1979). Within England and Wales there is estimated to be 800 km^2 of freshwater habitat, split almost equally between rivers and stillwaters. The majority of the stillwater sites are small (<1ha). However, many of these and the majority of the larger lakes are fished by anglers; canal systems also serve as fisheries.

Stillwaters can conveniently be classed into three groups: natural, improved and intensive (Environment Agency 2001). Natural fisheries have no known management activity of any kind in recent years, and are maintained entirely by the natural production of existing stocks. Improved fisheries have some level of management activity and while fish stocks are maintained mainly by natural production there may be some limited stocking. In intensive fisheries the primary management objective is to maximise the fish stock and hence angling performance by extensive direct manipulation. There are relatively few natural sites and the majority thus have elevated densities of fish due to stocking. Such sites are clearly attractive to opportunist predators like Cormorants.

The principal stakeholders affected by Cormorant predation in the UK are therefore anglers and owners/managers of recreational fisheries. The main conflict issues for recreational fisheries in the UK are seen as:

(i) Reduced stocks of fish (including impacts on spawning adults and juvenile fish);
(ii) Reduced catches,
(iii) Damage of ‘takeable’ fish and resulting higher levels of mortality,
(iv) Behavioural changes and stress in fish resulting in reduced catchability for anglers,
(v) Reduced income from anglers (fewer licence/ticket sales),
(vi) Reduced capital value of fisheries (value commonly linked to recent catches).

For fish farmers the main concerns are the loss of stock and the possible increase in incidence of disease and parasite infestation (where Cormorants and other fish-eating birds act as vectors). In isolated instances there can also be concerns about the potential impact of Cormorants on endangered species of fish.

Cormorant conflicts with fisheries are perceived to occur widely throughout England and Wales, reflecting the widespread distribution of the birds (see Figure 26.1). Where such conflicts are serious, and other methods of deterrence are either ineffective or impractical, licences can be issued permitting the shooting of some birds. The distribution of such licences thus provides one tangible measure of the distribution of Cormorant/fishery conflicts within the country. Figure 26.2 illustrates the distribution of licences issued, in England only, over one winter 'season', 2001-2002, for both stillwater and riverine fisheries. This confirms the widespread distribution of the conflicts.

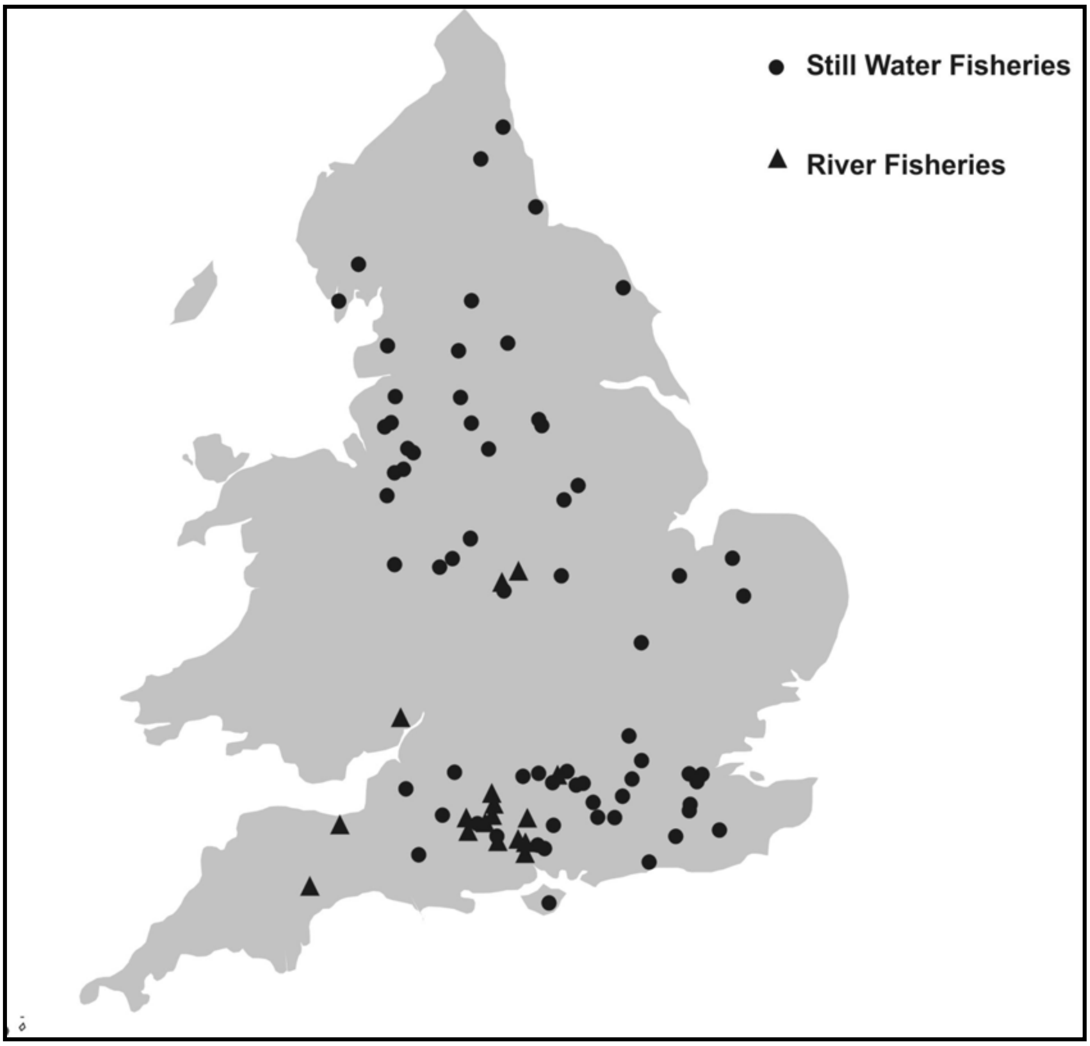


Figure 26.2 The distribution of Cormorant shooting licences at stillwater and riverine sites throughout England in 2001-2002 (Data and map courtesy of the Department for Environment, Food and Rural Affairs).

As a result of growing concerns about the Cormorant 'problem', the UK Government commissioned a number of R&D investigations in the mid 1990s. One of these investigations was to complete a series of impact assessment case studies (Feltham *et al*. 1999). This included the development of methodology aimed at improving confidence in the assessment process (Feltham *et al*. 1999, Davies *et al*. 2003a, Wilson *et al*. 2003). The following conflict assessment provides a brief overview of Cormorant/fishery conflicts, broadly aggregated by fishery/habitat 'type'. This draws extensively on the recent case study investigations in England and Wales, carried out between 1995-1998, and resulting scientific publications, but also includes other relevant information on conflicts throughout the UK. The assessment thus comprises both detailed scientific studies (from the recent R&D and other published sources) and less rigorous evaluations, anecdotal reports and perceptions. Where appropriate, specific mention is made of the situation in Scotland.

26.1.1 Conflict overview

On the basis of the recent R&D 'case studies' investigation (Feltham *et al*. 1999), it was concluded that levels of Cormorant depredation at fisheries in England and Wales were variable and in some cases high (e.g. median annual reductions of 55-57% of fish biomass were recorded). Depredation at stillwaters was found to be more variable than on rivers. This was felt to be consistent with the view that rivers were better 'buffered' against bird predation, at least in the short term. It was noted that the high levels of depredation observed at some sites did not result in detectable reductions in fishery performance during the study (although it was clearly not possible to predict how the fishery might have performed had predation not been a factor). However, the future 'collapse' of fisheries could not be ruled out should high levels of depredation continue coincident with poor recruitment.

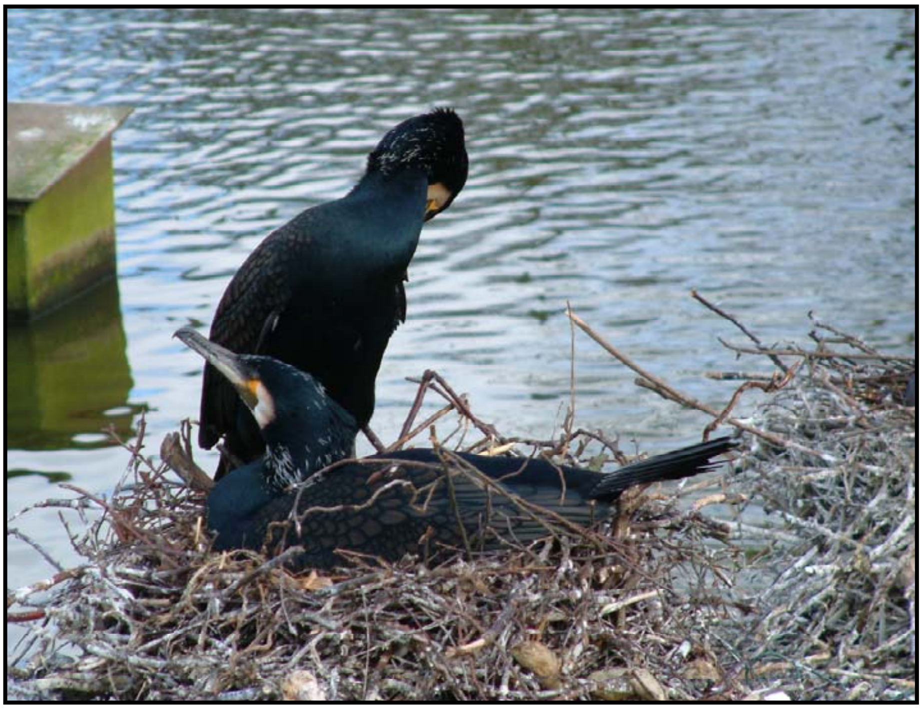
It was further concluded that the impact of Cormorants was a problem for *specific* fisheries rather than a general problem, with depredation levels being high enough to cause a decline in the fishery at some sites but not others. A more recent theoretical assessment of the overall impact of Cormorants on fish stocks in Great Britain (Diamond *et al*. 2003) supports this view. It was not considered possible to define a single level of depredation, in terms of the proportion of fish standing crop removed by birds, which could be used as a threshold for assessing whether losses were serious. It was thus considered necessary to continue to evaluate perceived conflicts on a case-by-case basis. Each fishery was expected to have its own threshold, dependent on the complex interaction between bird depredation and fish population dynamics, between consumption and production.

26.1.2 Conflict assessment for the main fishery/habitat 'types'

26.1.2.1 Rivers

There is marked variation in the diversity of fish species present in the river systems in the UK, with the number of species increasing with decreasing latitude and decreasing altitude. Thus fish communities are dominated by relatively small numbers of species (primarily salmonids) in many of the rivers in Scotland, northern England and in those draining more upland areas on the west coast and in Wales. In contrast, more diverse fish communities (predominantly cyprinids) are present in most of the rivers towards the south and east of England and in the lower reaches of some rivers elsewhere.

