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Status of the breeding population of Great Cormorants *Phalacrocorax carbo* in the Western Palearctic in 2006

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Abstract

There have been large increases in the population of Great Cormorants *Phalacrocorax carbo* across Europe over the past 30-40 years and there continues to be an interest in following changes in numbers and distribution. The IUCN/Wetlands International Cormorant Research Group (CRG) therefore decided to organise a Pan-European count of breeding colonies in 2006, also trying to stimulate counts of colonies around the Black Sea. Highest priority was given to covering areas where the 'continental' subspecies *P. c. sinensis* was breeding, as this subspecies has expanded most dramatically. Counts were organised by national coordinators and data were subsequently collated by the CRG. A comparison with a compilation of national breeding numbers made by BirdLife International showed that breeding numbers of *sinensis* in Europe (excluding Russia, Ukraine and a few other countries) had increased from c. 169,000 breeding pairs in 2000-2002 to c. 219,400 pairs in 2006. This increase of c. 50,000 pairs over a 5-year period was mainly due to an increase by 43,300 pairs in the Baltic Sea region (mainly in Sweden and Poland). Total breeding numbers in Central Europe and the Central and Eastern Mediterranean had not increased over this 5-year period. In 2006, the highest numbers of breeding *sinensis* were found in the countries around the Baltic Sea, where 517 breeding colonies held a total of 165,650 nests. In the western and central part of Europe the most important breeding areas were found in The Netherlands (23,500 nests), France (6,050 nests), Hungary (3,200 nests), Italy (2,150 nests), Croatia (2,150 nests) and Belgium (1,650 nests). The largest breeding numbers close to the Mediterranean Sea were found in Montenegro (2,000 nests) and Greece (>4,600 nests). The Danube Delta and the northern coastal areas of the Black Sea (Ukraine) made up very important breeding areas together with the Sea of Azov. The size of the breeding population in this region could not be precisely estimated due to incomplete coverage, but the observers recorded a total of 120,750 nests. The Black Sea region also held a single colony of 14,200 nests. The breeding population of the more marine 'Atlantic' subspecies *P. c. carbo* was estimated at a total of 57,100 pairs, with the majority breeding in Norway (30,050 nests) and fewer in The United Kingdom (c. 8,500 nests), Ireland, Iceland and Greenland (each with 4,100-5,000 nests). The population of *carbo* was found to have increased in Greenland, Iceland and Norway in the years up to 2006.

Introduction

Two subspecies of Great Cormorant *Phalacrocorax carbo* breed in the Western Palearctic. The 'Atlantic' subspecies *P. c. carbo* is mainly found breeding on rocky cliffs and unvegetated islands on exposed marine coasts in Northwest France, The United Kingdom, Ireland, Norway and Iceland. The 'continental' subspecies *P. c. sinensis* mainly breeds in trees and on the ground along shallow coasts and near inland waters in continental Europe, Scandinavia and the coasts of the Baltic Sea, and along the northern and eastern coasts of the Black Sea.

The population of the *carbo* subspecies has been increasing at least since the 1970s, but the rate of population growth has been only a few percent per annum and the increase has not continued in all breeding areas (e.g. Debout et al. 1995, Rov et al. 2003). The European breeding population of *carbo* was estimated at 42,000 pairs around the second half of the 1980s (including Greenland and Iceland, Debout et al. 1995).

The continental subspecies *sinensis* was exposed to persecution for more than a century, and by the early 1960s, total breeding numbers were as low as 3,500-4,300 pairs in the main breeding areas being The Netherlands, Germany, Denmark, Sweden and Poland (Bregnballe 1996). Thereafter numbers began to

increase. In these five countries, constituting the core breeding area, population growth rates were on average 11% per year during the 1970s and 18% per year during the 1980s, and breeding numbers had reached 95,000 pairs in these five countries by 1995 (van Eerden & Gregersen 1995, Bregnballe 1996). This fast population growth was apparently the result of both increased survival and improved breeding success due to the combined effects of protection of breeding colonies, protection against shooting, a decrease in the use of pesticides and high abundance of small fish in a large number of European waterbodies. Although breeding numbers stabilised in some of the core breeding areas in the early 1990s (Bregnballe et al. 2003), the *sinensis* population continued to extend its range into central Europe and along the Baltic Sea coast thereby returning to breeding areas from where it had been extinct for a century or more (e.g. Lindell et al. 1995).

The Great Cormorant has been in conflict with man for at least 150 years and the intensity of conflicts with fisheries and aquaculture increased as the species returned within a few years to a number of areas after a long absence and quickly moved into other previously unoccupied areas. The marked changes in numbers and geographical range led to an interest in monitoring the growth and geographical expansion of the population. With the aim of providing updated information about the size and distribution of the Great Cormorant population The IUCN/Wetlands International Cormorant Research Group (CRG) took the initiative to organise a count of breeding colonies in 2006 trying to cover the majority of breeding areas in the Western Palearctic. This initiative was facilitated by the COST Action (635) INTERCAFE network. The COST Action provided opportunities for several CRG members to meet and create new networks amongst interested people in the Western Palearctic.

In this paper we present the major results of the counts of the breeding colonies. Many of the results have been published at national levels by individual countries that participated in the 2006 count, and the overall result of the 2006 count was published in a leaflet (Wetlands International Cormorant Research Group 2008). Furthermore, van Eerden et al. (in press) have made extensive analyses of the distribution of breeding Great Cormorants in relation to a number of environmental variables.

Material and methods

Organisation of counts

The counts were coordinated by the CRG by making direct contact with persons known to have knowledge about the occurrence of Great Cormorants in their countries. However, for countries where the CRG had no contacts beforehand, letters were sent to Universities, natural history museums and ornithological organisations in an attempt to find persons willing to organise a breeding count at the national or sub-national level. The work to make contact and designate national coordinators began in the autumn of 2005 and continued right up to the start of the breeding season in 2006. Each national coordinator received a standard letter from the CRG, a short guide describing the preferred methods for counting Great Cormorant colonies and an Excel form recommended to be completed for each colony counted. Besides reporting numbers of apparently occupied nests, the colony counters were also asked to give information about: a) the locality (name of locality, geographical coordinates, protection), b) the colony and its surrounding habitat (type of fishing water, minimum distance to fishing water, type of colony, species of nesting trees, % breeding on the ground, occurrence of predators), c) the subspecies breeding in the colony, d) the counting method (date of count and method), e) brood size near to fledging and breeding success, f) the presence of other colonial species, g) the occurrence of conflicts with humans, h) the occurrence of colony management. The majority of national coordinators also completed a form where they noted how the collated data could be stored, published and made available to others.

