

GREAT CORMORANT – SUBSTANTIAL DANGER TO FISH POPULATIONS AND FISHERY IN EUROPE

W. STEFFENS

German Anglers Association, Weißenseer Weg 110, D-10369 Berlin, Germany

Abstract

STEFFENS, W., 2010. Great cormorant – substantial danger to fish populations and fishery in Europe. *Bulg. J. Agric. Sci.*, 16: 322-331

Numbers of great cormorant (*Phalacrocorax carbo*) increased considerably during the last three decades in the whole of Europe. In the middle of the last century the species was scarce in most of the European countries and was found mainly near the coast or estuaries, seldom in the vicinity of inland waters. According to countings of Wetlands International in summer 2006 the number of breeding great cormorants in the western Palearctic is 744 672. This means that the total number of birds is about 2 million. The increase and the expansion of the cormorants in Europe result in serious ecological damage to fish populations and in remarkable economic and socio-cultural losses to fishery. Considering that the daily food intake of a cormorant is 500 g the total daily fish predation by the birds comes to 1 000 t. Big problems appear as well in natural waters as in fish farms.

Already in 1995 a cormorant hearing in the European Parliament took place and in March 1996 a decision of the European Parliament followed. In July 1997 the subspecies *Ph. carbo sinensis* was deleted from Annex I of the Wild Birds Directive (79/409/EEC). In May 2007 the Parliamentarian Intergroup “Sustainable Hunting, Biodiversity and Countryside Activities” discussed in Strasbourg the problems evoked by cormorants in Europe.

In November 2007 the European Inland Fisheries Advisory Commission (EIFAC) asked for the promotion of preparation and effective implementation of a European cormorant management plan. In December 2008 the Committee on Fisheries of the European Parliament called for the establishment of a European management plan to minimize the increasing impact of cormorants on fish stocks, fishing and aquaculture. The resolution was adopted by the majority of the Plenary Sitting. It is now necessary that the European Commission realizes this resolution. With regard to the protection of fish populations and the maintenance of sustainable fishery and fish culture in Europe a considerable reduction of the cormorant population by a pan-European management plan is indispensable.

Key words: Great cormorant, *Phalacrocorax carbo*, fish losses, fish protection

Increase of cormorants in Europe

Great cormorant (*Phalacrocorax carbo*) is a widespread bird species occurring in temperate regions of Europe, Asia, Australia, Africa and North America.

w.l.steffens@t-online.de

Several subspecies are distinguished, e. g. *Ph. carbo novaehollandiae* (Australia), *Ph. carbo lucidus* and *Ph. carbo maroccanus* (Africa), *Ph. carbo hanedae* (Japan). In Europe there are two subspecies, *Ph. carbo carbo* and *Ph. carbo sinensis*.

Table 1
Number of breeding *Phalacrocorax carbo*
***carbo* in selected European countries**
(Kohl, 2008; Piwernetz, 2008)

Countries	1980	1995	2001/02
Norway	ca. 42 000	48 000	50 000
United Kingdom	ca. 12 000	16 000	18 200
Ireland	ca. 6 000	9 400	9 100
France	ca. 3 000	3 300	3 500
Russia		300	1 000
Spain			100
Total Europe	ca. 63 000	77 000	81 900

The Atlantic subspecies *Ph. carbo carbo* is living in the Atlantic coastal areas of Greenland, Iceland, Norway, Great Britain, Ireland and France, but also of North America. The continental subspecies *Ph. carbo sinensis* is found near the coasts as well as near inland waters and has expanded its distribution during recent decades in many European countries. It is a migratory form; Scandinavian birds are going to the south in autumn and are wintering in Central Eu-

rope or the Mediterranean (Müller-Braun, 2006). Possibly this subspecies was not indigenous in Europe and introduced for the purpose of fish catching centuries ago (Olburs, 2008).

Both subspecies have a similar morphology and are hardly to distinguish. In overlapping areas the continental subspecies is hybridising with the Atlantic one.

Table 1 shows the number of breeding birds of the Atlantic subspecies in Europe. The population is to be increasing slightly, however not strongly.

The continental subspecies on the other hand is increasing considerably in numbers and range since years (Table 2). While in former times the breeding sites were situated mainly near the European coasts (Peterson et al., 1965) there are now many colonies near inland waters (rivers and lakes) where these birds did not breed before (Piwernetz, 2007; Steffens, 2007). As an example the increase of breeding pairs of cormorants in Brandenburg (Germany) in the period from 1986 to 2004 is shown in Figure 1.