Cormorants are perceived to be a fairly widespread 'problem' on river systems throughout the UK. However, relatively few licences to shoot Cormorants have been issued over recent years for river systems in England and Wales, and these have mostly been in the south of the country (Figure 26.2). In Scotland, by contrast, many of the licences that have been issues have been for rivers. The data available from Cormorant stomach analysis for birds shot on river systems is consistent with the variable distribution of fish species and the fact that Cormorants are opportunist predators that consume locally abundant species. Marquiss *et al*. (1998) provide extensive details of the diet of Cormorants foraging in Scottish rivers, and a brief summary of Cormorant diet for different river 'types' is included in Russell *et al* (2003a).



Pair of Cormorants breeding at an inland colony in England (Photograph CEFAS).

Game angling (salmonid) rivers

On game angling (predominantly salmonid) rivers there are particular concerns about the potential impact of Cormorants on stocks of Atlantic Salmon and Brown Trout (both migratory and non-migratory). Both these species support major commercial and recreational fisheries. Cormorant numbers tend to be highest over the winter period, but birds appear to be present year round on some rivers. There are a few (largely anecdotal) reports for England & Wales of birds aggregating on estuaries and the lower reaches of these rivers in spring with resulting concerns about predation on shoals of smolts, which emigrate from the rivers at this time.

For riverine game fisheries, principal concerns relating to Cormorant impact are:

(i) Reduced stocks and catches,
(ii) Damage of 'takeable' fish,
(iii) Reduced income from anglers (fewer licence/ticket sales),

(iv) Reduced capital value of fisheries (linked to recent catches).

There are relatively few documented estimates of losses to Cormorants for such systems for the UK and none for England & Wales. Data for Scottish rivers appear in Marquiss *et al* (1998). Spring (March-April) samples from 5 Scottish rivers found Cormorant diet to be diverse, comprising 17 freshwater species. Spring samples were dissimilar and each locality had a different combination of commonly recorded fish species. Roach, Eel and Grayling were commonly taken on southern Scottish rivers, Brown Trout and Atlantic Salmon (juveniles) on northern ones. Winter diets also showed differences between southern and northern rivers. Temporal variation in Cormorant diet could be examined with samples from the River Tweed. Here, large Grayling predominated in February and March, Brown Trout in April, and Eel and Flounder in May (Marquiss *et al* 1998). There are also published estimates of losses for the River Bush (N. Ireland), brief details follow.

Case Study: River Bush

The River Bush is a small salmonid river in Northern Ireland. A Cormorant breeding colony is situated on the coast 13km to the east of the river mouth, and large numbers of birds have been observed feeding on the catchment, particularly during the spring Salmon smolt migration. Concerns have been expressed about the level of predation on both wild and hatchery-reared smolts.

A study was carried out in 1986 (Kennedy & Greer, 1988). Two bird counts were undertaken during the smolt run in May and one after the smolt run had finished in June, giving respective estimates of 147, 264 and 61 feeding birds. A small sample of these birds (n = 10) was shot and stomach contents analysed. Estimates of total daily predation rates in the catchment were derived from bird counts, proportions of prey types in the stomachs of shot birds and a Daily Food Intake estimate of 425g. On this basis, Cormorant predation during May was estimated to account for 51-66% of the wild smolt run, and 13-28% of the hatchery smolt release in 1986. No attempt was made to quantify predation losses in financial terms.

These estimates of smolt depredation for the River Bush are likely to be unusually high, as the river is situated near one of the largest Cormorant breeding colonies in the British Isles. A more recent study (Warke & Day, 1995) reported that predation on fish populations on the River Bush had declined and that the level of predation on fish stocks in the river appeared to be strongly influenced by the abundance of cyprinind and percid prey at alternative feeding sites.

Coarse angling rivers

The principal concerns at rivers supporting coarse fish relate to losses and damage of these species, mainly cyprinids and Perch, and the resulting impact on recreational fisheries. Cormorant numbers tend to be highest over the winter period, but at some sites, birds increasingly appear to be present year round.

Principal concerns relating to impact are:

(i) Reduced stocks and catches,
(ii) Damage to mature fish,

(iii) Behavioural changes and stress in fish resulting in reduced catchability for anglers,
(iv) Reduced income from anglers (fewer licence/ticket sales).

There are two recent case studies for England & Wales (note that the study sites were not selected at random, but on the basis of a perceived existing 'problem').

***Case Study:* River Trent, Nottingham (central England)**

A 25 km stretch of the River Trent was studied over a three-year period, incorporating: fish surveys, collation of angler catches, bird counts and feeding observations (Feltham *et al*. 1999). The study stretch was 60-70m wide, 2-5m deep and flowed mainly through pastureland, with some urban areas. The principal fish species were Roach, Bream, Chub, Gudgeon and Perch and these supported a popular coarse fishery. Main findings:

(i) Peak winter bird counts for the upper two sections of the study area ranged from 36-63, and 130-190 birds respectively. For the lower two sections peak counts of 42-155 and 41-96 birds were recorded.
(ii) Cyprinids were the main prey item observed during observations of feeding birds, and were also the dominant species in electrofishing surveys and angler catches.
(iii) Densities of fish varied temporally and spatially, as did angler catches and estimates of Cormorant depredation. Fish growth rates indicated no major changes due to Cormorant predation.
(iv) Cormorants were estimated to be removing up to 4 tonnes of biomass annually from the 25km stretch of river. Median estimates of the percentage of standing crop biomass removed by Cormorants ranged from 5 to 55% depending on location and year, although estimates of standing crop biomass had large interquartile ranges.
(v) Angling catches were variable, but appeared to be predominantly related to water temperature and quality, and were not considered to be seriously affected by the levels of Cormorant depredation observed during the study.
(vi) Recent changes in the fish population structure were felt to be attributable to increasing water quality.


Great Cormorants at (Left) an inland colony in England and (Right) a coastal colony in Scotland (Photographs Dave Carss).

Case Study: Lower River Ribble (NW England)

Two study areas on the River Ribble, one tidal and the other non-tidal, were studied over a three year period, incorporating: fish surveys, collation of angler catches, bird counts and feeding observations (Feltham *et al*. 1999). The river supports both a coarse and game fishery, but the surveyed stretches were dominated by cyprinids. Main findings:

(i) Numbers of Cormorants declined on both river sections during the course of the study. Distribution between the two sites varied between years, and birds were only observed during winter months (October to April).
(ii) In the non-tidal stretch, the population was dominated by cyprinids, mainly Chub and Dace (48% to 65%); Eel, Trout, Perch and Grayling were also present. Cyprinids were also dominant in Cormorant diet (91.2%) and angler's catches (93.2%), with salmonids and Eel also observed. Cormorants mainly preyed on cyprinids of 10-20cm, the commonest size class revealed by electrofishing surveys. The majority of rod caught cyprinids were in the size range 13-23cm and so Cormorants were in direct competition with anglers for these fish.
(iii) In the tidal stretch, cyprinids and Flounder dominated Cormorant diet (32-54%).
(iv) The percentage of standing crop biomass removed by Cormorants (from the non-tidal stretch) was estimated to vary between 14% and 30%, but there was marked temporal and spatial variation.
(v) It was suggested that Cormorants were more likely to be responding to changes in fish populations rather than causing them. It was speculated that variable catches (by both birds and anglers) may be attributable to cyclical changes in fish populations.

In an earlier study, Feltham & Davies (1995) estimated that Cormorants removed 2-38% of the cyprinid stock of Chub, Roach and Dace over a 36km stretch of the River Ribble. The level of damage attributable to wounding by Cormorants was: Roach (6-7%), Dace 20-26cm (2-7%) and Chub 26-29cm (14-18%) (Davies, cited in Russell *et al*. 1996).

26.1.2.2 Stillwater fisheries

Stillwater fisheries vary enormously in their size and in the fish populations that they support. Many are intensively managed and are run as recreational fisheries; larger sites often have multiple amenity use. Commonly, fisheries are either run as 'put-and-take' trout fisheries (i.e. a highly artificial fishery system where stocked fish are put into a water to be taken by anglers) or as coarse fisheries. Cormorants are perceived to be a common and widespread 'problem' at stillwater fisheries in all parts of England and Wales (Figure 26.2). The majority of licences issued in England and Wales to permit shooting of Cormorants are for stillwater fishery sites. The data available from Cormorant stomach analysis for birds shot at such sites is consistent with the fish species present and the fact that Cormorants are opportunist predators which consume locally abundant species (Russell *et al*. 1996, 2003a). The same appears to be the case for Scottish stillwaters (Marquiss *et al*. 1998).

One of the common anecdotal observations from fishery owners and managers is that Cormorant numbers at a particular site vary markedly over time. There have been numerous reports of periods of high Cormorant occupancy, followed by relatively few, if any, birds frequenting a site. The common perception is that this is a result of sites being 'fished out'. It is difficult to substantiate such claims, however.

Such behaviour would be consistent with the reported dependence of the birds on high-density prey assemblages (Grémillet & Wilson 1999), but substantial changes in stock density can occur for a variety of reasons and do not necessarily result from predation by Cormorants.

Great Cormorant prey from the inland colony at Abberton Reservoir (SE England) including Roach, Koi Carp, Gudgeon, Dace (see 26.1.2.4, Photograph Dave Carss).

Stillwater put-and-take trout fisheries

The main conflict at put-and-take fisheries is the loss and damage of stocked trout and the resulting impact on recreational fisheries. The loss of coarse fish species may also be considered a problem, particularly where sites are run as mixed fisheries. Cormorant numbers tend to be highest over the winter period, when many put-and-take fisheries do not operate, but at some sites birds are increasingly reported to be present year round. The principal concerns relating to impact are:

(i) Reduced stocks and catches,
(ii) Damage of ‘takeable’ fish,
(iii) Behavioural changes and stress in fish resulting in reduced catchability for anglers,
(iv) Reduced income from anglers (fewer licence/ticket sales).

Available information for ‘case study’ sites in England & Wales (which were not selected at random, but on the basis of a perceived existing ‘problem’), include:

Case Study: Colwick Park Trout Lake (central England)

Colwick Park Trout Lake is a 25 ha gravel pit on the bank of the River Trent in Nottingham. The lake is run as a put-and-take trout fishery and is stocked annually with 9-10,000 Rainbow Trout. Larger fish (>35cm) are stocked earlier in the season, and smaller fish are stocked later in the season when Cormorant numbers fall. Coarse fish are also present in the lake, including cyprinds, Pike, Perch and Eel. A 50% reduction in angler attendance was noted between 1987 and 1998; the reasons for this were unclear, but the perceived Cormorant problem was a contributory factor.