Methods

The practical guide for the colony counts recommended that observers made counts of apparently occupied nests, defined as nests in use and sufficiently completed to hold one or more eggs (Bregnballe & Lorentsen 2006). Breeding numbers are therefore given as numbers of “apparently occupied nests” (AON) but, for simplicity, we use the term “numbers of nests” or “numbers of breeding pairs”. The guide to national coordinators further recommended that a colony was defined as a group or groups of nests that were located within 2,000 m of one another (Bregnballe & Lorentsen 2006). Groups of nests located within 2,000 m of one another should be referred to only as ‘sub-colonies’. A single nest was sufficient to be termed a ‘colony’ as long as it was not located within 2,000 m of other nests. Despite these recommendations, national coordinators were free to use other definitions of what constituted a colony if this was an accepted protocol in their countries.

It was recommended that counts were made when the maximum numbers of nests were likely to be occupied. The ability of observers to count at the time when nest numbers peaked was in many cases constrained by several factors. First of all, the observer rarely knew at exactly what time of the season nest numbers could be expected to peak. In planning the time of a nest count, the observer also had to take into account the fact that a) the number of nests tends to reach a maximum later in the season in newly-founded colonies than it does in older ones, and b) that the visibility of nests in trees declines after leaf-burst. Some observers were forced to count at a suboptimal time because of other duties or poor weather conditions on the day when the count was planned to be undertaken.

A few *sinensis* colonies and a large number of the *carbo* colonies along open, rocky coasts were counted by taking photographs of the colony from the air (particularly in Iceland, Greenland and Norway). However, the vast majority of colonies were counted by walking through the colony and counting the apparently occupied nests. Some colonies were counted without entering the colony to avoid disturbance. Instead the observer found a suitable vantage point (or several) and counted the nests from there. In many cases the duration of disturbance was reduced by coordinating two or three people to carry out the count together.

Coverage

In the count project we gave highest priority to trying to obtain good coverage of breeding colonies in the region where Great Cormorants of the *sinensis* subspecies bred. Furthermore, we gave priority to the breeding areas that constitute the areas of origin of the birds that, outside the breeding season, occur in continental Europe and west of Russia-Belarus-Ukraine-Romania. However, if possible without extra effort, we also tried to obtain information from countries with breeding populations of *carbo* (e.g. Greenland, Iceland, Ireland, UK, Norway) and from countries further east, especially the northern coasts of the Black Sea (Ukraine).

For countries where it was impossible to organise counts in 2006, we tried to collate data from years prior to 2006 or from 2007 (see tables). In some countries colonies in one part of the country were covered in one year, whereas colonies in another part of the country were counted in another year. Therefore data from different years had to be combined to reach an estimate of the total breeding population (e.g. *carbo* colonies along the coast of Norway and colonies in Russia east of Ukraine). This is not ideal because Great Cormorants may more or less abandon a colony within a few years and move to another one if breeding conditions deteriorate in the colony where they originally bred. Overall, the effect of this on the precision of the count has been very small.

We were unsuccessful in obtaining information about the occurrence of breeding cormorants in Bosnia and Herzegovina, Albania, Macedonia and Moldavia.

Whilst considerable effort was made in the majority of countries to compile a complete list of colonies, it is highly likely that in some countries some colonies and breeding attempts were missed, either because these were not known or were not reported. We have not been able to obtain clear knowledge about the completeness of the coverage of breeding colony counts in all the countries. However, the general judgement was that all known colonies were counted. For countries where the coordinator(s) knew or judged that coverage was incomplete, it is denoted in the tables with results. It was difficult for coordinators to estimate breeding numbers of Great Cormorants in areas that were not covered by the counts. For some countries coordinators were willing to try to estimate numbers in uncovered areas, even though it was an uncertain 'best estimate' (e.g. Greenland, coasts of UK, Latvia). For a number of countries, no estimates were made for uncovered parts of the countries (e.g. Romania, Ukraine, Russia east of Ukraine, Georgia, Turkey).

Precision of counts

Despite the large and often conspicuous nest of this species, counts of apparently occupied nests are not necessarily straightforward. No particular effort was made in this project to try to evaluate the precision of counts of AON in the breeding colonies. Some counters reported a minimum and a maximum number of nests in the colony they counted. A few national coordinators used these lower and upper values and gave a range of nest numbers when reporting on total numbers in their country. Other coordinators decided to use the mean number of nests when a minimum and a maximum was given. The coordinators used the largest count for colonies where there was more than one count for a particular site and year.

The number of nests present at the time of the season when nest numbers reach their maximum will, in most cases, be lower than the total number of nests actually built in the colony. Thus nests may disappear before, and new nests may be built after, the peak in nest numbers (Harris & Forbes 1987).

The number of pairs that attempted to breed is higher than the number of apparently occupied nests at the time of the season when nest numbers reached their maximum (Harris & Forbes 1987, Walsh et al. 1995). Thus nests built by pairs that give up early in the season are frequently taken over by new pairs, and some breeders may not initiate breeding until after the nests have been counted.

Handling of data

Each of the national or provincial coordinators was in contact with the persons counting the colonies, and the coordinator ensured that the results from the counts were delivered. Having collated the data, the coordinator passed it on to the project coordinators. Data on individual colonies were transferred from Excel to an Access database for further processing. For the majority of colonies we only received information about its location of the colony and the numbers of apparently occupied nests counted and not details about such things as habitats, management actions etc. The information about these other parameters is therefore not presented here.

Handling of subspecies

Two subspecies of Great Cormorants were recognized in Europe when the data from this count were collated: The nominate Atlantic race *P. c. carbo* and the continental race *P. c. sinensis*. It is relevant to try to distinguish between these subspecies when describing population development partly due to their different needs for conservation. With the exception of France, this was not difficult when populations were small because the subspecies generally lived in different environments, particularly during the breeding season. However, as the populations of both subspecies have expanded they have begun to breed in mixed colonies in England and in coastal and inland colonies in France (e.g. Winney et al. 2001, Marion & Le Gentil 2006, Newson & Marchant 2007, Newson et al. 2004, Newson et al. 2007); it is, with a few exceptions, unknown to what extent *carbo* and *sinensis* are breeding in mixed colonies in other countries.