Deriving from these figures it can be estimated that the total number of breeding birds of the species *Ph. carbo* in Europe is at least 700 000 (Piwernetz, 2007, 2008; Steffens, 2007, 2009). This is in accordance with data published by Wetlands International for summer 2006 (Table 3). Based on the breeding count in

Table 2
Number of breeding *Phalacrocorax carbo sinensis* in selected European countries
(Kohl, 2008)

Countries	1970	1980	1995	2000
Ukraine		2 000	48 000	150 000
Russia (Europ. part)				120000
Denmark	1 800	4 080	72 600	80 000
Sweden	300	1 540	30 800	52 000
Romania		8 300	30 000	40 000
Netherlands	4 100	9 000	32 000	39 000
Germany*		1 588	30 000	36 000
Poland	1 900	2 780	22 000	25 000
Estonia			4 760	20 000
Total Europe	ca. 12 000	ca. 35 000	ca. 300 000	> 600 000

* revised data

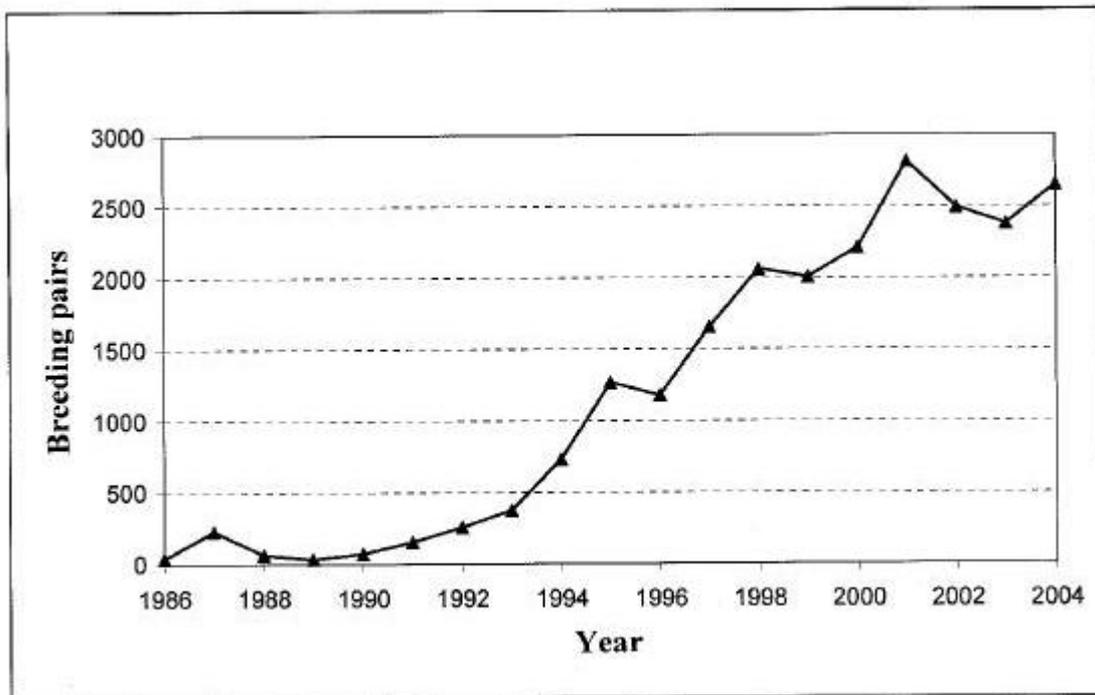


Fig. 1. Development of the number of breeding pairs of cormorants in Brandenburg (Germany) in the period from 1986 to 2004 (Bramick, 2007)

summer 2006 the number of breeding cormorants in the western Palearctic (including North Africa and Middle East) is 744 672.

However, the total number of cormorants is much higher since the great cormorant starts breeding not before an age of three to five years. According to Suter (1995) and Kohl (2006/2007) the total number of cormorants corresponds to the number of breeding birds x 2.8. Therefore, it can be stated that the total number of both subspecies of great cormorant in Europe is about 2 million birds.

Table 3

Number of great cormorant nests and breeding birds in the western Palearctic, including North Africa and Middle East, in summer 2006, separated by three geographic regional groups (Wetlands International, 2008)

Regional Group "Population"	Nests	Breeding birds
Atlantic – North Sea	121 763	243 526
Baltic – Central Europe	162 691	325 382
Black Sea – East Mediterranean	87 882	175 764
Total	372 336	744 672

Feed intake of cormorant and impact on fish populations and fisheries in Europe

Feed of cormorants is fish. The birds can dive to depth of 35 m. The daily feed intake is between 400 and 600 g (Guthorl, 2006; Knosche, 2008).