A 3-year investigation was completed (Feltham *et al*. 1999) incorporating: electric fishing surveys, collation of angler catches, bird counts and feeding observations. Main findings:

(i) Birds were most numerous in the period from March to April each year. Peak bird counts of 50 in February 1995 declined slightly to 32 in December 1997. Most birds left by May, and began returning in September.
(ii) During the winter, prior to stocking, the birds typically used the site as a daytime loafing site, having fed previously at other sites. This pattern changed when stocking started, with birds arriving at first light and actively feeding on the lake.
(iii) The few birds feeding prior to stocking preyed exclusively on Perch and fry; the post stocking diet consisted exclusively of Rainbow Trout.
(iv) Cormorants consumed trout in the size range of 20-45cm, with a high proportion of these being <30cm.
(v) Between 16.2% and 19.4% of the trout stocked in March and April were eaten by Cormorants during those months, which, together with small numbers of trout eaten in the autumn, equated to between 7.2% (1996) and 9.1% (1998) of the total fish stocked over the whole season.
(vi) Restocking costs to replace fish eaten by Cormorants were estimated at between £506 (1996) and £602 (1998). In addition, Cormorants were found to have wounded 11.4%, on average, of the fish not directly consumed.

Other studies

Moore and Ferguson (1986) reported a marked decline in return rates for stocked Brown Trout coincident with a sharp rise in the numbers of Cormorants wintering at Rutland Water (eastern England). It was speculated that the trout (traditionally stocked at a relatively small size to over winter and recruit to the fishery the following spring) were particularly vulnerable to Cormorant predation. Although there appears to be little other documented evidence on this issue, it should be noted that this fishery management strategy has now been widely discontinued in England and Wales. It is generally agreed among fishery managers that this option is not cost-effective due to the high over-winter losses of these fish to Cormorants.

In a survey of put-and-take trout fisheries, Callaghan *et al.* (1994, 1998) concluded that Cormorant density at 22 fishery sites accounted for very little of the variance in the reported trout catches at these sites. Catches depended mainly on fish densities and angler effort. However, it was concluded that Cormorants might cause localised damage by consuming and wounding fish. It was also noted that angler perceptions could result in reduced effort and financial loss to fisheries. It was recommended that the economic aspects needed further evaluation.

A separate questionnaire survey of angling clubs (Carss & Marquiss 1995) reported a widespread increase in Cormorant ‘problems’ at both trout and coarse fisheries, particularly in southern England. Financial losses of between £100 and £100,000 were claimed, attributed to extra restocking costs and to loss of revenue from permit sales and reduced subscriptions. At some clubs, revenue was reported to have fallen by as much as 50% in 2 years and stock losses of between 50 to 60 % were also claimed. Falling catches were also reported to lead to unquantifiable financial losses to local economies. There were no data to substantiate these loss estimates.

Both the above surveys also noted concerns about the high levels of damage to trout by Cormorants at stillwater game fisheries. Surveys carried out over 3 years at Chew Valley Lake in SW England (Klee, cited in Russell *et al*. 1996) found overall wounding rates of 21.4%, 6% of these being deep punctures. The incidence of wounding was also found to be positively correlated with the number of Cormorants at the site. Further data on wounding rates at put-and-take trout fisheries have been reported by Hopkins (cited in M^{c}Kay *et al*. 1999). In this study at a fishery in eastern England, the overall incidence of Cormorant damage was recorded at 14.3 % of the catch, but differences were noted between different size classes of fish, with fish in the range 40-44cm bearing the highest levels of wounding (21%). More recently, it has been noted at a number of put-and-take trout fisheries that wounding (and loss) rates can be significantly reduced by stocking with larger fish, slightly later in the spring once Cormorant numbers have fallen (David Moore pers. comm.). This practice has now become widely adopted at a number of put-and-take fisheries.

Cormorant predation at a stocked Scottish stillwater, Loch Leven, has also been investigated.

Case study: Loch Leven

Loch Leven (13.3 km^2, central Scotland) is arguably the most famous and productive Brown Trout fishery in the world. Cormorants use the loch as a feeding and roosting site and numbers have increased considerably there in recent years. Fisheries managers were concerned about the impact of Cormorants on the fishery and an investigation was undertaken (Carss *et al*. 1997). The main findings were:

(i) From 1983, increasing numbers (exceeding 100, 000 per year) of hatchery-reared (native stock) Brown Trout were released into Loch Leven. After 1989 the numbers of trout caught by anglers declined dramatically but such low catches were not unprecedented. In 1993 Rainbow Trout were introduced to the loch in an attempt to increase anglers' catches.
(ii) Coincident with the large increase in stocking from 1987 (and a decline in catches from 1989), over-wintering Cormorant numbers increased three-fold after the 1987-88 winter to a maximum of 800 birds.
(iii) Assessing historical (and current) data from stomach contents analysis showed that proportions of Perch in Cormorant diet had declined. Cormorants were likely to have consumed large numbers of trout in recent years, many of which were large enough to have been caught by anglers. There was potential for conflict between birds and the fishery but the true impact of the Cormorant was unknown.
(iv) Investigations into the trout population in the loch in 1992 showed that it was probably approaching carrying capacity and suggested that declining angling catches were not caused by a decline in fish stocks. The abundance of fish suggested that Cormorant predation was not a problem in terms of angling harvest and killing Cormorants had not resulted in elevated fish catches. Wright (2003) also found no

evidence of an increase in angling catches as a consequence of shooting Cormorants at the site.

Stillwater coarse fisheries

The principal concerns at these sites relate to losses of coarse fish (mainly cyprinids, Perch, Pike and Eel) and the resulting impact on recreational fisheries. Cormorant numbers tend to be highest over the winter period, but, increasingly, birds appear to be present year round. Principal concerns relating to impact are:

(i) Reduced stocks and catches,
(ii) Damage of mature fish,
(iii) Behavioural changes and stress in fish resulting in reduced catchability for anglers,
(iv) Reduced income from anglers (fewer licence/ticket sales).

Available information for stillwater coarse fishery sites in England & Wales (not selected at random, but on the basis of a perceived existing 'problem'), include:

Case Study: Holme Pierrepont (central England)

This 26.7ha man-made lake at Nottingham is a relatively featureless water body with clear water and a depth of 2 to 4m. The site is primarily managed as a water sports venue, but is also used for pleasure and match angling. Roach, Bream and Perch are the dominant species, with other cyprinids, Pike and Eel also present.

It was once considered a premier coarse fishing venue in the 1980s and early 1990s, with angling revenue peaking at £40,000 per year. However, this perception altered after 1994 when poor catches were experienced during the World Angling Championship at the venue. Angler attendance fell after this date and in 1996-97 day ticket charges were dropped. It is not clear how the venue has performed in more recent years or whether angler attendance has recovered since the completion of the investigation in 1998.

Many people blamed the declining catches on the large numbers of over-wintering Cormorants, which have been foraging on the lake since 1993-94. The site was subject to a detailed three-year investigation (Feltham *et al*. 1999, Britton *et al*. 2002, Britton *et al*. 2003, Davies *et al*. 2003b), incorporating: electric fishing surveys, analysis of angler catch data, bird counts and feeding observations. Main findings:

(i) Large numbers of Cormorants used the site. Peak numbers occurred between December and February, with the peak count declining from 153 in 1996 to 83 in 1996 and 79 in 1997. Occupancy was greatest for the first 2 hours after dawn.
(ii) Substantial fish losses were estimated, with the percentage of fish standing crop biomass removed by Cormorants rising from 42% in 1995/6 to 48% in 1996/7 and 55% in 1997/8.
(iii) Fish standing crop biomass increased during the study period and the fishery was considered to be performing reasonably well at the end of the study despite the high levels of depredation. There was a steady increase in angler catch per unit effort from 1994 to 1998, believed to reflect reasonable recruitment of fish over this time.

(iv) The species composition of Cormorant diet, angler catches and electric fishing surveys differed. Cormorants tended to consume smaller size classes of fish than those targeted by anglers.
(v) Cormorants were observed mainly to prey upon fish <10cm, although larger fish were more frequent in electrofishing surveys.
(vi) The researchers considered that the fish populations had compensated to some extent for the losses to Cormorants by accelerating their growth rate, spawning at an earlier age and thus increasing overall production (Britton *et al*. 2002).
(vii) Although angler catch rates improved over the study period these are known to have experienced large 'natural' fluctuations in the past (e.g. catch rates recorded at the site in 1990 and 1991 were well in excess of those recorded during the study). It was recognised that the fishery had been 'sustained' over the study period by a series of good recruitment years in 1995, 1996 and 1997. However, coarse fish recruitment is known to be highly variable and the researchers noted that "a succession of poor and average recruitment years could lead to a collapse in the fishery" and that " the potential for decline of the fishery in the future is of some concern".
(viii) In a subsequent 'key factor analysis', the researchers concluded that Cormorant depredation at Holme Pierrepont *did* reduce the availability of fish for angler exploitation in subsequent years (Britton *et al.* 2003).
(ix) Direct financial losses due to Cormorants could not be quantified, but the authors recognised that lost revenues may have been related to the perception that angler catches were reduced by Cormorant depredation.

Case Study: Grimsargh Reservoirs (NW England)

The Grimsargh reservoir complex in Lancashire consists of 3 water supply reservoirs, one being used as a put-and-take trout fishery, and the others as coarse fisheries. One of the latter sites was selected as a study site, as fish stocks were thought to be impoverished and angler catches were reported to have declined substantially due to Cormorant depredation. Bird counts, feeding observations and fishery surveys were undertaken over a two year period (Feltham *et al*. 1999). Main findings:

(i) Cormorant occupancy was low in the winter, and zero in the summer. The mean number of birds visiting the site peaked at a mean of 6.5 birds per day in February 1996.
(ii) Seine net catches were dominated by cyprinids, with Perch, Pike and Eel also present. Cormorant diet comprised entirely cyprinids.
(iii) The estimated percentage of standing crop biomass removed from the site over the winter of 1996/7 was 3.7%. It was concluded that at this low depredation rate, fish stocks were unlikely to be seriously affected by Cormorants. Fish surveys indicated a high proportion of small, stunted fish suggesting overcrowding.

Case Study: Rye Meads (SE England)

Two short-term (ca. 6 week) investigations were carried out at two small, adjacent lagoons at Rye Meads in Hertfordshire in an effort to evaluate two possible management options (size of stocked fish and fish refuges) as a means of limiting losses to Cormorants (M^{c}Kay *et al*. 1999, Feltham *et al*. 1999, Davies *et al*. 2003b). The shallow lagoons could be drained down allowing the fish population to be evaluated and one lagoon was covered to exclude Cormorants and to act as a control.

Cormorant presence was assessed by observers to enable observed losses to be compared with the estimates of depredation gained from feeding observations.

The trial and control lagoons were both stocked with equivalent numbers and sizes of Carp. Observations of feeding birds were carried out at regular intervals throughout the study. At the end of this period the lagoons were drained down and the remaining fish were counted. In the first trial a 62% mortality was observed in the open lagoon, compared with a 4% mortality in the control lagoon (i.e. 58% ‘lost’ fish); similar results were evident in the second trial with 62% ‘lost’ fish. In both trials, feeding observations could only account for a small proportion of the ‘lost’ fish. It was concluded that the difference was explained by the fact that birds swallowed many of the fish underwater; the biomass of fish removed was within the overall predicted food requirements for the number of birds estimated to have visited the site over the trial period.

(Left) cage fish farms in western Scotland, note Grey Herons on top nets, and (Right) Great Cormorant damage to caged juvenile Atlantic salmon (Photographs Dave Carss).