The relative proportion of the two subspecies can vary extensively between colonies located relatively close to each other, and the *sinensis/carbo* proportions are also known to change over time (e.g. Marion & Le Gentil 2006). This makes it very difficult to reach precise estimates of population sizes separately for the two subspecies. To keep it simple, we decided to treat all coastal colonies in France and United Kingdom as if only *carbo* were breeding in these marine habitats. For the inland colonies in England we used the estimate by S. Newson (unpublished) that the proportion of *carbo* among inland breeders was 75% in 2005. For the inland colonies in France we assumed that all breeders belonged to the continental subspecies *P. c. sinensis* even though genetic studies documents that this is not the case (e.g. Marion & Le Gentil 2006).

The question of subspecies is apparently more complicated than described above. Thus Marion & Le Gentil (2006) found genetic evidence for the existence of a third subspecies which they named *P. c. norvegicus*. This subspecies was mainly found in Norway (north of Skagerrak) and Brittany (France), but the subspecies also occurred in colonies near to the sea in Sweden, Denmark and The Netherlands. We have not taken these new findings into account in our present reporting of the 2006 count of breeding colonies.

Results

Overall distribution

The total numbers of nests is given in Table 1 for each subspecies and for each of the four Counting Areas defined in Figure 1. Excluding the estimated c. 9,000 pairs in Greenland-Iceland, the breeding population of *carbo* was estimated to be approximately 48,000 breeding pairs, of which 62% bred in Norway.

The largest numbers of breeding Great Cormorants of the *sinensis* subspecies were found in the countries bordering the Baltic Sea (165,650 nests) and the Black Sea (>103,000 nests). Breeding numbers were lower in the countries along the Atlantic Sea and the North Sea (31,392 nests) where the vast majority were found in The Netherlands (75%; note that Germany and Denmark were not included in this Counting Area). The countries included in the area of Central Europe and the Central and Eastern Mediterranean held a breeding population of approximately 16,000 nests.

The numbers of Great Cormorants breeding in each of the countries around 2006 are given in Tables 2-5. Great Cormorants were found breeding in almost all the countries that were covered by our counts.

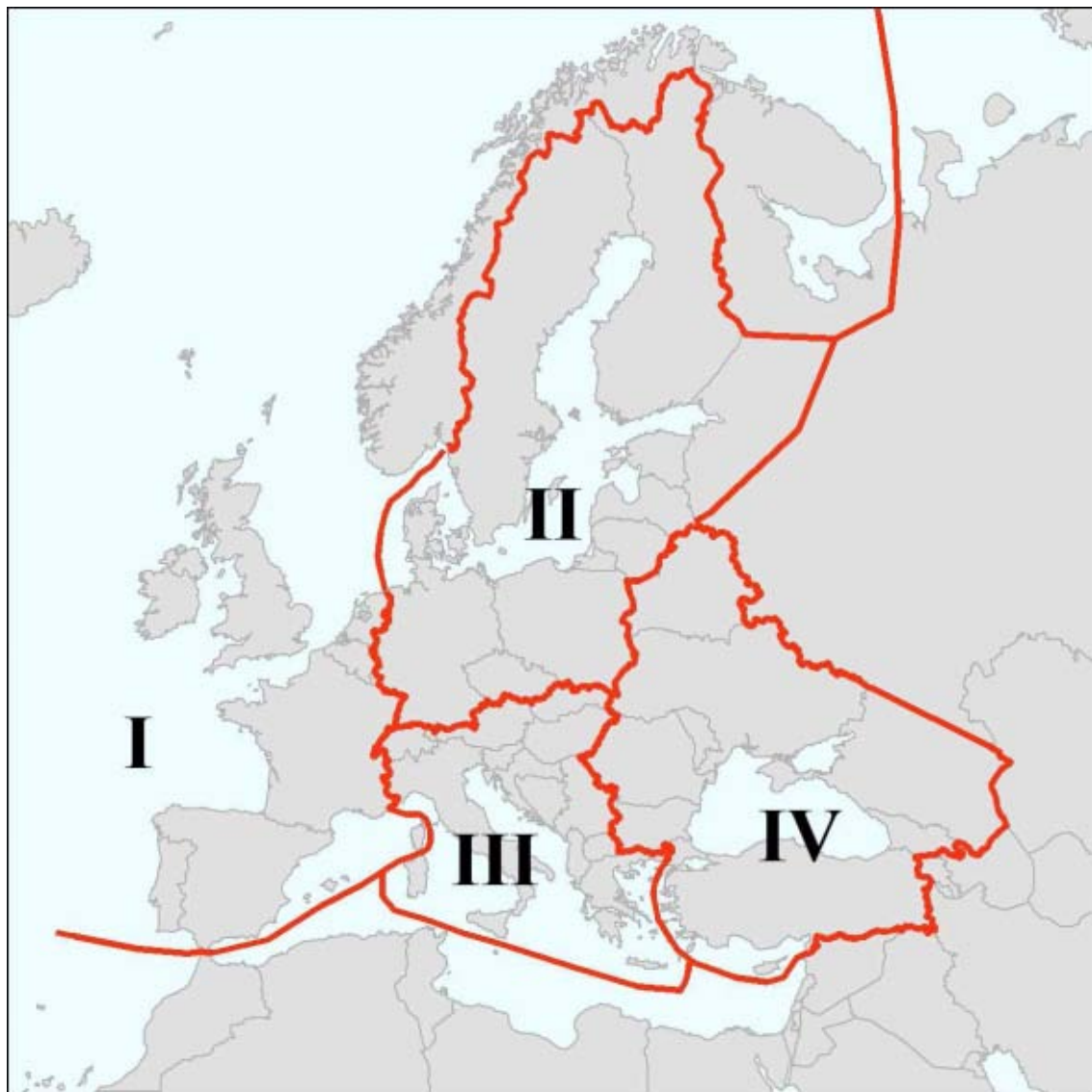


Fig. 1 The borders of the four Counting Areas used for presenting the results of the counts of Great Cormorant colonies around 2006.

The overall distribution and relative size of colonies where *sinensis* were breeding are shown in Figure 2 (not all colonies that existed are shown due to the absence of location for some of them). It is evident from Figure 2 that the largest concentrations of breeding cormorants were found: In The Netherlands (especially near to IJsselmeer and Markermeer).

Along the Baltic Sea coasts (especially near Danish, North German and Swedish shallows and at the mouth of large rivers further east in the Baltic Sea)

To the north, west and east of the Krim peninsula in the northern part of the Black Sea and around the Sea of Azov.