Species composition of the prey is depending on the structure of the fish fauna in the waters and their availability (Suter, 1997). Prey size mainly is less than 500 g. However, intake of fish up to 800-900 g is

possible (Schröder et al., 2007; Schwarten, 2009).

Considering that there are about 2 million of cormorants in Europe the daily fish intake of these birds is 1 000 t. It is obvious that this predation is affecting fish populations and fisheries. In Germany 130 000 cormorants eat about 23 000 t fish per year. This is more than the average catch of professional and recreational fishermen in natural waters (Steffens, 2007).

During the last years very often remarkable decreases of fish populations and economic damage in fisheries caused by cormorant invasion were ascertained in natural waters of Europe (Guthörl, 2006). These are related to rivers as well as to lakes and coastal waters.

Especially in small rivers in the foothills regions populations of grayling (*Thymallus thymallus*) and brown trout (*Salmo trutta fario*) are endangered by cormorants. However, considerable losses in other fish species are also observed frequently (Kainz, 1994, 1995; Wiß math and Wunner, 1996; Honsig-Erlenburg and Friedl, 1997; Woschitz and Parthl, 1997; Schwevers and Adam, 1998; Kohl, 2005; Görner, 2006, 2007; Kohl, 2006/2007; Füllner and George, 2007; Görlach and Müller, 2008; Görlach and Wagner, 2008; Wagner et al., 2008; Görner, 2008). Fish losses are similar in natural and canalized sections of rivers. In the river Enns in Austria, e. g., the biomass of grayling was reduced from 145-154 kg/ha to 2-8 kg/ha and the biomass of brown trout from 27-54 kg/ha to 3-9 kg/ha after the occurrence of cormorants during several winters from 1994 to 1998 (Zauner, 1999; Kohl, 2005; Schröder et al., 2007). Irrespective of the ecological damage economic losses result for recreational fishery.

Even in large lakes cormorants can cause a substantial decrease of fish populations and significant problems for fishermen (Kammereit et al., 2005; Guthörl, 2006; Dersinske, 2006; Haastert, 2007). In Lake Chiemsee in Bavaria the catch of commercial fishery decreased from 9-11 kg/ha to 4-4.6 kg/ha due to cormorant predation (Klein, 2000, 2005). In inland waters of Brandenburg cormorants contribute for a considerable reduction of the eel (*Anguilla anguilla*) population and to remarkable economic losses to fish-

ermen (Bramick, 2007).

Large problems are caused by the high numbers of cormorants to fish populations and fisheries in the coastal areas of the Baltic Sea, too. According to estimates of Schlieker (2005, 2007) 60 000 cormorants consume more than 5 000 t of fish per year in Mecklenburg-Vorpommern. In a Danish fjord 50 % of tagged juvenile eel, 25-40 % of tagged Atlantic salmon (*Salmo salar*) smolts and nearly all tagged juvenile flounders (*Platichthys flesus*) were lost by cormorant predation (Jepsen and Olesen, 2006).

High fish losses result from cormorant invasions in fish ponds since there is low water depth (excellent fish availability) combined with high fish densities. In Saxonian carp farms (8 382 ha) yearly losses by cormorant predation come to about 250 t of juvenile carp (Stiehler, 2007). This results in economic losses of 750 000 to 1 million Euros per year. In some cases German farmers were forced to stop rearing young carp in consequence of cormorant predation. Fish farm Lelystad (220 ha) in the Netherlands must be closed due to high incidence of cormorants (Kohl, 2008).

Besides the direct fish losses caused by the fish intake of the bird's additional indirect losses occur on the strength of fish wounding by cormorant attacks. Injured fish often die later on since lesions of skin or muscle frequently are very serious (Wiß math and Wunner, 1996; Adámek et al., 2007; Kortan et al., 2008). Surviving fish often are stressed and exhibit less feed intake and slow growth.

Heavy economic losses to fishery in natural waters also follow from destroying of fish nets by the birds (Wiß math et al., 1998, 2000; Wiß math, 2009).

Efforts to reduce the damage caused by cormorants in Europe

Already in September 1995 a cormorant hearing in the European Parliament took place. Representatives of Germany and Austria informed about the increasing cormorant problem in several European countries and asked for taking suitable actions to protect fish populations. In March 1996 a decision of the European Parliament followed and in July 1997 the

subspecies *Ph. carbo sinensis* was deleted from the list of bird species to which special conservation measures in terms of habitat apply (Annex I to the EU Council Directive on the Conservation of Wild Birds, 79/409/EEC). The other European subspecies *Ph. carbo carbo* had never been endangered and was not included on that list at all.