26.1.2.3 Fish Farms

In general, the level of predation by Cormorants at fish farm sites in England and Wales is thought to be relatively low. At many smaller sites protective measures have been installed, where this has been practicable. However there are believed to be some localised problems, particularly at more open sites with extensive pond systems where netting is impractical. Concerns have also been expressed about birds attacking fish-rearing cages located in open water bodies in England and Wales, and there are some published reports confirming that birds do damage some fish in such rearing facilities (Ransom & Beveridge 1983, Carss 1993).

Most UK cage aquaculture occurs in Scotland. Atlantic Salmon are reared in cages at marine sites and Rainbow Trout at both marine and freshwater sites. Great Cormorants have been recorded visiting such cages and attacking stock. Two cage farms in western Scotland (one off the coast, the other in a freshwater loch) were investigated over a 2-year period (1985-1987) to determine the circumstances of any stock loss to Cormorants and to quantify such losses (Carss 1993). Cormorants apparently did not take fish from farm cages but attacked them through the netting and sometimes caused fatal wounds. Some individual attacks appeared severe but the resulting stock losses were small in relation to the overall recorded fish mortality. At one farm, such 'Cormorant-damaged' fish accounted for just 1.4% of the annual financial outlay of the business.

Cormorant damage to stock can be reduced, but not eliminated, by the use of underwater anti-predator netting (set from walkways < 1m from the fine-mesh net bag containing the fish). Similarly, unprotected cage nets fouled with algae appeared to give more protection than do clean ones. Most of the fish eaten by Cormorants foraging near farm cages, in both coastal and freshwater sites, appeared to be free-living. Intensive seine netting around fish cages showed high concentrations of both wild and escaped fishes in waters immediately adjacent to cages, presumably an attractive food source to diving predators such as Cormorants (Carss 1990).

Seine net catch adjacent to freshwater Rainbow Trout farm cages: Rainbow and Brown Trout (Photograph Dave Carss).

26.1.2.4 Estuaries and coastal areas

There are few published estimates of fish losses to Cormorants at estuarine or coastal sites in England and Wales. The summer diet of (*carbo* and *sinensis*) Cormorants at the inland colony at Abberton Reservoir (< 10 km from the coast of SE England) was investigated by Carss & Ekins (2002) in 1992-5. Here, diet was dominated by Eel (47% biomass), Right-eyed flatfishes (20%) and Garfish (10%). Calculations suggested that during the breeding season Cormorants at the colony (526 nests in 1993) consumed 70 tonnes of fish, of which 33 tonnes were Eel.

26.1.2.5 Cormorant conflicts with endangered fish species

A recent study (Winfield *et al*. 2003) has reported on a conflict between Cormorants and an endangered fish species. Within the UK, the whitefish (Powan) is protected under nature conservation legislation. The species is restricted to a small number of sites and at one of these, Haweswater in the English Lake District, the population has been in decline since the 1960s. While variable lake levels during the fish's spawning period have accounted for some of this decline, particularly earlier in the period (Winfield *et al*. 2004), recent improvements have resulted in a series of years when spawning conditions have been good. Nevertheless, recruitment has continued to be poor and studies have indicated that foraging by a local Cormorant breeding colony, which grew rapidly after establishment in 1992 and then stabilised after six years, is thought to be responsible for preventing a recovery in the fish population.

26.2 Cormorant conflicts with fisheries

Care must be taken when interpreting information provided in this section. Please refer to section 2.2.3 (*Methodological limitations and difficulties*). The conflicts described hereafter should be taken as representative examples (they were not selected at random, but on the basis of a perceived existing 'problem' and where documentation was available). These examples do not provide a complete overview of conflict cases occurring in the UK.

26.2.1 Conflict site descriptions

Nine Cormorant conflicts were reported from the UK: on 9 lakes (Haweswater, Grimsargh Reservoirs, Holme Pierrepont, Colwick Park Trout Lake, Blithfield reservoir [2 sites], Loch Leven) and 2 rivers (Ribble, Trent) (Table 26.1).

	Feature	**Category**		
Habitat	**Reach**	**Upper**	**Middle**	**Lower**
Rivers	N = 2 cases			2
	Width (m)	**< 10m**	**10-50m**	**50-100m**
Rivers	N = 2 cases		1	1
	Altitude (m)	**< 100m**	**100-500m**	**500+m**
Rivers	N = 2 cases	2		
Lakes	N = 7 cases	4	3	
	Trophic status	**Oligotrophic**	**Mesotrophic**	**Eutrophic**
Lakes	N = 7 cases	2	2	3
	Anthropogenic Influence	**Natural**	**Semi-natural**	**Artificial**
Rivers	N = 2 cases	2		
Lakes	N = 7 cases		2	5

Table 26.1 The number of Cormorant conflict cases reported from the UK in relation to habitat and habitat features.

26.2.2 Birds and fish

In the UK, Cormorants reported to be involved in conflicts were both *P.c. carbo* and *P.c. sinensis*. Reported Cormorant densities in the 6 lake cases for which data were provided are given in Table 26.2.

		Cormorant density (maximum no. ha^{-1})			
Habitat	**No. cases**	**Mean**	**SE**	**Minimum**	**Maximum**
Lakes	6	1.8	0.87	0.19	5.73

Table 26.2 Cormorant density (mean, standard error [SE], minimum and maximum) for the UK cases in relation to habitat type.

Based on 7 lake and 2 river cases, cyprinids and a further 7 fish species were reported to be involved in conflicts (Table 26.3).

Species	Frequency (% of cases) Lakes (7 cases)	Rivers (2 cases)
Rainbow Trout	86	
Brown Trout	86	50
Cyprinids	71	100
Perch	71	100
Powan	14	
Arctic Char	14	
Atlantic Salmon		50
Eel		50

Table 26.3 Fish species reported to be in conflict with Great Cormorants in 9 cases from the UK.

26.2.3 Seasonality

Cormorant conflicts in the UK were reported to occur predominantly in winter (i.e. Oct-Mar): grey boxes indicate months where fewer conflict cases were reported.

Month of conflict												
COUNTRY	J	F	M	A	M	J	J	A	S	O	N	D
United Kingdom												

26.2.4 Finance

Financial information on the ‘costs’ of Cormorant predation was not provided for UK cases.

26.2.5 Conflict issues: magnitude of conflict

As the number of cases reported from the UK was small (n = 9), information from all was combined. Cormorant conflicts with recreational fisheries stakeholders were the most frequently reported (all 9 cases), and 2 cases (both lakes) involved nature conservationists. Recreational fisheries stakeholders reported a total of 15 conflict issues relating to fisheries, fish stocks or the environment. The most commonly cited major conflicts were reduced catches and reduced stocks through lowered production (Table 26.4).

26.2.6 Conflict issues: status of information used by stakeholders

Overall, stakeholders provided 175 records of the status of the information they used to inform themselves about Cormorant conflict issues in the UK. The highest proportion of records (46%) was for ‘scientific literature’, followed by ‘grey literature’ (35%) and ‘popular’ articles. Overall, there were differences in the use of popular, grey and scientific literature sources between the 2 stakeholder groups providing information (Table 26.5).

Status of information	Stakeholder group			
	Recreational	**Commercial**	**Aquaculture**	**Nature conservation**
Popular	46.3%	-	-	19.2%
Grey literature	5.4%	-	-	34.6%
Scientific literature	48.3%	-	-	46.2%
Total no. records (= 100%)	**149**	**None**	**None**	**26**

Table 26.5 Categorisation of the status of information used by stakeholders to inform themselves about Cormorant conflict issues. Nature conservationists used more grey literature than expected (X^2 = 23.35, df = 2, $P < 0.001$).

26.3 Potential Cormorant management tools

One of the projects commissioned by the UK government in the 1990s provided a comprehensive review of Cormorant management measures (McKay *et al.* 1999). A number of techniques were investigated during the review project, these included: the effects of shooting, the use of laser light, habitat management, conditioned taste aversion, fish stocking control and the use of fish refuges. Parrott *et al.* (2003) provide further analysis of the shooting investigation.

Preliminary results on the use of fish refuges (McKay *et al.* 1999, 2003) were encouraging and have resulted in further government-funded investigations into the efficacy and acceptability of utilising fish refuges to reduce Cormorant impact at inland fisheries (Russell *et al.* 2003b, in press). This research has provided very clear evidence that refuges can protect fish and reduce the foraging efficiency of Cormorants. The technique is expected to be particularly suitable for smaller stillwater coarse fisheries, especially where fish such as Roach, Perch, Rudd and Bream are the main target species. There are a number of issues to resolve in order to determine how best to apply this approach to a range of fishery types and to assess the extent to which fisheries might benefit. Work is therefore continuing to evaluate this management technique further. Summaries of the work on fish refuges have been made available to anglers and fishery managers via advisory leaflets (Moran Committee 2004, Defra 2005).

REDCAFE participants also summarised available information on management practices as they apply in the UK. Information (summarised in the following tables) was provided on (1) general actions taken against Cormorants in the UK and management plans/legal regulations, (2) actions at breeding colonies, (3) at roosts, (4) at small rivers, (5) at small stillwaters, (6) at very large waterbodies, and (7) at aquaculture sites.

26.4 Stakeholders consulted

In compiling the overall conflict resolution table for England and Wales a range of stakeholder groups were consulted for their views. This included both non-governmental organisations (NGOs) representing both nature conservation and angling interests. No comments were received; some NGOs commented that they did not feel sufficiently qualified to alter or update information compiled by REDCAFE participants. Organisations consulted:

Nature conservation NGOs
(1) British Trust for Ornithology (BTO).
(2) National Trust.
(3) The Wildlife Trusts.
(4) Wildfowl & Wetlands Trust (WWT).
(5) World Wide Fund for Nature (WWF-UK).
(6) Royal Society for the Protection of Birds (RSPB).

Member organisations of the National Angling Alliance
(7) Salmon & Trout Association (S&TA).
(8) National Federation of Anglers (NFA).
(9) National Federation of Sea Anglers (NFSA).
(10) Specialist Anglers' Alliance (SAA).
(11) Angling Trades Association (ATA).
(12) National Association of Fisheries & Angling Consultatives (NAFAC).

Conflict issue	Not claimed/not applicable	No impact	Minor effect	Major effect
(1) FISHERIES				
Reduced catch		2	1 [1]	3 [1]
Loss of stocked fish			4	1
Reduced value of catch (damage)			6 [1]	[1]
Reduced catchability (stress/behaviour)			4 [2]	
Loss of earnings from the fishery			6 [2]	
Reduced fishing tackle sales			[2]	
Increased recurrent costs			4	
Loss of employment			3	
(2) FISH STOCKS				
Reduced stock - lowered production			3 [1]	3 [1]
Effects on popn. dynamics/community structure			1 [1]	2[1]
Threats to endangered fishes			[1]	[1]
Vectors of diseases/parasites			[1]	[1]
Loss of juvenile fish – lowered recruitment				1 [1]
Loss of spawners				1 [1]
(3) ENVIRONMENTAL				
Scaring/shooting disturbance			1	

Table 26.4 Cormorant conflict issues as recorded by recreational angling stakeholders for UK lakes (n = 7 cases) [and n = 2 rivers in square brackets]. Each figure is the number of times a particular issue was cited by stakeholders.