Besides these areas, moderately high numbers of breeding Great Cormorants of the *sinensis* subspecies were found near coasts, estuaries, coastal lakes, as well as near to large rivers and lakes in inland areas in Sweden, Poland, Germany, The Netherlands, France, northern Italy, Hungary (not included in Fig. 2), Croatia, Montenegro, Greece and Romania (Fig. 2, Tables 2-5).

Numbers and status

Tab. 1 The numbers of Great Cormorants *P. c. carbo* (Counting Area I) and *P. c. sinensis* (Counting Areas I-IV) recorded breeding in or around 2006 in four Counting Areas in the Western Palearctic. Counting Areas are defined in Figure 1 and Tables 2-5. Note that coverage was incomplete in Counting Areas III and IV.

Counting Area	Name of Counting Area	Numbers of nests
I	Atlantic Sea & North Sea ¹	
	<i>P. c. carbo</i> ²	57,109
	<i>P. c. sinensis</i> ²	31,392
II	Baltic Sea	165,650
III	Central Europe and Central and Eastern Mediterranean ³	>15,792
IV	Black Sea ⁴	>>120,739

¹ This Counting Area includes Greenland and Iceland but not Germany and Denmark

² For France it is assumed that only *carbo* are breeding in coastal colonies and that only *sinensis* are breeding in inland colonies, although it is known that the subspecies mix in both coastal and inland colonies (see Marion & Gentil 2006). For United Kingdom is assumed that only *carbo* are breeding in coastal colonies and that 75% of those breeding in inland colonies are *carbo* (cf. S. Newson unpubl.).

³ Information is lacking from one colony in Greece

⁴ Information is lacking from some states and several provinces

Status within Counting Areas

Counting Area I. This area includes the East Atlantic Sea and the North Sea states, except Germany and Denmark. The vast majority of the subspecies *P. c. carbo* were found along the coast of Norway north of Skagerrak (ca. 30,000 pairs). The second most important area was The United Kingdom with ca. 8,500 pairs. Ireland, Iceland and Greenland each held about 4,100-5,000 breeding pairs (Table 2).

The *sinensis* breeders in this Counting Area occurred in highest numbers in The Netherlands (23,500 nests out of the total of 31,400 nests), whilst inland France and Belgium were the second most important breeding areas (Table 2). Among these three countries, mean colony sizes were highest in The Netherlands (429 nests) and smallest in Belgium (79 nests).

Counting Area II. The area includes the States that border the Baltic Sea. The vast majority of birds here were found breeding along coasts in Sweden, Poland, North Germany and Denmark (Table 3). Two very large colonies were found on the Baltic coast in Poland (the Katy Rybackie colony with 11,459 nests) and on the coast of Kaliningrad (8,500 pairs in one colony on the Curonian Lagoon). However, all countries around the Baltic Sea - except Latvia - had one or several colonies with 800-3,500 nests. A total of 517 breeding colonies were recorded in this Counting Area.

Counting Area III. The area includes the States in Central Europe and in the Central and Eastern Mediterranean. Greece had the highest number of breeding pairs (>4,750 nests) and breeding numbers ranged from 2,000 to 3,200 nests in Hungary, Croatia, Montenegro and Italy (Table 4). Serbia had 940 nests and fewer than 300 nests were recorded in each of Austria, Switzerland, Czech Republic and Slovakia. No information about breeding cormorants was obtained for Bosnia-Herzegovina, Albania and Macedonia.

Counting Area IV. This area includes the States that border the Black Sea. Despite incomplete coverage, the results clearly show that the Black Sea coasts and the Azov Sea coasts of Ukraine and Russia are very important breeding areas, with more than 85,000 breeding pairs here (Table 5). The largest colony counted during the entire survey in the Western Palearctic in 2006 was a tree colony located on a protected island in Lake Aktashskoye – it held 14,200 nests. The other breeding areas of major importance were the Danube Delta (ca. 22,000 nests; the highest numbers of nests were on the Romanian side of the delta) and Georgia (possibly around 7,000 nests).

Numbers and status

Tab. 2 The number of assumed occupied nests in Counting Area I, given per country or country part. The numbers given refer to counts in 2006 unless otherwise stated. The “Total” refers to the numbers of nests counted if the coverage was believed to be complete, and “Total” refers to the best estimate made by the national coordinator for countries where coverage was incomplete. The numbers of nests counted is only denoted for countries and regions where not all colonies were counted. “No. of colonies” refers only to colonies where numbers of occupied nests were counted.

Country	Sub-species	Numbers of nests		No. of colonies	Largest colony	Remarks
		Total	Counted			
Greenland	<i>carbo</i>	5,000	2,600	207	398	Counted numbers are from 1997, since then population numbers and range has increased considerably. Source: Boertmann & Mosbech (1997), Bakken et al. (2006)
Iceland	<i>carbo</i>	4,134		39	334	Gardarsson (2008)
Russia						
Murman coast of Barents Sea	<i>carbo</i>	1,092		14	120	Data from full survey at Murman coast in 1992. Source: Røv & Paneva (2000). For Onega Bay, full survey in 2006. Source: Cherenkov et al. 2011
Onega Bay, White Sea	<i>carbo</i>	198		4		
Norway						Refers to 2006 for most colonies; for others to 2004 or 2005 There might be some <i>carbo</i> in <i>sinensis</i> colonies
North of Skagerak	<i>carbo</i>	30,051		97	1,510	
Skagerak	<i>sinensis</i>	1,338		5	822	
United Kingdom						
Coastal colonies	<i>carbo</i>	8,545 ²	3,190	66	490	Refers to 2005
Inland colonies	<i>carbo/sinensis</i> ¹	2,184		26	308	See Newson et al. (2007) for details
Eire	<i>Carbo</i>	4,495		61	675	Refers to 1998-2002. Source: JNCC, the Environment and Heritage Service and Birdwatch Ireland
The Netherlands	<i>Sinensis</i>	23,476		55	3,746	See van Rijn & van Eerden 2007 for details
Luxemborg		0				
Belgium	<i>Sinensis</i>	1,648	1616	22	301	For one colony nest numbers is the average of numbers counted in 2005 and 2007
France						
Coastal colonies	<i>carbo/sinensis</i>	1,956	1,935-1,977	31-32	805	For details, see Marion (2008)
Inland colonies		4,094	4,023-4,164	46-47	c. 1,500	
Spain	<i>Sinensis</i>	290		9	220	Numbers refer to 2007
Portugal		0				

¹ The proportion of *carbo* among inland breeders was estimated to 75% for 2005, S. Newson unpubl.² The following nest numbers in coastal colonies were estimated for 2005 by Newson in prep.: Scotland, 2,992; England, 1,979; Wales, 1,845; Northern Ireland, c. 1,000.