Cormorant populations in Europe continued to increase enormously and damage to fish stocks and fishery grew worse. Therefore, several European countries and fisheries associations tried to reduce the problem by national, regional or local measures based on the derogation system laid down in Article 9 of the Wild Birds Directive. Derogation is possible where there is no other satisfactory solution:

I - to prevent serious damage to crops, livestock, forests, fisheries and water;

II - for the protection of flora and fauna.

However, since the continental subspecies of the cormorant is migratory and covers long distances isolated mitigation measures such as scaring proved to be not effective. Expenses of scaring are great and the birds are adaptive learners of high mobility. Therefore, scaring is no way to reduce the extent of the total cormorant population and to minimize the predatory pressure to the fish stocks on principle (Keller and Lanz, 2003). Obviously the only promising possibility to solve the cormorant problem is an internationally co-ordinated management (Behrens et al., 2008). This would enable a sustainable reduction of the number of cormorants in Europe and thus an effective protection of the fish fauna and maintaining professional and recreational fishery.

Efforts in the frame of the Convention on Migratory Species (CMS, "Bonn Convention") for a pan-European cormorant management plan were not successful (CMS, 1994, 1997).

During a meeting in Strasbourg in 2002 the European Anglers Alliance (EAA) asked for an action plan to protect the fish fauna and to reduce the numbers of cormorants in Europe (EAA, 2002). This demand was, however, refused by the ORNIS Committee.

In May 2007 the Parliamentarian Intergroup "Sustainable Hunting, Biodiversity and Countryside Ac-

tivities" again discussed in Strasbourg the growing problems evoked by cormorants in Europe. Experts of Germany and Ireland reported on the recent alarming increase in the cormorant populations and on the damages they cause to fish and fisheries (Piwernetz, 2007; Steffens, 2007). Furthermore, the threat to biodiversity was highlighted, as regionally many wild fish species are in serious danger of extinction. Several Members of the Parliament expressed their concern about the fact that, despite existing data, this European problem is insufficiently addressed. Just as the experts, they urged the EU Commission to elaborate an appropriate management plan for cormorants as well as guidelines to implement Article 9 "Derogations" of the Wild Birds Directive, so that Member States are informed correctly about the possible measures to prevent damages but also to reduce cormorant populations. This request was expressed in a Draft Declaration.

In November 2007 the European Inland Fisheries Advisory Commission (EIFAC) organized a working party on prevention and control of bird predation in Bonn, Germany (Hilge, 2007; FAO, 2008). Aim of the workshop was to provide a forum to initiate the work for a pan-European management plan for cormorants, which would more appropriately take into account the aspects of management of fish stocks, fishing and aquaculture which are affected by, or vulnerable to, the cormorants. The workshop discussed cormorant-fisheries issues including the legal situation for the protection and control of cormorants in the EIFAC region. It was stated, that isolated actions to reduce the cormorant population size in Europe have failed. Therefore such an initiative to start work on a pan-European management plan is timely.

On the basis of these discussions several conclusions and recommendations were formulated, including the promotion of preparation and effective implementation of a European Cormorant Management Plan.

The following conclusions of the EIFAC workshop were drawn:

- The enormously increased impact of cormorant predation on fish species conservation and the losses

caused to aquaculture pond owners, professional fishermen and anglers has reached unacceptable levels.

- There is a need to reduce the reproductive success of the great cormorant population in order to achieve a reduced population size and distribution, which is still compatible with a favourable conservation status, but also compatible with acceptable impacts on fish species conservation and on losses in enterprises living from fish.

- The coordination of fish and bird interests makes it necessary to explore the possibility of establishing an achievable and acceptable size and distribution for the total European breeding population.

- There is a need to explore the consequences of moving the cormorant to the status of Annex II, 2 of the EU Birds Directive 79/409/EEC (non-protected species)

- In total, there is a need for urgent and coordinated action to manage the European cormorant population in order to reduce its impact on fish species conservation and to mitigate the losses caused to aquaculture pond owners, professional fishermen and anglers.

- EIFAC should take the initiative to promote the preparation and effective implementation of a European Cormorant Management Plan (ECMP) using all information from previous projects such as FRAP, INTERCAFE and others.

- The ECMP should include elements that can be extrapolated from the local to a pan-European level. A mechanism is needed for continued monitoring, evaluation and iterative adoption of the ECMP.

- The participation of all relevant stakeholders in creation, implementation and continued monitoring of the ECMP should be assured.

Four recommendations of the EIFAC workshop were formulated:

I. Coordinate the isolated national efforts by promoting the preparation and implementation of an effective European Cormorant Management Plan (ECMP), involving all relevant stakeholders.