NAME OF RESPONDENT AND YOUR AFFILIATION	Ian Russell -(CEFAS), Julian Hughes (RSPB, Ian Winfield, Dave Carss (CEH)
COUNTRY	UK (England & Wales, Scotland)
REGION / PROVINCE / etc. (if applicable)	UK (England & Wales, scotland)
Period which is concerned [year(s)]	Current situation (2001/02)

General information: actions against Cormorants in UK (annual nos)

	Total numbers		Regional numbers	
	National numbers	Count/Estimate?	England & Wales	Scotland
Number of breeding colonies destroyed or disturbed	1	Count	1	
Number of nests destroyed	0		0	
Number of nestlings killed	0		0	
Number of adults killed in the non-breeding season	ca. 500-550 (licensed)	Count	ca. 200-250 (licensed)	ca. 300
Is there any killing of breeding adults??? Please give numbers	No			
Number of night roosts destroyed or disturbed	Some (<20)	Est.	Some (<20)	

Management plans / legal regulations (details below the table)

	Total country	England & Wales	Scotland
Are there any management plans in effect? Please list all national or regional plans and give details	No	No	No
Are there any regulations in effect that allow Cormorant culling? Please list all national or regional regulations and give details	No	No	No
Are there any coordinated culling programmes in your country?	No	No	No
Is it mandatory to obtain single permits for Cormorant killing?	Yes	Yes	Yes
Has a general permit for Cormorant killing been issued?	No	No	No
Is there any financial compensation for fish losses?	No	No	No
Is there any financial aid for the construction of Cormorant exclosures or for scaring programmes, etc.?	No	No	No

Remarks (on General information & on Management plans /legal regulations):

Licences to shoot limited numbers of cormorants at specific sites can be issued as an aid to scaring. Applicants need to be able to demonstrate that serious losses are occurring and that other management options have been tried and have failed. Unknown level of illegal shooting.

NAME OF RESPONDENT AND YOUR AFFILIATION	**Ian Russell (CEFAS), Julian Hughes, (RSPB), Ian Winfield, Dave Carss (CEH)**
COUNTRY	**UK (England & Wales, Scotland)**
REGION / PROVINCE / etc. (if applicable)	**UK (England & Wales, Scotland)**
Period which is concerned [year(s)]	**Current situation (2001/02)**
A. Breeding Sites (no attempts made in Scotland)	

Cormorant Damage Control Activities								
1. Avoid foundation of new colonies	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Removal of trees at a roost to prevent colony establishm	Rarely	Years	2	1/5	4	Small number of stillwaters	Effective only in situations where there is no alternative nest site	Anecdotal - not aware that this has ever been
2. Existing colonies: Hinder cormorants from breedi	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Removal of trees	Regularly (just at one site)	Highly variable days to years	2	3/4	2/4	Haweswater (N54:31:23 W2:47:50)	Effectiveness depends on proximity of alternative roost sites & turnover of birds. Not acceptable at nature reserves. Haweswater study relates to 1999-2002 - limited number of trees in breeding colony have	Winfield et al (in press) - see below
Scaring by human presence	Regularly (just at one site)	Days	2	3	3	Haweswater (N54:31:23 W2:47:50)	Relates to 1999-2002. Following short trials of other audio-visual scaring techniques in 1999, this method has subsequently	Winfield et al (in press) - see below

Winfield, I. J., Crawshaw, D. H. & Durie, N. C. (in press). Management of the cormorant, *Phalacrocorax carbo* , and endangered whitefish, *Coregonus lavaretus,* populations of Haweswater, UK. In: Cowx, I. G. (editor) *Interactions between Fish and Birds: Implications for Management* . Fishing News Books, Blackwell Scientific Publications, Oxford.

NAME OF RESPONDENT AND YOUR AFFILIATION — **Ian Russell (CEFAS), Julian Hughes (RSPB), Dave Carss (CEH)**

COUNTRY — **UK (England & Wales, Scotland)**
REGION / PROVINCE / etc. (if applicable) — **UK (England & Wales, Scotland)**
Period which is concerned [year(s)] — **Current situation (2001/02)**
B. Roosting Sites (no attempts made in Scotland)

Cormorant Damage Control Activities

1. Avoid foundation of new roost sites	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Scaring by use of live ammunition	Rarely	Days	2	3	2	Unknown	Effectiveness depends on proximity of alternative roost sites, turnover of birds. Not acceptable at	
Shooting some birds to reinforce scaring	Not used							
Gas bangers / cannons (propane gas exploders)	Rarely	Days	2	3	2	Unknown	As above.	
Pyrotechnics / Fireworks	Rarely	Days	2	3	2	Unknown	As above.	
Laser light	Not used	Days	3	2	1	Unknown	Tested in trials only, not believed to be used	McKay et al (1999)
Scaring by human presence	Rarely	Days	1	2	3	Unknown	Effectiveness depend on proximity of alternative roost sites, turnover of birds. Not acceptable at	

2. Existing roost sites: Hinder cormorants from roos	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Removal of trees	Rarely	Highly variable	2	4	2	Unknown	As above.	
Other modification of habitat	Rarely	Unknown						
Scaring by use of live ammunition	Rarely	Days	2	3	2	Unknown	As above.	
Gas bangers / cannons (propane gas exploders)	Rarely	Days	2	3	2	Unknown	As above.	
Pyrotechnics / Fireworks	Rarely	Days	2	3	2	Unknown	As above.	
Laser light	Not used	Days	3	2	1	Unknown	Tested in trials only, not believed to be used	McKay et al (1999)
Scaring by human presence	Rarely	Days	1	2	3	Unknown	Effectiveness depend on proximity of alternative roost sites, turnover of birds. Not acceptable at nature reserves.	

McKay, H., Furness, R., Russell, I., Parrott, D., Rehfisch, M., Watola, G., Packer, J., Armitage,M., & Gill, E. (1999). The assessment of the effectiveness of management measures to control damage by fish-eating birds to inland fisheries in England and Wales. Draft Contract Report for MAFF (Contract VC 0107). 171pp + Annex.

NAME OF RESPONDENT AND YOUR AFFILIATION **Ian Russell (CEFAS), Julian Hughes (RSPB), Dave Carss (CEH)**
COUNTRY **UK (England & Wales, Scotland)**
REGION / PROVINCE / etc. (if applicable) **UK (England & Wales, Scotland)**
Period which is concerned [year(s)] **Current situation (2001/02)**
C. Feeding Sites
C1. Small Rivers (Width < 100 m)

Cormorant Damage Control Activities								
1. Resource Management	**Technique is used?**	**Effectiveness ?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Habitat management								
Improve habitat quality for fishes	Regularly	Years	2	1	1/2	Various	Not specifically used to deter cormorants	
Fish management								
Altering fish stocking regimes. Please give details (a) timing	Rarely	Days	3	3	5	Various	Localised measure - applies to stocked trout only. Stocking may have adverse ecological	
(b) frequency	Rarely	Days	3	3	2	Various	As above.	
(c) density	Rarely	Days	4	4/5	2	Various	Low densities will not be favoured by anglers. Localised measure - applies to stocked trout only. Stocking may have adverse ecological	
(d) stocked fish sizes	Rarely	Months	2	3	2	Various	Localised measure - applies to stocked trout only. Stocking may have adverse ecological consequences - possibly enhanced by stocking	
2. Bird-proof barriers (overhead barriers and peripheral fencing/netting)	**Technique is used?**	**Effectiveness ?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Submersed fish refuges (please specify)	Rarely	Years	4	3	2	Various	Not specifically to deter cormorants; May have conflicts with navigation & land drainage; Need to secure against flood flows	
3. Wildlife Management								
3.1 Non-lethal techniques	**Technique is used?**	**Effectiveness ?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Human harassment								
Human patrol on foot or in vehicles (incl. boats)	Regularly	Hours	1	1	4	Various	Potential impacts on other wildlife and people	McKay et al., 1999
Audio frightening techniques								
Gas bangers / cannons (propane gas exploders)	Regularly	Hours	2	4	3	Various	As above.	
Pyrotechnics / Fireworks (shell crackers, screamers, whistling projectiles, exploding projectiles, bird bangers, flash/detonation cartridges)	Regularly	Hours	2	4	2	Various	As above.	
Live ammunition	Regularly	Hours	2	4	2	Various	As above.	
3.2 Lethal techniques	**Technique is used?**	**Effectiveness ?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Shooting adults and immatures								
to reinforce non-lethal harassment	Rarely	Weeks	2	3	2	Various	As above. Unknown quantity of illegal shooting.	McKay et al., 1999 (see below)
to reduce bird numbers at specific sites	Rarely	Weeks	2	3	2	Various	Potential impacts on other wildlife and people. Unknown quantity of	As above.

NAME OF RESPONDENT AND YOUR AFFILIATION	Ian Russell (CEFAS), Julian Hughes (RSPB), Dave Carss (CEH)							
COUNTRY	**UK (England & Wales, Scotland)**							
REGION / PROVINCE / etc. (if applicable)	**UK (England & Wales, Scotland)**							
Period which is concerned [year(s)]	**Current situation (2001/02)**							
C. Feeding Sites								
C3. Small Still Waters (< 100 ha); not aquaculture								
Cormorant Damage Control Activities								
1. Resource Management	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Habitat management								
Improve habitat quality for fishes	Rarely	Years	2	1	1/2	Various	Not specifically used to deter cormorants	
Increase of turbidity	Regularly	Not known	3	4/5	3	Various	Not specifically used against cormorants. Stocking of large benthic species (e.g. carp) in fisheries now commonplace in UK (E&W). Acceptability questionable on biodiversity/aesthetic grounds.	
Others (please specify) New footpaths	Rarely	Years	2	1	1/2	Various	Possible conflict with anglers interests	
Fish management								
Altering fish stocking regimes. Please give details								
(a) timing	Rarely	Days	3	3	5	Various	Localised measure - applies mainly to stocked	
(b) frequency	Rarely	Days	3	3	2	Various	As above.	
(c) density	Rarely	Days	4	4/5	2	Various	As above.	
(d) stocked fish sizes	Rarely	Months	2	3	2	Various	Localised measure. Has been shown to be cost-effective for put-and-take-trout fisheries.	McKay et al., 1999; Moore, 2002
Conditioned Taste Aversion	Not used	Months	5				Tested under controlled Lab. Conditions and proved effective. Not clear how this might be applied in the field.	McKay et al (1999)
2. Bird-proof barriers (overhead barriers and peripheral fencing/netting)	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Wire, lines or string in parallel patterns (please give spacing)	Rarely	Not known	3	4	2	Various	Spacing thought to be ad hoc and variable. Only used on smaller sites. Will impede angling. Efficacy likely to depend on proximity of alternative feeding sites.	
Polyethylene rope with foam floats	Rarely	Not known	2	4	4	Various	Likely to impede angling & only suitable for smaller sites.	
Coloured streamers to increase visibility of wires and stri	Rarely	Not known	3	4	2	Various	As above.	
Submersed fish refuges (please specify)	Rarely	Not known	3	3	3	Various	As above. Currently under investigation in E&W.	McKay et al (1999); McKay et al (2002); Russell et al (2002)