Numbers and status

Tab. 3 The number of assumed occupied nests in Counting Area II, given per country or country part. The numbers given refer to counts in 2006 unless otherwise stated. It is believed that all, or almost all, Great Cormorants breeding in this Counting Area belong to the sub-species *sinensis*. However, it is possible that some carbo breeds in *sinensis* colonies in for example Denmark. For explanations, see also legend to Table 2.

Country	Numbers of nests		No. of colonies	Largest colony	Remarks
	Total	Counted			
Germany	23,329		134	4,861	See Herrmann (2007) for details
Denmark	38,014		62	3,439	See Eskildsen (2006) for details
Sweden	44,000	43,884	191	2,610	
Finland	5,770		23	802	See SYKE (2007) for details
Russia, Gulf of Finland	3,814		7	1,588	
Estonia	12,300	11,695	24	1,999	1 site not covered before 2007 had 560 nests in 2007; 5 sites not covered in 2006 had a total of 266 nests in 2007 but no nests in 2005.
Latvia	500	416	12	158	
Lithuania	3,692		8	2,862	
Kaliningrad	8,500		1	8,500	
Poland	25,731	25,637- 25,825	55	11,459	

Tab. 4 The number of assumed occupied nests in Counting Area III, given per country. The numbers given refer to counts in 2006 unless otherwise stated. It is believed that all Great Cormorants breeding in this Counting Area belong to the sub-species *sinensis*. For explanations, see also legend to Table 2.

Country	Numbers of nests		No. of colonies	Largest colony	Remarks
	Total	Counted			
Switzerland	214		3	166	
Italy	2,142		15	815	
Austria	178		2	130	
Czech Republic	288		3	219	
Slovakia	104		3	78	
Hungary	3,200				Numbers of colonies unknown
Slovenia	0				
Croatia	2,156		2	1,435	Refers to 2008
Bosnia-Herzegovina	0				No breeding in 2006, but 5 pairs in 2008 and 80 pairs in 2010. Source: Kotrošan et al. 2011.
Serbia	940		5	500	
Montenegro	2,000		3	1,700	.
Albania	?				
Macedonia	?				BirdLife International (2004) gives 600 nests with reference to 2000-2002
Greece	>4,570	4,550- 4,600	7	3,850	Nest numbers not known for at least one colony

Numbers and status

Tab. 5 *The number of assumed occupied nests in Counting Area IV, given per country or country part. The numbers given refer to counts in 2006 unless otherwise stated. It is believed that all Great Cormorants breeding in this Counting Area belong to the sub-species sinensis. For explanations, see also legend to Table 2.*

Country	Numbers of nests		No. of colonies	Largest colony	Remarks
	Total	Counted			
Belarus	2,136	1,958-2,314	24	650	
Moldova	?				BirdLife Europe (2004) gives 500 nests with reference to 2000-2002
Ukraine					
Inland	?				See Discussion
Mainly Black Sea and Azov Sea coasts	62,491		27	14,200	Details in Kirokova et al. (2007)
Danube Delta	5,255		?	?	Numbers refer to 2002. Source: Platteeuw et al. (2004)
Romania, Danube Delta	16,455		28	2,500	Numbers refer to 2007. 17,532 nests counted in 2002 by Platteeuw et al. (2004)
Romania (excl. Danube Delta)	>970		>4	300	Along the Danube River. Including one colony counted in 2008, only. Source: Shurulinkov et al. (2007); J.-Y. Paquet pers. comm.
Bulgaria	>1,989	1,953-2,025	10	560	For details see Shurulinkov et al. (2007)
Russia, east of Sea of Azov					
Rostov region	>5,403		>5	3,500	Largest colony counted in 2006, other colonies in 2003, 2004 or 2008; V. Belik pers. comm.
Krasnodarski Kray region	>16,540		>8	4,700	One colony counted in 1996 and one colony in 2005, other colonies in 2006; Y. Lokhman pers. comm.
Georgia	>5,000		?	?	B. Japoshvili estimated c. 7,000 pairs
Turkey	>4,500		?	3,300	3,300-4,500 for 2004 according to Kýlýç & Eken. However, E.S. Karauz (pers. comm.) suggested that total numbers were higher

It is uncertain to what extent all the major breeding areas in the States around the Black Sea were covered. For example, we had no information from Moldova and, with a few exceptions; we had no information from inland areas in Romania, Ukraine, and Russia east of Ukraine. Furthermore we had only incomplete information from Georgia and Turkey.