II. Establish a central mechanism for coordinating, monitoring and evaluating actions on cormorants.

III. Reduction of the reproductive success of the

great cormorant population to achieve a reduced population size and distribution, still compatible with a favourable conservation status for the cormorant.

IV. Explore the consequences of moving the cormorants to the status of Annex II,2 of the European Union Birds Directive (not protected species).

The Federation of European Aquaculture Producers (FEAP) supported in a resolution of the Presidents' Meeting held in Adelsdorf (Germany) in December 2007 the conclusions, suggestions and recommendations of EIFAC in respect of the development of a pan-European management plan for the control of cormorants in Europe.

In the meeting of the Bureau of the Advisory Committee on Fisheries and Aquaculture (ACFA) the recommendations of EIFAC were also supported and the adoption of a resolution for a pan-European management plan for the control of cormorants concluded.

In this connexion the scientific statement in an expert opinion (Groger et al., 2009) is noteworthy. Based on population viability analysis (PVA) and minimum viable population (MVP) for the cormorant population of Mecklenburg-Vorpommern (Germany) it was calculated that 1 400 breeding pairs of cormorants are sufficient for maintaining the population in this German state. This corresponds to 10 % of the actual population size which is about 14 000 breeding pairs. If there are no reduction measures it might be expected that the population size is nearly fourfold within 20 years compared to the present situation.

On December 4th, 2008 Members of the Committee on Fisheries made a motion for a European Parliament Resolution “on the adoption of a European Management Plan to minimise the increasing impact of cormorants on fish stocks, fishing and aquaculture” (2008/2177(INI)). This was adopted by the imposing majority of votes (96 %, 558 in favour, 7 against, 18 abstentions) of the Plenary Sitting.

In this resolution the European Parliament

1. Calls on the Commission and the Member States, by promoting regular scientific research, to provide reliable and generally recognised data on the total size and structure of cormorant populations in Eu-

rope, as well as their fertility and mortality parameters;

2. Proposes that, by means of systematic monitoring of cormorant populations supported by the EU and the Member States, a reliable, generally recognised and annually updated database should be drawn up on the development, size and geographical distribution of cormorant populations in Europe, with closer involvement on the part of fishery research institutes and fishery authorities;

3. Calls on the Commission to put out to tender, and finance, a scientific project aimed at supplying an estimation mode for the size and structure of the total cormorant population on the basis of currently available data on breeding population, fertility and mortality;

4. Calls on the Commission and the Member States to foster in an appropriate manner the creation of suitable conditions for bilateral and multilateral scientific and administrative exchanges, both within the EU and with third countries, identifying the origins of the findings, communications, contributions or publications, and in particular the statistics, in such a way as to make clear whether they come from academic or official sources or from associations in particular nature and bird conservation associations;

5. Calls on the Commission to carry out a comparative study of the contradictory conclusions concerning a cormorant management plan reached by REDCAFE, on the one hand, and FRAP and EIFAC, on the other;

6. Calls on the Commission to set up a working party with a binding mandate to carry out within one year a systematic cost-benefit analysis of possible cormorant management actions at Member States level, to assess their plausibility on the basis of logical and scientific criteria and to submit a recommendation; the composition of the working party should reflect the degree to which the stakeholders are affected;

7. Calls on the Commission to submit a cormorant management plan in several stages, seeking to integrate cormorant populations into the environment as developed and cultivated by man in the long term without jeopardising the objectives of the Wild Birds Di-

rective and Natura 2000 as regards fish species and marine and freshwater ecosystems;

8. Urges the Commission, in the interests of greater legal certainty and uniform interpretation, to provide without delay a clear definition of the term "serious damage" as used in Article 9(1)(a), third indent, of the Wild Birds Directive;

9. Calls on the Commission also to produce more generalised guidance on the nature of the derogations allowed under Article 9(1) of the Wild Birds Directive, including further clarification of the terminology where any ambiguity may exist;

10. Urges the Commission and the Member States to promote the sustainable management of cormorant populations by means of increased scientific and administrative coordination, cooperation and communication, and to create appropriate conditions for the drafting of a Europe-wide cormorant population management plan;

11. Calls on the Commission to consider all the legal means at its disposal to reduce the negative effects of cormorant populations on fishing and aquaculture and to take into account, when developing its initiative for the promotion of aquaculture in Europe, the positive effects of a Europe-wide cormorant population management plan and, where appropriate, to propose solutions to the cormorant problem in this context;

12. Calls on the Commission and the Member States to make some of the funds earmarked in the EU budget for data collection in the fisheries sector, in particular under heading 11 07 02: "Support for the management of fishery resources (improvement of scientific advice)", available for investigations, analyses and forecasts of the cormorant population on the territory of the European Union, in preparation for the future regular monitoring of these species;

13. Instructs its President to forward this resolution to the Council and Commission and the governments and parliaments of the Member States.