NAME OF RESPONDENT AND YOUR AFFILIATION	Ian Russell (CEFAS), Julian Hughes (RSPB), Dave Carss (CEH)
COUNTRY	UK (England & Wales, Scotland)
REGION / PROVINCE / etc. (if applicable)	UK (England & Wales, Scotland)
Period which is concerned [year(s)]	Current situation (2001/02)
C. Feeding Sites	
C3. Small Still Waters (< 100 ha); not aquaculture - continued	

Cormorant Damage Control Activities								
3. Wildlife Management								
3.1 Non-lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Human harassment								
Human patrol on foot or in vehicles (or by boat)	Regularly	Days	1	1	4	Various	Potential impacts on other wildlife and people	McKay et al (1999)
Audio frightening techniques								
Gas bangers / cannons (propane gas exploders)	Regularly	Days	2	4	3	Various	As above. Most effective if moved regularly and used in conjunction with other visual deterrents	McKay et al (!999)
Pyrotechnics / Fireworks (shell crackers, screamers, whistling projectiles, exploding projectiles, bird bangers, flash/detonation cartridges)	Regularly	Days/Weeks	2	4	3	Various	Potential impacts on other wildlife and people. Most effective if moved regularly and used in conjunction with other visual deterrents	
Live ammunition	Regularly	Weeks	2	4	2	Various	Potential impacts on other wildlife and people. High manpower costs.	McKay et al (!999)
Visual frightening techniques								
Simple human effigies or scarecrows	Regularly	Not effective						
Animated scarecrows (moving and/or in combination with automated sound devices)	Rarely	Days	2	3	3	Various	Best used in conjunction with other audio scarers and if moved regularly	
Raptor silhouettes	Rarely	Not effective						
Live raptors (trained birds of prey)	Rarely	Not effective						
Mirrors	Rarely	Not effective						
Moving disks	Rarely	Not effective						
Mylar tape	Rarely	Not effective						
Eye spot balloons	Rarely	Not effective						
Laser light	Not used						Laser guns have been evaluated at night roosts	McKay et al (1999)
Combination of audio and visual techniques	Regularly	Days/weeks	2	3	3	Various		
3.2 Lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Shooting adults and immatures								
to reinforce non-lethal harassment	Regularly	Weeks	2	3	2	Various	Potential impacts on other wildlife and people. Unknown quantity of illegal shooting.	McKay et al., 1999 (see below)
to reduce bird numbers at specific sites	Regularly	Weeks	2	3	2	Various	As above.	As above.

McKay, H., Furness, R., Russell, I., Parrott, D., Rehfisch, M., Watola, G., Packer, J., Armitage,M., & Gill, E. (1999). The assessment of the effectiveness of management measures to control damage by fish-eating birds to inland fisheries in England and Wales. Draft Contract Report for MAFF (Contract VC 0107). 171pp + Annex.

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NAME OF RESPONDENT AND YOUR AFFILIATION **Ian Russell - CEFAS/Julian Hughes - RSPB**
COUNTRY **UK (England & Wales)**
REGION / PROVINCE / etc. (if applicable) **UK (England & Wales)**
Period which is concerned [year(s)] **Current situation (2001/02)**

C. Feeding Sites

C4. Very Large Waterbodies (Still Waters >100ha and Coastal Waters)

N.B. No management measures used at coastal sites (in England & Wales)as there are no perceived conflicts at such sites. Coastal sites in Scotland covered in 'aquaculture' spreadsheet. This table applies to large lakes only.

Cormorant Damage Control Activities

1. Resource Management	Technique is used?	Effectiveness?	Practicability?	Acceptability?	Costs?	Location(s) where in use	Remarks, Details, & Additional information	References
Habitat management								
Improve habitat quality for fishes	Rarely	Years	2	1	1/2	Various	Not specifically used to deter cormorants	
Fish management								
Altering fish stocking regimes. Please give details								
(a) timing	Rarely	Days	3	3	5	Various	Localised measure - applies mainly to stocked	
(b) frequency	Rarely	Days	3	3	2	Various	As above.	
(c) density	Rarely	Days	4	4/5	2	Various	As above. Low densities contrary to angler interests.	
(d) stocked fish sizes	Rarely	Months	2	3	2	Various	Localised measure. Has been shown to be cost-effective for put-and-take-trout fisheries.	McKay et al., 1999; Moore, 2002
3. Wildlife Management								
3.1 Non-lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Human harassment								
Human patrol on foot or in vehicles (or by boat)	Regularly	Days	1	1	4	Various	Potential impacts on other wildlife and people	McKay et al (1999)
Audio frightening techniques								
Gas bangers / cannons (propane gas exploders)	Rarely	Days/Hours	2	4	3	Various	As above. Only localised impact.	McKay et al (1999)
Pyrotechnics / Fireworks (shell crackers, screamers, whistling projectiles, exploding projectiles, bird bangers, flash/detonation cartridges)	Rarely	Days/Hours	2	4	3	Various	As above.	
Live ammunition	Regularly	Weeks	2	4	2	Various	Potential impacts on other wildlife and people. High manpower costs.	McKay et al (1999)
Visual frightening techniques								
Simple human effigies or scarecrows	Rarely	Not effective						
Animated scarecrows (moving and/or in combination	Rarely	Not effective						
Mylar tape	Rarely	Not effective						
Combination of audio and visual techniques	Rarely	Hours/Days	2	3	3	Various	Only localised impact	
3.2 Lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Shooting adults and immatures								
to reinforce non-lethal harassment	Rarely	Days/Weeks	3	3	2	Various	Potential impacts on other wildlife and people. Unknown quantity of	McKay et al (1999)
to reduce bird numbers at specific sites	Rarely	Days/Weeks	3	3	2	Various	As above.	McKay et al (1999)

McKay, H., Furness, R., Russell, I., Parrott, D., Rehfisch, M., Watola, G., Packer, J., Armitage,M., & Gill, E. (1999). The assessment of the effectiveness of management measures to control damage by fish-eating birds to inland fisheries in England and Wales. Draft Contract Report for MAFF (Contract VC 0107). 171pp + Annex.

Moore, D. (2002). Experiences of managing the impact of cormorants *Phalacrocorax carbo* . in large recreational trout fisheries. In: I.G. Cowx (ed.) Interactions between Birds and Fish – Implications for Management. Fishing News Books, Oxford

NAME OF RESPONDENT AND YOUR AFFILIATION — **Ian Russell (CEFAS), Julian Hughes (RSPB), Dave Carss (CEH)**
COUNTRY — **UK (England & Wales, Scotland)**
REGION / PROVINCE / etc. (if applicable) — **UK (England & Wales, Scotland)**
Period which is concerned [year(s)] — **Current situation (2001/02)**
C. Feeding Sites
C5. Aquaculture

Cormorant Damage Control Activities

1. Resource Management	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Fish management								
Altering fish stocking regimes. Please give details								
Locating most susceptible fish species and size close to the centre of human activity or near buildings	Unknown	Years	1	1	4/5	Various		
Use/management of feeding ponds to attract Cormorants (i.e. to distract them away from production ponds)	Unknown	Weeks/Months	3	3	3/4	Unknown		
2. Bird-proof barriers (overhead barriers and peripheral fencing/netting)	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Physical exclosures with narrow meshed systems (mesh sizes < 20 cm) using wire, lines or string in parallel or grid patterns	Regularly	Years	2	2	1	Various	Mainly targeted against herons	McKay et al., (1999)
Wire, lines or string in grid patterns (5 m mesh size)	Regularly	Years	2	2	2	Various	As above.	As above.
Wire, lines or string in grid patterns (7,5 m mesh size)	Regularly	Years	2	2	2	Various	As above.	As above.
Wire, lines or string in grid patterns (10 m mesh size)	Regularly	Years	2	2	2	Various	As above.	As above.
Wire, lines or string in grid patterns (other mesh size)	Regularly	Years	2	2	2	Various	As above.	As above.
Wire, lines or string in parallel patterns (please give spacing)	Regularly	Years	2	2	2	Various	As above.	As above.
Partial exclosures (narrow meshed)	Unknown	Not known	2	2	3	Not known		
Coloured streamers to increase visibility of wires and strings	Unknown	Not known	2	2	2	Not known		
Others (please specify) submerged anti-predator nets - submerged as curtains around cages (net pens).	Regularly	Years	2	2	3	Almost all cage farms	Nets need to be cleaned every few months to remove algal fouling.	Carss (1990).
3. Wildlife Management								
3.1 Non-lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Human harassment								
Human patrol on foot or in vehicles	Regularly	Days/Hours	1	1	4	Various		
Audio frightening techniques								
Gas bangers / cannons (propane gas exploders)	Regularly	Days	2	3	3	Various	Potential impacts on other wildlife and people. Most effective if moved regularly and used in conjunction with other visual deterrents	
Pyrotechnics / Fireworks (shell crackers, screamers, whistling projectiles, exploding projectiles, bird bangers, flash/detonation cartridges)	Regularly	Days/Weeks	2	3	3	Various	As above.	
Live ammunition	Regularly	Weeks	2	3	3	Various	Potential impacts on other wildlife and people..	
Visual frightening techniques								
Simple human effigies or scarecrows	Regularly	Not effective						
Animated scarecrows (moving and/or in combination with automated sound devices)	Regularly	Days	2	3	3	Various	Best used in conjunction with other audio scarers and if moved regularly	
Raptor silhouettes	Rarely	Not effective						
Mirrors	Rarely	Not effective						
Moving disks	Rarely	Not effective						
Mylar tape	Rarely	Not effective						
Eye spot balloons	Rarely	Not effective						
Laser light	Not used						Laser guns have been evaluated at night roosts	McKay et al (1999)
Combination of audio and visual techniques	**Regularly**	**Days/weeks**	**2**	**3**	**3**	**Various**		
3.2 Lethal techniques	**Technique is used?**	**Effectiveness?**	**Practicability?**	**Acceptability?**	**Costs?**	**Location(s) where in use**	**Remarks, Details, & Additional information**	**References**
Shooting adults and immatures								
to reinforce non-lethal harassment	Regularly	Weeks	2	3	3	Various	Potential impacts on other wildlife and people. Unknown quantity of illegal shooting.	McKay et al., 1999 (see below)
to reduce bird numbers at specific sites	Regularly	Weeks	2	3	3	Various	As above.	As above.