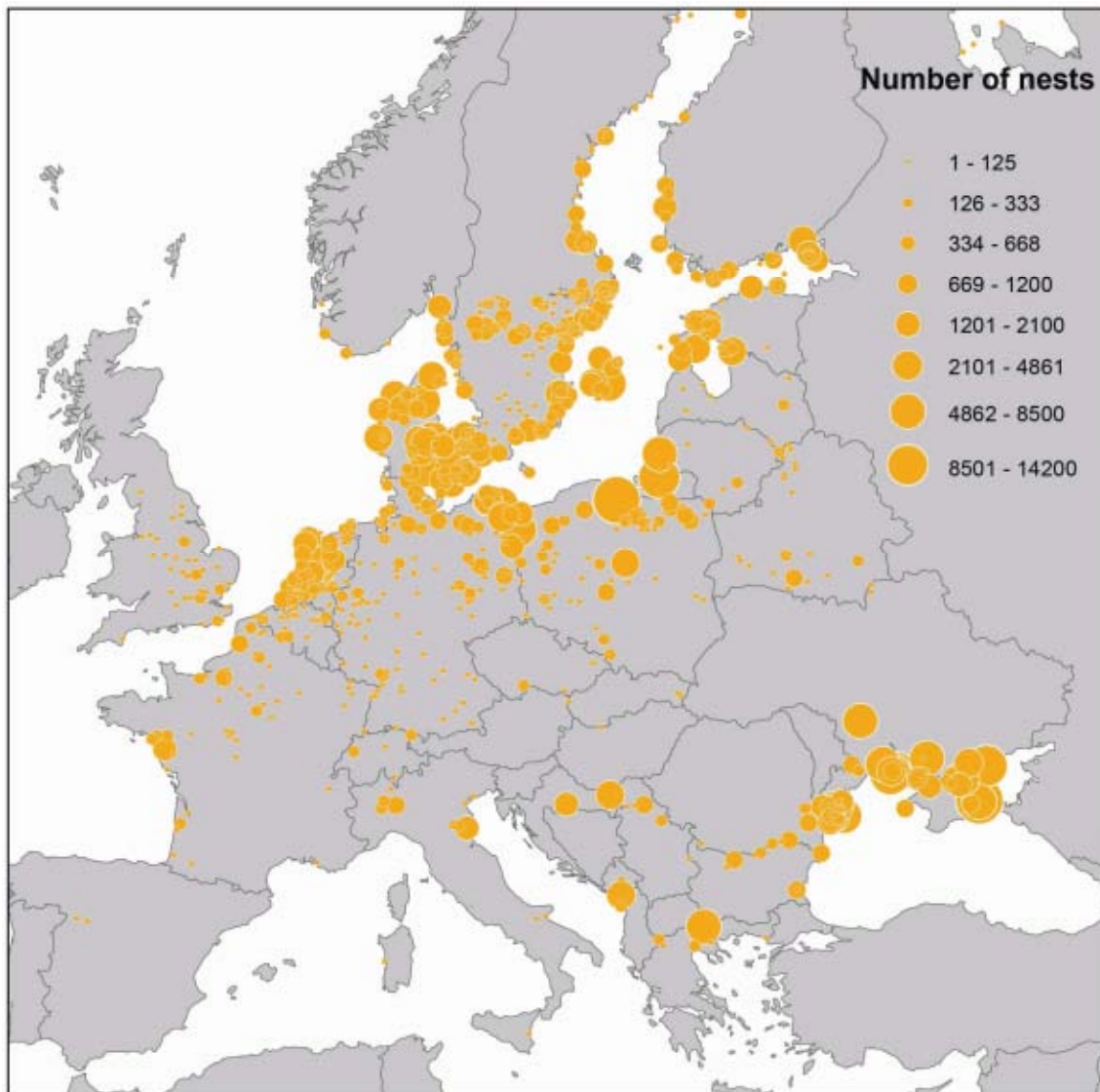


Fig. 2 Distribution and relative size of Great Cormorant colonies in the Western Palearctic around 2006. The map only denotes the location of colonies where the subspecies *sinensis* was breeding. The size of the circles is proportional to colony size (see legend). We had no geo-reference for *sinensis* colonies located in Hungary, Bosnia-Herzegovina, Albania, Macedonia, Moldova, Turkey and information was missing for some colonies or areas in the following countries: Latvia, France, Spain, Greece, Romania, Ukraine and Russia. The two subspecies *carbo* and *sinensis* are known to breed in mixed colonies in inland colonies in England and in coastal and inland colonies in France and most of these colonies are included on the map.

Discussion

The breeding population of P. c. carbo

The estimate of the size of the breeding population of *carbo* was not very precise because of the incomplete coverage and/or because of lack of recent counts (e.g. Greenland, United Kingdom, Murman coast of Barents Sea). Furthermore, exact numbers of breeding *carbo* are not known for the colonies where *carbo* and *sinensis* breed in mixed colonies (it is known that the subspecies mix in inland colonies in England and in coastal and inland colonies in France). Furthermore, the new studies by Marion and Le Gentil (2006) suggest that there are three (not two) Great Cormorant subspecies breeding in Europe and that these subspecies mix to various extents in at least Swedish, Danish, Dutch and French coastal colonies.

However, keeping it simple and comparing with older counts in breeding areas that traditionally were believed to hold only breeding *carbo* birds, shows that by 2006 breeding numbers had increased in:
Greenland (White et al. 2010, D.M. Boertmann pers. comm.)
Iceland. Logistic growth from 2,350 nests in 1995 to 4,500 nests in 2007 (Gardasson 2008)
Norway. From 27,000 nests in 1995 and 25,000 nests in 2000 (Rov et al. 2003) to 30,000 nests in 2006.

However, breeding numbers in coastal colonies in The United Kingdom have apparently been stable during 1986-2005, with annual estimates ranging from ca. 8,000 to 9,500 nests (Newson et al. in prep.). Along the coast of France, nest numbers were estimated at ca. 1,600 in 1988 (Debout et al. 1995) and numbers declined slightly from 2,122 nests in 2003 to 1,956 nests in 2006 (Marion 2008). In Onega Bay (White Sea, Russia) where only few Great Cormorants breed (200 nests in 2006), numbers increased up to the late 1990s and then began to decline (Cherenkov et al. 2011).

The breeding population of P. c. sinensis

Despite missing information from a few States and the incomplete coverage of others (especially around the Black Sea), the present count carried out around 2006 provides a very precise overview of the overall size and distribution of the breeding population of *sinensis* birds in the Western Palearctic.

For the years 2000-2002, BirdLife International (2004) estimated total breeding numbers of *sinensis* to be 169,000 breeding pairs in the countries that largely correspond with Counting Area I, II, III and Romania and Bulgaria from Area IV. Using the same countries as BirdLife International, the comparable figure for the 2006 status was 219,400 nests (excluding England inland and Macedonia but including *sinensis* in South Norway). This represents an increase of ca. 50,000 breeding pairs between the years 2000-2002 and 2006. The comparison suggests that the most marked increases in terms of total nest numbers has taken place in Counting Area II, the Baltic Sea (an increase of 43,300 nests, mainly due to great increases in Sweden and Poland; the comparison excludes Kaliningrad and the Russian part of the Gulf of Finland). The numerical increase in Counting Area I amounted to 8,600 nests (mainly due to an increase in The Netherlands and in inland France). The proportional increase in each of these two regions corresponds to 28% over this period of about 5 years. Unlike the other areas, overall numbers declined in Counting Area III (here including Romania and Bulgaria) by 1,700 nests (mainly due to a decrease in Romania of 2,600 nests).

BirdLife International (2004) estimated that Ukraine had a breeding population of 75,000 breeding pairs in 2000-2002. Kirikova et al. (2007) and Nementzov (2008) described that the Great Cormorant populations in the Azov-Black Sea region had increased over the last few decades, and Nementzov (2008) states that the increase was to the point that there were apparently about 100,000 pairs of Great Cormorants around the Azov-Black Sea region in around 2006. Nementzov mentioned that not all nesting colonies were known, and that new ones were constantly being discovered, especially as the Great Cormorants were moving more and more into inland rivers and wetlands in recent years. BirdLife International (2004) also estimated that for 2000-2002 Belarus, European Russia, Ukraine and Turkey together had a breeding population of 141,000 breeding pairs. Assuming that these numbers are reliable, this confirms our statement that the coverage of especially Ukraine and Russia was incomplete in the 2006 counts. Thus these published estimates are higher than the numbers counted in these countries in 2006 during the present project.