It is now necessary that the Commission realizes this resolution. However, resulting from first consultations with the European Commission in 2009 it is evident, that the GD Environment is not willing to ac-

comply with the requests of the European Parliament and to support a European Cormorant Management Plan.

Conclusions

Number and expansion of great cormorants in Europe is growing considerably since years, and the enormously increased impact of cormorant predation on fish populations, fisheries and fish culture causes substantial ecological, economic and socio-cultural damage and has reached unacceptable levels.

Scaring measures proved to be insufficient for fish species conservation and for maintenance of fishery and aquaculture.

Therefore, in December 2008 the European Parliament called for a European Cormorant Management Plan to reduce the increasing problems.

In future it is indispensable

- to mobilize the abilities in all Member States (by Governments, Members of Parliaments, NGOs) to compel the European Commission to realize the challenges of the European Parliament and to establish a Pan-European Management Plan which makes it possible to protect fish populations and fishery effectively;
- to use all national possibilities to reduce cormorant populations corresponding to Article 9 of the Wild Birds Directive (79/409/EEC) in the Member States.

References

- Adamek, Z., J. Kortan and M. Flajshans**, 2007. Computer-assisted image analysis in the evaluation of fish wounding by cormorant (*Phalacrocorax carbo sinensis* (L.)) attacks. *Aquaculture International*, **15**: 211-216.
- Behrens, V., F. Rauschmayer and H. Wittmer**, 2008. Managing international „problem“species: why pan-European cormorant management is so difficult. *Environmental Conservation*, **35**: 55-63.
- Brämick, U.**, 2007. Schäden durch Kormorane an Fischbeständen und Fischerei in Seen. *Arbeiten des Deutschen Fischerei-Verbandes*, **84**: 67-86.
- CMS**, 1994. Recommendation 4.1: Conservation and management of cormorants in the African-Eurasian region, Conference of Parties, Fourth Meeting, Nairobi, Kenya (www document). URL <http://www.tematea.org/?q=node/765>
- CMS**, 1997. Recommendation 5.3: Development of an action plan for the great cormorant in the African-Eurasian region, Conference of the Parties, Fifth Meeting, Geneva, Switzerland (www document). URL http://www.cms.int/bodies/COP/cop5/cop5_documents_overview.htm
- Dersinske, E.**, 2006. Aalertragseinbußen durch Kormoranfraß am Beispiel des Grimnitzsees. *Fischer und Teichwirt*, **57**: 91.
- EAA**, 2002. Meeting in European Parliament: Five million European anglers call for action on cormorants (www document). URL http://www.eaa-europe.org/sub/EP_Meeting-Cormorants-EN.htm
- FAO**, 2008. Report of the EIFAC Workshop on a European Cormorant Management Plan. Bonn, Germany, 20-21 November 2007. *EIFAC Occasional Paper 41*, Rome, FAO, 34 pp.
- Füllner, G. and V. George**, 2007. Zum Einfluss des Kormorans (*Phalacrocorax carbo sinensis*) auf den Fischbestand der Mulde. *Fischer und Teichwirt*, **58**: 290-294.
- Görlach, J. and R. Müller**, 2008. Die Bestandssituation der Äsche (*Thymallus thymallus*) in Thüringen. *Artenschutzreport*, **22**: 54-62.
- Görlach, J. and F. Wagner**, 2008. Überprüfung des winterlichen Kormoraneinflusses auf die Fischbestandssituation der Ilm/Thüringen. *Artenschutzreport*, **22**: 30-45.
- Görner, M.**, 2006. Der Einfluss des Kormorans (*Phalacrocorax carbo*) und weiterer piscivorer Vögel auf die Fischfauna von Fließgewässern in Mitteleuropa. *Artenschutzreport*, **19**: 72-88.
- Görner, M.**, 2007. Schäden durch Kormorane an Fischbeständen in Fließgewässern. *Arbeiten des Deutschen Fischerei-Verbandes*, **84**: 115-135.
- Görner, M.**, 2008. Zum Verhalten des Kormorans (*Phalacrocorax carbo*) an und in Fließgewässern des Binnenlandes. *Acta ornithoecologica*, **6**: 131-

142.