26.5 Bibliography

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27. After REDCAFE: an interdisciplinary approach to European Cormorant-fisheries conflicts (INTERCAFE)

Background

The REDCAFE project ("*Reducing the Conflicts between Cormorants and Fisheries on a pan-European scale*") was a two-year Concerted Action (2000-2002) funded under the European Union's Framework Five Programme. It addressed, for the first time, cormorant-fisheries conflicts on a European scale by establishing a very active network of research institutes across 25 countries, and including many members of the Cormorant Research Group. Focussing on the Great Cormorant (*Phalacrocorax carbo*), REDCAFE's final report (Carss 2003) is available at: http://www.ceh.ac.uk/redcafe/redcafedocs.htm

Cormorant-fisheries conflicts are a truly pan-European issue affecting a variety of stakeholder groups living and working in a diverse range of aquatic habitats across the continent. One of the most important aspects of REDCAFE's work, in relation to the provision of management solutions for cormorant-fisheries conflicts, was to show clearly that such conflicts are complex in terms of their biology but that social and economic issues are equally important: these conflicts are sometimes as much human:human ones as they are human:wildlife ones.

An interdisciplinary approach involving the collaboration of biological and social scientific expertise, economic and political interest and practical local experience was seen by REDCAFE as vital to the development and successful implementation of practical cormorant-fisheries conflict resolution strategies across Europe. The challenge was both to continue with relevant research and to improve information exchange, dialogue, participation and trust between all stakeholders involved in such conflicts. This challenge has recently been taken up by a new four-year, pan- European COST Action, INTERCAFE ("*Conserving Biodiversity - Interdisciplinary Initiative to Reduce pan-European Cormorant-Fisheries Conflicts*"). COST is an intergovernmental framework for European Co-operation in the field of Scientific and Technical Research, which promotes the building of scientific networks. In INTERCAFE, this involves the collaboration of biological and social science expertise, economic and political interests, and practical local experience.

INTERCAFE builds on REDCAFE's successful foundation by coordinating biological and social research programmes and integrating cultural, economic and political/policy concerns so that conflict resolution strategies can be devised, through collaboration with local people, that are tailored to the specific needs of local stakeholders and decision makers. Moreover, the international coordination of national research efforts through this COST Action will ensure that the opportunities to understand conflicts and learn from experiences elsewhere are exploited as fully as possible across Europe.

Goals

The main objective of INTERCAFE is to improve European scientific knowledge of cormorant-fisheries interactions in the contexts of the interdisciplinary management of human:wildlife conflicts and of sound policy formation, so as to inform policy decisions at local to international levels across Europe and to deliver a coordinated information exchange system and improved communication between all stakeholders. Project participants, currently covering 28 countries in Europe and beyond, will ultimately create a coordinated research network and an information bank that will be used to develop long-term collaborative management solutions to pan-European cormorant conflicts.

INTERCAFE is targeted towards the development of policy aimed at maintaining the favourable conservation status of Europe's cormorant populations whilst enabling the sustainable exploitation of fish stocks in a wide variety of aquatic habitats. To achieve this goal, which requires considerable coordination and synthesis, three Working Groups have been established. These Working Groups and their associated processed are integrated and will deliver a number of outputs (see below and Figure 28.1).

Work Group 1: Ecological databases and analyses

Addressing the issue of the management of cormorant-fisheries conflicts requires consideration not merely of technical solutions (i.e. site-specific actions and mitigation measures) but also of the ecology of cormorants at the continental level, particularly their temporal and spatial status and distribution and choice of breeding roosting and foraging sites. Analysis of these data at the continental scale in relation to ecological characteristics (e.g. geographical, climatological, biological – size, nutrient status, fish communities etc) through a Geographic Information System will provide better understanding of current cormorant distribution across Europe and could also allow predictions of their future distribution.

Cormorant population models are required to predict both the ultimate size of the European cormorant population and the likely consequences of large-scale control activities. The predictive power of such models depends on the input of the most up to date information – both on bird status and distribution but also ecological habitat data. The data collected in WG1 on cormorant population status and distribution, and on the numbers of birds killed, provides just such input and should lead to improved predictive models. Importantly, this Work Group will also collate information on lethal actions carried out against cormorants and improve understanding of the migratory patterns of cormorants particularly during the winter.

Work Group 2: Conflict resolution and management

Due to the site-specific nature of cormorant-fisheries conflicts, conflict resolution and management must be assessed on a case-by case basis. Work Group 2 will thus coordinate biological, social and economic assessments of actions and mitigation measures at local to national scales. Work Group 2 will also examine more closely the legal frameworks operating in relation to actions and mitigation measures (linked closely with Work Group 1) and consider economic aspects of specific fisheries.

The main objective of Work Group 2 is thus to conduct interdisciplinary research into site-specific actions and mitigation measures taken to manage cormorant-fisheries conflicts. Furthermore this research will also be linked to legal frameworks and economies operating at regional to national scales. The research community, in collaboration with local stakeholders and policy makers, will analyse and evaluate the success or failure of various actions and mitigation measures applied to cormorant-fisheries conflicts across Europe in relation to biological, social and economic factors.

Work Group 3: Linking science with policy and best practice

REDCAFE identified that research must first identify the true nature of cormorant-fisheries conflicts and then look to the most appropriate solutions. The overall aim of WG3 is thus to promote links between the biological and social science communities, local stakeholders, economists and policy advisors to better understand the role of socio-cultural issues in conflicts, their management within legal frameworks, and efforts towards their resolution. These links will be forged through the interdisciplinary investigation of a series of conflict case studies chosen to be representative of cormorant-fisheries conflicts across Europe.

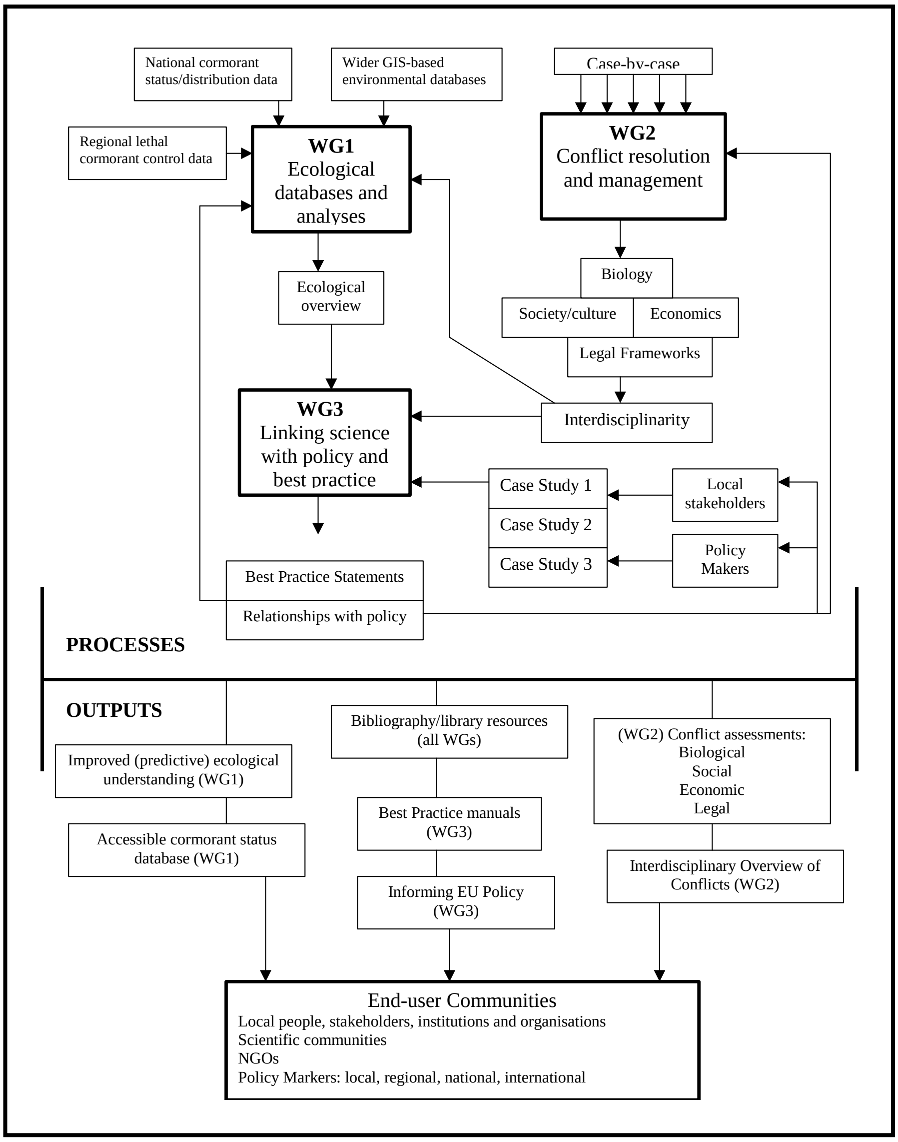

Figure 27.1 INTERCAFE COST Action (635) WorkingGroups and proposed outputs.

Case study selection will take into account various factors: for example, geographic location, habitat types, stakeholder groups, fishery type, and current and potential mitigation actions. Case studies will be investigated through Workshops that concentrate on issues operating at two spatial scales. First, local stakeholders will provide key site-specific inputs providing ecological, social, economic and policy contexts. Second, input from other participants, particularly ecologists (for example, through direct input from WG1) and policy makers, will enable all to appreciate the specific case study in both national and international contexts. Thus, Workshops will enable all participants to take a 'holistic' view of specific case studies.

Overall outputs

Outputs from INTERCAFE will thus include:

(1) Databases detailing both the size and location of European cormorant breeding colonies and winter roosts at the national level and the lethal management actions taken against cormorants at the regional level.

(2) Biological, social and economic assessments of the cost-effectiveness and efficacy of conflict resolution and management strategies through the interdisciplinary examination of site-specific, regional and national actions and mitigation measures taken to counter predation by cormorants.

(3) The promotion of links between the biological and social scientific communities, local stakeholders and policy advisors to better understand the role of socio-cultural issues in conflicts, their management within legal frameworks, and efforts towards their resolution. The development of a set of scientifically founded conflict management recommendations specifically aimed at improved policy formulation.

In addition, INTERCAFE includes a number of Sub-groups where researchers focus on a number of specific issues including Baltic Sea research, the ecology of Pygmy Cormorants (*P. pygmeus*), the production of a cormorant fieldwork manual, conflicts and mitigation at carp ponds, and potential sources of research funding.

Further information about both COST and the INTERCAFE Action (no. 635) are available at: http://cost.cordis.lu

Further information about INTERCAFE will soon be made available on the Action's web site:

http://www.intercafeproject.net

or contact Dave Carss or Mariella Marzano.

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29. Appendix 1: Executive Summary from REDCAFE Final Report

Carss, D. N. (2003) (ed) Reducing the conflict between cormorants and fisheries on a pan-European scale: REDCAFE. Final Report to the EU, contract No. Q5CA-2000-31387, pp 169.

The full report is available at either:
http://banchory.ceh.ac.uk/REDCAFE/REDCAFEdocs.htm
or from Dave Carss, Mariella Marzano.