A review of the trends in population growth of the *sinensis* population in the different parts of the Western Palearctic will hopefully be written up and published in future. However, the country-by-country trends in development up to 2006 have already been described in scientific papers and reports for a fairly large number of the countries involved in this count.

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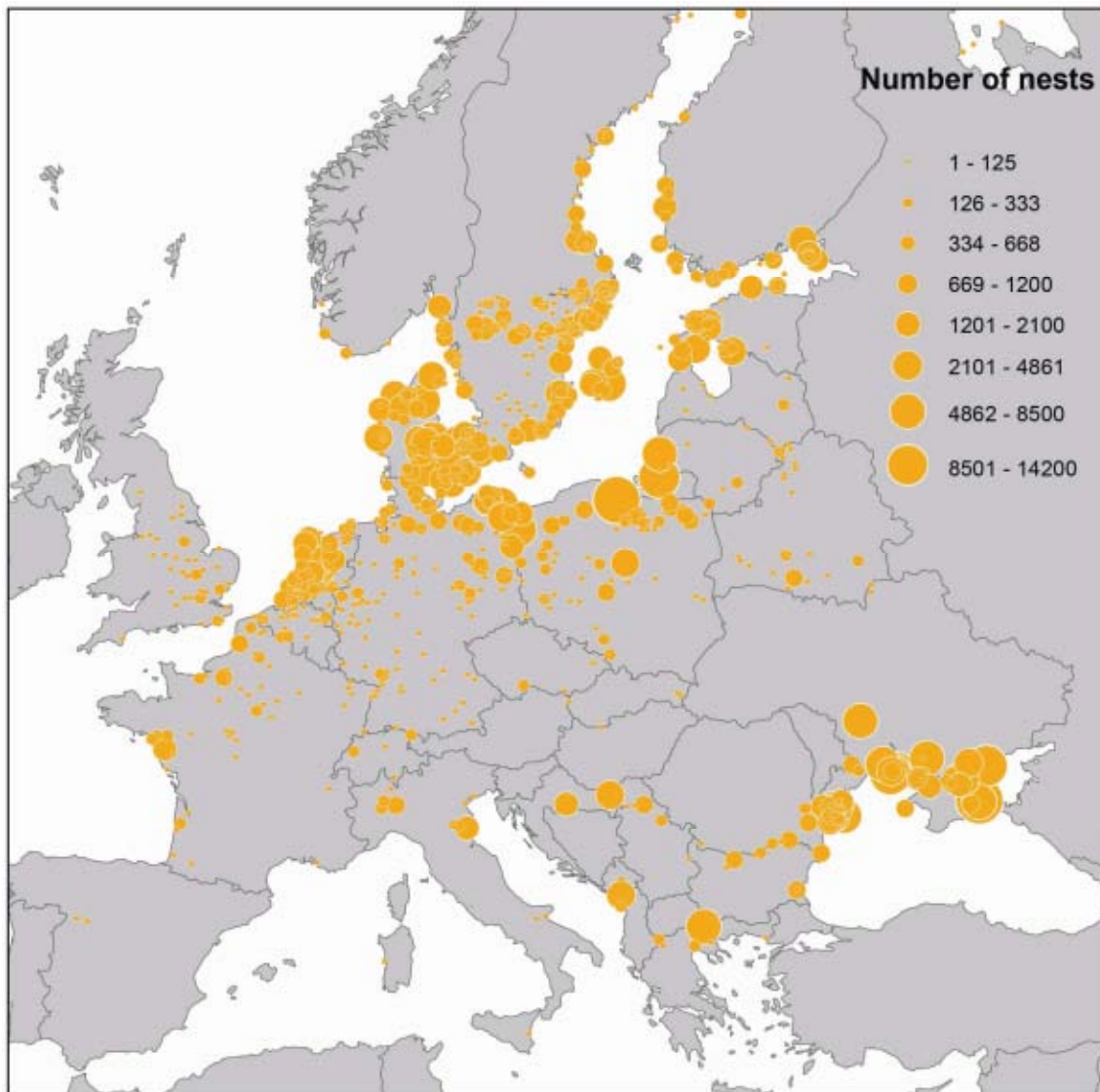


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Michael, T. Mikuska, K. Millers, I. Mirowska-Ibron, B. Molina, J.C. del Moral, P. Musil, S.E. Newson, I. Nigmatouline, I. Nikolov, J.-Y. Paquet, R. Parz-Gollner, Z. Petrovich, M. Platteeuw, V. Popenko, G. Rogan, A. Rudenko, P. Rusanen, I. Rusev, N. Røv, I. Samusenko, D. Saveljic, V. Semashko, R. Staav, O. Tanechka, N. Tarina, G.M. Tertitski, J. Trauttmansdorff and M. Zhmud. We would also like to acknowledge the JNCC, UK and its Irish partners in Seabird 2000 - the Environment and Heritage Service and Birdwatch Ireland for providing data. We are pleased that the COST Action (635) INTERCAFE network was able to facilitate communication, testing of methods and fund short-term missions aimed at transferring methodologies and collating data.