- Gröger, J., R. Kinzelbach, S. Puls and H. M. Winkler**, 2009. Wissenschaftliches Gutachten zur Gefährdungsanalyse (PVA) und Abschätzung einer potenziellen Populationsgröße und Populationsstruktur des Kormorans in M-V, angelehnt an das Konzept der Mindestgrößen von Populationen (MVP) und die Bewertung des „guten Zustandes der Population“ des Kormorans (*Phalacrocorax carbo sinensis*) in M-V mit Ableitung eines theoretischen Managementzieles. *Ministerium für Landwirtschaft, Umwelt und Verbraucherschutz des Landes Mecklenburg-Vorpommern, Abt. Naturschutz und Landschaftspflege*, 27.2.2009, Schwerin, 17 pp.
- Guthörl, V.**, 2006. Zum Einfluss des Kormorans (*Phalacrocorax carbo*) auf Fischbestände und aquatische Ökosysteme – Fakten, Konflikte und Perspektiven für kulturlandschaftsgerechte Wildhaltung. *Wildlife International*, Rolbing, France, 251 pp.
- Haastert, H. H.**, 2007. Der Kormoran räubert Seen, Flüsse und Teiche leer. *Fischer und Teichwirt*, **58**: 10-13.
- Hilge, V.**, 2007. Europäisches Kormoran-Management aus Sicht der EIFAC. *Arbeiten des Deutschen Fischerei-Verbandes*, **84**: 255-262.
- Honsig-Erlenburg, W. and Th. Friedl**, 1997. Einfluss des Kormorans auf die Fischbestände in der mittleren Gail (Kärnten). *Österreichs Fischerei*, **50**: 113-117.
- Jepsen, N. and Th. Olesen**, 2006. Cormorants in Denmark – re-enforced management and scientific evidence. *FRAP Project EU, WP11-D21 Reconciliation action plans for targeted conflicts*, 13 pp.
- Kämmereit, M., U. Matthes, R. Werner and H. Belting**, 2005. Zur Entwicklung der Fischbestände im Dümmer. *Arbeiten des Deutschen Fischerei-Verbandes*, **82**: 7-39.
- Kainz, E.**, 1994. Auswirkungen von Kormoranen auf die Fischbestände von zwei oberösterreichischen Fließgewässern. *Österreichs Fischerei*, **47**: 238-250.
- Kainz, E.**, 1995. Zu den Auswirkungen des Kormorans auf die Fischbestände in der Steyr. *Fischer und Teichwirt*, **46**: 74-81.
- Keller, T. M. and U. Lanz**, 2003. Great cormorant *Phalacrocorax carbo sinensis* management in Bavaria, southern Germany – What can we learn from seven winters with intensive shooting? *Vogelwelt*, **124** Suppl.: 339-348.
- Klein, M.**, 2000. Neubewertung des Einflusses von Kormoranen auf Fischbestände in großen Voralpenseen. *Fischer und Teichwirt*, **51**: 211-216.
- Klein, M.**, 2005. Die Kormoransituation in Bayern unter besonderer Berücksichtigung der Verhältnisse am Chiemsee. *Arbeiten des Deutschen Fischerei-Verbandes*, **82**: 40-58.
- Knösche, R.**, 2008. Der Kormoran – ein gesundes Regulativ oder eine Gefahr für die Süßwasserfischbestände? *Schriftenreihe Landesfischereiverband Baden-Württemberg*, Stuttgart, **3**: 11-26.
- Kohl, F.**, 2005. Kormoranschäden an Forellen- und Äschengewässern – Beispiele aus Österreich. *Arbeiten des Deutschen Fischerei-Verbandes*, **82**: 99-130.
- Kohl, F.**, 2006/2007. Zur Kormorandiskussion in Europa. *Fischwaid*, **2006** (5): 14-17; (6): 18-21; **2007** (1): 10-13.
- Kohl, F.**, 2008. Cormorants and protection of fish stocks. A pan-European problem. *Paper presented to the Committee on Fisheries, EU Parliament, Brussels, 26 June 2008*, 39 pp.
- Kortan, J., Z. Adámek, M. Flajš hans and V. Piaèková**, 2008. Indirect manifestation of cormorant (*Phalacrocorax carbo sinensis* (L.)) predation on pond fish stock. *Knowledge and Management of Aquatic Ecosystems* 389,01, 11 pp.
- Müller-Braun, T.**, 2006. Der lange Weg des finnischen Kormorans. *Fischer und Teichwirt*, **57**: 95.
- Olburs, Ch.**, 2008. Den kinesiska skarven *Phalacrocorax carbo sinensis* Blumenbach 1798 – en främmanda fågel. *olburs@hotmail.com*
- Peterson, R., G. Mountford and P. A. D. Hollom**, 1965. Die Vögel Europas. 7th ed. *Paul Parey*, Hamburg, Berlin, 417 pp.