29.1 Background to the project

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

29.2 Aims and set up of the project

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

29.3 Cormorant conflicts with fisheries

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

29.4 Cases of Cormorant conflicts

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

29.5 Habitat features of conflict cases

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

29.6 Conflicts in time and space

Information on the seasonality of Cormorant conflicts showed patterns that fitted closely with the known seasonal movements of birds across Europe. As a consequence, the broad pan-European picture of Cormorant conflicts has three elements. First, winter (October-March) conflicts in those countries where birds overwinter, either towards the north west or south east. Second, summer (April-September) conflicts, presumably involving breeding birds, in the Netherlands and almost all countries bounding the Baltic. Third, conflicts throughout the year in the 'centre' of Europe (Denmark, Germany and the Czech Republic), presumably involving both breeding birds and others overwintering there from the north. Cormorant abundance increased with water surface area on a pan-European scale for stillwater lakes, freshwater aquaculture ponds and coasts and water surface area explained 56% of the variation in maximum Cormorant numbers across these habitats. There was no such relationship on rivers based on the information available for this synthesis. Such apparent differences require further investigation, particularly as information suggests that average Cormorant density on rivers is significantly higher than that in other habitats.

29.7 Conflicts: fish

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

29.8 Conflicts: finance

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

29.9 Conflict issues

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

29.10 Information sources

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

29.11 Cormorant ecology: factors leading to conflicts

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

29.12 Ecology synthesis in relation to Cormorants

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

29.13 Ecology synthesis in relation to fish

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

29.14 Ecology synthesis in relation to damage at fisheries

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

29.15 Potential Cormorant management tools

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

29.16 Cormorant population modelling

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

29.17 Relatively large-scale Cormorant control

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

29.18 Site-specific actions: non aquaculture habitats

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

29.19 Site-specific actions: aquaculture habitats

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

29.20 Cormorant management tools: conclusions

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

29.21 Cormorant-fishery conflict resolution: a case study

REDCAFE analysed a specific Cormorant-fishery conflict case study, in the form of a three-day Workshop designed to give project participants and local stakeholders the opportunity to share their knowledge and experience. This case study also formed the basis for evaluating REDCAFE progress and the applicability of the ‘REDCAFE experience’ to the real world. Furthermore, it allowed participants to explore whether the project’s concept of equitable stakeholder involvement was a useful framework for future Cormorant-fisheries conflict resolution elsewhere in Europe. An opportunity arose to link the project to a ‘live’ conflict case study - that of Cormorants and recreational fisheries in the Lea Valley, Hertfordshire, south-east England. Importantly, selecting the Lea Valley Cormorant-fishery issue also allowed REDCAFE to link with

Fisheries Action Plans, and the government agency-led process being developed to address and prioritise issues affecting inland fisheries at a catchment scale. The REDCAFE case study was placed in perspective through reviews and discussions of values and dialogue in conflict resolution and management, Fisheries Action Plans in the UK, and the Lea Valley case study area.

29.22 Lea Valley Workshop

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

29.23 Workshop progress

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

29.24 Workshop evaluations

A specific element of the REDCAFE project was to evaluate the conflict resolution Workshop in terms of determining whether the project’s concept of equitable stakeholder involvement was a useful framework for future Cormorant-fisheries conflict resolution elsewhere in Europe. To this end, the Facilitator organised an anonymous questionnaire survey of delegates immediately after the Workshop.

Twenty-six responses (50% of Workshop delegates) were received and almost all agreed that the case study was useful and enjoyable and that REDCAFE had helped them relate conflict management methods to Cormorant-fisheries conflicts elsewhere. A series of questions were also asked of delegates and those responding to the questionnaire provided over 200 responses which are synthesised in the report.

29.25 The REDCAFE process: main strengths

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

29.26 The REDCAFE process: main weaknesses

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

29.27 The REDCAFE process: main lessons learned

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

29.28 Looking forward: overview

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

29.29 Looking forward: case studies, individuals and stakeholder groups

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

29.30 Looking forward: the scientific community

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

29.31 Looking forward: Fisheries co-management

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

29.32 Looking forward: future research

A major challenge for natural scientists will be to make their work more relevant and useful to stakeholders. It is clear that different stakeholders involved in Cormorant-fisheries conflicts have different values and perceptions over these issues. It is also clear that other stakeholders view scientists as having different values and perceptions. Thus, scientists should be considered as another stakeholder group involved in the issue of Cormorants and fisheries. Given the recognition that there is no single value or perception (i.e. ‘reality’) for all the different stakeholders groups within this conflict, it is unrealistic to expect a single method of collecting, analysing and interpreting useful scientific information. The development of a rigorous scientific research programme to address Cormorant conflict issues will have to maintain high scientific standards but will also have to be both relevant to and influential in the decision-making process. There is a need for a practical pan-European Cormorant-fishery research programme that includes ecological study, collaboration between natural and social scientists and a strong conflict management element. Similarly, there is a need for long-term studies to quantify the effectiveness of various measures to mitigate against Cormorant problems at fisheries. Stakeholders have a long list of possible management actions against Cormorants but relatively little guidance on their likely effectiveness, practicability, acceptability or costs at a specific site. Clearly, considerably more work is required to trial the use of techniques to reduce Cormorant impact at feeding sites. Whatever framework future scientific research into Cormorant conflicts takes, it is clear that all stakeholders are concerned over the common issues of quality, health and status of biological resources in wetland systems. Dialogue with stakeholders highlighted several areas where major conflicts were currently poorly served by scientific literature and these are discussed. However, it must be stressed that such research should be undertaken with participation from stakeholders at all stages where possible. Ultimately, this should increase the useful knowledge of both scientists and other stakeholder groups whilst also increasing collaboration between all parties, but particularly local people, in the decision-making process with regard to Cormorant conflict issues across Europe.

29.33 Looking forward: concluding remarks

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

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

30. Appendix 2: Common and scientific names of fish species

PETROMYZONIDAE - Lampreys	Dace *Leuciscus leuciscus*
Sea Lamprey *Petromyzon marinus*	Danubian Roach *Rutilus pigus*
	Gibel Carp *C. a. gibelio*
ACIPENSERIDAE - Sturgeons	Goldfish *Carassius auratus*
Sturgeon *Acipenser sturio*	Grass Carp *Ctenopharyngodon idella*
	Gudgeon *Gobio gobio*
ANGUILLIDAE - Eels	Ide/Orfe *L. idus*
Eel *Anguilla anguilla*	Italian Barbel *B. b. plebejus*
	Jarabugo *Anaecypris hispanica*
CLUPIDAE - Herrings	Minnow *Phoxinus phoxinus*
Baltic Herring *C. h. membras*	Nase *Chondrostoma nasus*
Herring *Clupea harengus*	Roach *Rutilus rutilus*
Shad *Alosa* spp.	Rudd *Scardinius erythrophthalmus*
	Savetta *Chondrostoma soetta*
COREGONIDAE - Whitefishes	Schneider *Alburnoides bipunctatus*
Peled/Northern Whitefish *C. peled*	Silver Carp *Hypophttalmichthys molitrix*
Powan *Coregonus lavaretus*	Soufie/Blageon *L. souffia*
Vendace *C. albula*	South European Nase *Chondrostoma genei*
	Sunbleak *Leucaspius delineatus*
SALMONIDAE – Salmonids	Streber *Zingel streber*
Arctic Char *Salvelinus alpinus*	Tench *Tinca tinca*
Atlantic Salmon *Salmo salar*	White/Silver Bream *Blicca bjoerkna*
Brook Char/Trout *S. fontinalis*	Zährte *Vimba vimba*
Brown/sea Trout *S. trutta*	
Huchen/Danube Salmon *Hucho hucho*	**COBITIDAE** - Loaches
Marbled Trout *S. marmoratus*	Golden Loach *Sabanejewia aurata*
Rainbow Trout *Oncorhynchus mykiss*	Weather Fish *Misgurnus fossilis*
THYMALLIDAE – Graylings	**SILURIDAE/ICTALURIDAE** – Catfishes
Grayling *Thymallus thymallus*	Black Bullhead *Ictalurus melas*
	Channel Catfish *I. punctatus*
OSMERIDAE - Smelts	Wels *Silurus glanis*
Smelt *Osmerus eperlanus*	
	GADIDAE – Cod fishes
ESOCIDAE – Pikes	Burbot *Lota lota*
Northern Pike *Esox lucuis*	Cod *Gadus morhua*
	Saithe *Pollachius virens*
CYPRINIDAE – Carps	
Asp *Aspinus aspinus*	**ZOARCIDAE** – Eelpouts
Barbel *Barbus Barbus*	Eelpout/Viviparous Blenny *Zoarces viviparus*
Big-head Carp *Aristichthys nobilis*	
Bleak *Albrunus albrunus*	**BELONIDAE** – Garfishes
Bream *Abramis brama*	Garfish *Belone belone*
Carp *Cyprinus carpio*	
Chub *L. cephalus*	
Crucian Carp *Carassius carassius*	

ATHERINIDAE – Sand-smelts	**SCOPHTHALMIDAE** – Left-eyed Flatfishes
Big-scaled Sand-smelt *Atherina boyeri*	Turbot *Scophthalmus maximus*
Sand-smelt *A. presbyter*	
	PLEURONECTIDAE – Right-eyed Flatfishes
GASTEROSTEIDAE – Sticklebacks	Dab *Limanda limanda*
3-spined stickleback *Gasterosteus aculeatus*	Flounder *Platichthys flesus*
SYNGNATHIDAE – Pipefishes	**SOLIDAE** – Soles
Deep-snouted Pipefish *Syngnathus typhle*	Senegal Sole *S. senegalensis*
	Sole *Solea solea*
COTTIDAE – Sculpins/Bullheads	
Bullhead *Cottius gobio*	**VALLENCIIDAE** – Killifishes
Bull-rout *Myoxocephalus scorpius*	Valencia Toothcarp *Valencia hispanica*
Fourhorn Sculpin *M. quadricornis*	
	CYPRINODONTIDAE – Pupfishes
PERCICHTHYMIDAE – Sea Basses	Spanish Toothcarp *Aphanius iberus*
Bass *Dicentrarchus labrax*	
	CICLIDAE – Cichlids/Tilapia
CENTRARCHIDAE – American Sunfishes	Mango Tilapia *Sarotherodon galileus galileus*
Large-mouth Bass *Micropterus salmoides*	St. Peter's Fish = Tilapia hybrid
Pumpkinseed *Lepomis gibbosus*	
PERCIDAE – Perches	
Perch *Perca fluviatilis*	
Pikeperch/Zander *Sander lucioperca*	
Ruffe *Gymnocephalus cernuus*	
SPARIDAE – Sea Breams	
Gilthead *Sparus auratus*	
Striped Sea Bream *Lithognathus mormyrus*	
MUGILIDAE – Grey Mullets	
Flathead Mullet *Mugil cephalus*	
Leaping Mullet *L. saliens*	
Thin-lipped Grey Mullet *Liza ramada*	
LABRIDAE – Wrasses	
Ballan Wrasse *Labrus bergylta*	
GOBIDAE – Gobies	
Round Goby *Neogobius melanostomus*	
SCOMBRIDAE – Mackerels	
Markerel *Scomber scomber*	