References

- Bakken, V., Boertmann, D., Mosbech, A., Olsen, B., Petersen, A., Strøm, H., Goodwin, H. 2006. Nordic seabird colony databases. - *TemaNord* 2006: 512: 1-96.
- BirdLife International 2004. Birds in Europe: population estimates, trends and conservation status. - Cambridge, U.K.: BirdLife International, BirdLife Conservation Series No. 12.
- Boertmann, D. & A. Mosbech. 1997. Breeding distribution and abundance of the great cormorant *Phalacrocorax carbo carbo* in Greenland. - *Polar Research* 16: 93-100.
- Bregnballe, T. 1996. Development of the north and central European population of cormorant *Phalacrocorax carbo sinensis*, 1960-1995. - *Dansk Ornitologisk Forenings Tidsskrift* 90: 15-20.
- Bregnballe, T. & Lorentsen, S.-H. 2006. Great Cormorant counting. - INTERCAFE cormorant manual.
- Cherenkov, A.E, Semashko, V.Y. & Tertitski, G.M. 2011. Great Cormorant *Phalacrocorax carbo carbo* population dynamics and current status in Onega Bay, White Sea. - *Wetlands International Cormorant Research Group Bulletin* 7: 19-25.
- Debout, G., Røv, N. & Sellers, R.M. 1995. Status and population development of cormorants *Phalacrocorax carbo carbo* breeding on the Atlantic coast of Europe. - *Ardea* 83: 47-59.
- Eskildsen, J. 2006. Skarver 2006. Naturovervågning. Danmarks Miljøundersøgelser. - Arbejdsrapport from DMU nr. 233. <http://arbejdsrapporter.dmu.dk>
- Gardarsson, A. 2008. Distribution and numbers of the Great Cormorant *Phalacrocorax carbo* in Iceland in 1994-2008. - *Bliki* 29: 1-10.
- Harris, M.P. & Forbes, R. 1987. The effect of date on counts of nests of Shags *Phalacrocorax aristotelis*. - *Bird Study* 34: 187-190.
- Herrmann, C. 2007. Bestandsentwicklung und Kormoran management in Mecklenburg-Vorpommern. - *BfN-Skripten* 204: 48-71.
- Kirikova, T., Gregersen, J., Grinchenko, A. 2007. The development of the largest colony of the Great Cormorant (*Phalacrocorax carbo sinensis*) in Europe. - *Branta* 10: 175-182.
- Kotrošan, D., Šimić, E., Sjeničić, J. & Topić, G. 2011. Great Cormorant (*Phalacrocorax carbo*) population status in Bosnia and Herzegovina - report for the period 2005 – 2011. - IUCN/Wetlands International Cormorant Research Group Bulletin 7: 33-38.
- Lindell, L., Mellin, M., Musil, M., Przybysz, J. & Zimmerman, H. 1995. Status and population development of breeding cormorants *Phalacrocorax carbo sinensis* of the central European flyway. - *Ardea* 83: 81-92.
- SYKE (Finnish Environment Institute) 2007. Cormorant population grew by more than fifty percent from last year. Press release, 08/15/2007, <http://www.environment.fi>
- Lindell, L., Mellin, M., Musil, P., Przybysz, J., Zimmerman, H. 1995. Status and population development of breeding Cormorants *Phalacrocorax carbo sinensis* of the central European flyway. - *Ardea* 83: 81-92
- Marion, L. 2008. Recensement national des grands cormorans *Phalacrocorax carbo* Nicheurs en France en 2006. - *Alauda* 76: 135-146.
- Marion, L. & Le Gentil, J. 2006. Ecological segregation and population structuring of the Cormorant *Phalacrocorax carbo* in Europe, in relation to the recent introgression of continental and marine subspecies. - *Evolutionary Ecology* 20: 193-216.
- Nemtsov, S.C. 2008. Israel-Ukraine cooperation for experimental management of a shared overabundant population of Great Cormorants (*Phalacrocorax carbo*). - In: Proc. 23rd Vertebr. Pest Conf. Published at Univ. of Calif., Davis.
- Newson, S.E., Hughes, B., Russell, I.C., Ekins, G.R. & Sellers, R.M. 2004. Sub-specific differentiation and distribution of Great Cormorants *Phalacrocorax carbo* in Europe. *Ardea* 93: 3-10.
- Newson, S.E. & Marchant, J. 2007. Cormorants continue to expand inland. - *BTO News* November-December: 10-12.
- Newson, S.E., Marchant, J., Ekins, G.R. & Sellers, R.M. 2007. The status of inland-breeding Great Cormorants in England. - *British Birds* 100: 289-299

- Platteeuw, M., Botond, J.K., Zhmud, M.Y. & Sadoul, N. 2004. Colonial waterbirds and their habitat use in the Danube Delta. As an example of a large-scale natural wetland. - RIZA report 2004.002. ISBN 90.369.5658.7. Institute for Inland Water Management and Waste Water Treatment, RIZA, Lelystad, The Netherlands.
- Røv, N., Lorentsen, S.-H., Nygård, T. 2003. Status and trends in the Great Cormorant *Phalacrocorax carbo carbo* populations in Norway and the Barents Sea Region. - *Vogelwelt* 124: 71-75.
- Røv, N & Paneva, T. 2000. Great Cormorant *Phalacrocorax carbo*. In: Anker-Nilssen, T., Bakken, V., Strøm, H., Golovkin, A.N., Bianki, V.V. & Tatarinkova, I.P. (eds.): The status of Marine birds breeding in the Barents Sea Region. - *Norsk Polarinstitutt Rapport* 113: 30-33.
- Shurulinkov, von P., Nikolov, I., Demerdzhiev, D., Bedev, K., Dinkov, H., Daskalova, G., Stoychev, S., Hristov, I. & Ralev, A. 2007. Die aktuelle Brutverbreitung und die Bestände koloniebrütender Reiher und Kormorane in Bulgarien. - *Ornithol. Mitt.* 59: 370-378.
- Van Eerden, M.R. & Gregersen, J. 1995. Long-term changes in the northwest European population of cormorants *Phalacrocorax carbo sinensis*. - *Ardea* 83: 61-79.
- Van Rijn, S. & van Eerden, M.R. 2007. Recent population changes of Cormorants (*Phalacrocorax carbo*) in the IJsselmeer area, the Netherlands. - *Aves* 44: 151-154.
- Van Eerden, M.R., van Rijn, S.H.M., Volponi, S., Paquet, J-Y. & D.N. Carss (eds) In press. Cormorants and the European environment: exploring Cormorant ecology on a continental scale. Report from COST Action (635) INTERCAFE network.
- Walsh, P.M., Halley, D.J., Harris, M.P., del Nevo, A., Sim, I.M.W. & Tasker, M.L. 1995. Seabird monitoring handbook for Britain and Ireland. - JNCC / RSPB / ITE /Seabird Group, Peterborough.
- Wetlands International Cormorant Research Group 2008. Cormorants in the western Palearctic. - Leaflet. http://web.tiscali.it/sv2001/Cormorant_Counts_2003-2006_Summary.pdf
- Winney, B.J., Litton, C.D. Parkin, D.T. & Feare, C.J. 2001. The subspecific origin of the inland breeding colonies of the cormorant *Phalacrocorax carbo* in Britain. - *Heredity* 86: 45-53.
- White, C.R., Boertmann, D., Grémillet, D., Butler P.J., Green, J.A. & Martin, G.R. 2010. The relationship between sea surface temperature and population change of Great Cormorants *Phalacrocorax carbo* breeding near Disko Bay, Greenland. – *Ibis* 153: 170-174.