- Piwernetz, D.**, 2007. Zur Entwicklung der Kormoranbestände in Europa. *Fischer und Teichwirt*, **58**: 244-247.
- Piwernetz, D.**, 2008. „Der Kormoran“ und sein Einfluss auf Ökosysteme in Gewässern. *Fischer und Teichwirt*, **59**: 83-90.
- Schlieker, E.**, 2005. Wachsende Probleme mit der Bestandsentwicklung des Kormorans in der Küstenregion des Landes Mecklenburg-Vorpommern und erkennbare Möglichkeiten zur Entspannung der Situation. *Arbeiten des Deutschen Fischerei-Verbandes*, **82**: 131-146.
- Schlieker, E.**, 2007. Schäden durch Kormorane an Fischbeständen und Fischerei in Küstengewässern. *Arbeiten des Deutschen Fischerei-Verbandes*, **84**: 87-102.
- Schröder, W., F. Kohl and S. Hanfland**, 2007. Kormoran- und Fischbestand. Kritische Analyse und Forderungen des Landesfischereiverbandes Bayern e. V. *Landesfischereiverband Bayern*, München, 68 pp.
- Swartzen, S.**, 2009. Fischfraß durch Kormorane. *Fischer und Teichwirt*, **60**: 207.
- Schwevers, U. and B. Adam**, 1998. Zum Einfluss des Kormorans (*Phalacrocorax carbo sinensis*) auf die Fischbestände der Ahr (Rheinland-Pfalz). *Österreichs Fischerei*, **51**: 198-210.
- Steffens, W.**, 2007. Auswirkungen der Kormoranpopulation auf Fischbestände und Fischerei. *Fischer und Teichwirt*, **58**: 249-253.
- Steffens, W.**, 2009. EU-Parlament für verbesserten Schutz der Fischbestände vor Kormoranfraß. *Artenschutzreport*, **24**: 53-62.
- Stiehler, W.**, 2007. Schäden durch Kormorane an Fischbeständen und Fischerei in der Teichwirtschaft. *Arbeiten des Deutschen Fischerei-Verbandes*, **84**: 103-113.
- Suter, W.**, 1995. Are cormorants *Phalacrocorax carbo* wintering in Switzerland approaching carrying capacity? An analysis of increase patterns and habitat choice. *Ardea*, **83**: 255-266.
- Suter, W.**, 1997. Roach rules: shoaling fish are a constant factor in the diet of cormorants *Phalacrocorax carbo* in Switzerland. *Ardea*, **85**: 9-27.
- Wagner, F., W. Schmalz and M. Görner**, 2008. Zum Einfluss des Kormorans (*Phalacrocorax carbo*) auf den Fischbestand der Ulster (Thüringen). *Artenschutzreport*, **22**: 1-10.
- Wetlands International**, 2008. Cormorants in the western Palearctic. Distribution and numbers on a wider European scale. [http://web.tiscali.it/sv2001/Cormorant Counts 2003-2006 Summary.pdf](http://web.tiscali.it/sv2001/Cormorant%20Counts%202003-2006%20Summary.pdf)
- Wißmath, P.**, 2009. Neues zur Kormoranplage am Ammersee. *Fischer und Teichwirt* **60**: 323.
- Wißmath, P. and U. Wunner**, 1996. Kormoranschäden in oberbayerischen Fließgewässern im Winter 1995/96. *Fischer und Teichwirt*, **47**: 126-129.
- Wißmath, P., U. Wunner and B. Huber**, 1998. Kormoranschäden an Stellnetzen der Seenfischer – eine hinnehmbare Bagatelle oder ein handfester fischereiwirtschaftlicher Schaden? *Fischer und Teichwirt*, **49**: 486-489.
- Wißmath, P., M. Reschenauer and U. Limburg**, 2000. Kormoranschäden in der Netzfischerei am Ammersee im Dezember 1999. *Fischer und Teichwirt*, **51**: 82-84.
- Woschitz, G. and G. Parthl**, 1997. Die Auswirkungen des erstmaligen Kormoraneinflugs im Winter 1995/96 auf die Fischfauna der Mur im Bereich der Entnahmestrecke KW Laufnitzdorf, Stmk. *Landesregierung Umweltschutz*, **1997**.
- Zauner, G.**, 1999. Einfluss des Kormorans auf die fischökologischen Verhältnisse der steirischen Enns zwischen Liezen und Johnsbach. *Publikationsreihe Universität für Bodenkunde Wien, im Auftrag der stmk. Landesregierung*, Dez. 1999.