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The occurrence of the Great Cormorant *Phalacrocorax carbo* in Sweden, with special emphasis on the recent population growth

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Abstract

The population of Great Cormorants *Phalacrocorax carbo sinensis* in Sweden has increased considerably in size during recent decades and currently Sweden holds about a quarter of the total Northwest European population. In 1999, the population contained an estimate of 25,600 pairs, distributed over about 154 colonies. The increase was particularly strong between 1986 and 1994 (mean annual increase 31%), and the population grew from 1800 to 15,500 pairs. After the mid-1990s, the population increase within most of the core area appear to have levelled off, while now fluctuating in size. However, in some northern breeding areas (including the coasts of Södermanland, Uppland, Gotland and several lakes) the population continued to grow at a high rate. With growing cormorant numbers, conflicts with human interests, mainly fishery, have increased. Hunting and egg pricking have frequently been used as methods to reduce cormorant densities locally and to solve fishery related problems. It seems, however, as these measures, in most areas, only have had limited effects in terms of stabilising or reducing population size of cormorants.

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Introduction

In many countries in Europe the Great Cormorant *Phalacrocorax carbo sinensis* became extinct in the 19th century or remained at low numbers (Zijlstra & van Eerden 1989, Lindell et. al 1995). In the early 1970s only a handful of colonies existed in the Netherlands, Sweden and Denmark and the total population in Europe consisted of no more than a few thousand pairs (Bregnballe 1996). However, due to several protective measures taken in various countries in the period 1965–1980 the population slowly started to recover. From about 1980 and in the following 10–15 years, populations of cormorants in several countries showed a spectacular population development with annual increases of 10–25% (Bregnballe 1996). From about the mid 1990s, the populations in the core areas of the Netherlands, Denmark, Germany and southern Sweden appear to have became saturated.

The return of the Great Cormorant has been so successful that renewed conflicts have come into existence in many areas. This has led to a pressure from, mainly, fishery organisations to reduce cormorant numbers. The main areas of conflict are related to (1) effects on natural fish populations leading to decreases in fishery yields (e.g. Keller 1995, Suter 1995b, Dekker 1997, Engström 2001), (2) predation and damage to fish in standing fishing gears (Bildsoe 1998, Engström 1998), (3) fish consumption at fish farms (Osieck 1991), and (4) effects on the vegetation at breeding and roosting sites.

In the management recommendations for the Great Cormorant in Europe, it is suggested that each country, or regional authority, should attempt to reduce these conflicts by local solutions (Anonymous 1997). In 1995, Sweden joined the European Community and the open hunting season on cormorants had to be abolished. Due to increasing conflicts between cormorants and mainly fishery interests, local authorities have in several areas decided upon widespread control actions during the last ten years. In addition to management practises approved by local authorities, a number of illegal actions against cormorants have taken place in the same period. However,

Cormorant colony (17 nests) at the islet Måsgrund close to the island of Svartö in southern Kalmars Sound, 1965. In total, 71 chicks were killed that year at the colony and the cormorants did not return to the islet the following year. Tage Olsson at a hide used for duck hunting (photo Edling Olsson).
Skarvkoloni (17 bon) på Måsgrund ca 1 000 m från Svartö i södra Kalmarsund 1965. 71 ungar dödades det året och skarvarna återkom aldrig mer till platsen. Skjutskåran användes vid andjakt. Fotot taget av Edling Olsson med fiskardrängen Tage Olsson i skåran.

despite the disputed value of present day management actions, no effort has been taken to evaluate the effects on local or national cormorant population sizes. Furthermore, no information exists on to what level management actions has solved or reduced fishery-related problems in Sweden.

The aim of this study is to give data on the population development of the Great Cormorant in Sweden, with special emphasis on the last fifteen years with rapid population growth and extensive geographical expansion. This paper also reviews the historical distribution of the cormorant in Sweden. Moreover, data on management practises to control cormorant numbers and illegal persecution are presented, and the roles of these actions are evaluated in relation to population development.

Methods

I gathered data on recent population estimates of the size of Great Cormorant colonies, mainly from local ornithologists. Annual number of breeding pairs are based on nest counts, usually at the peak breeding season. Normally, a group of nests was considered as a colony when separated by at least 200 m of water from other clumped breeding pairs. In rare cases, data from an established colony were missing in one year. In those cases, I chose a value in between the most immediate accurate sampling years. Data on management actions were collected from County Administration Boards, and data on illegal actions mainly from persons doing the inventories.

The geographical division of the data is based on provinces. Data from Lake Vättern, Lake Vänern, Lake Hjälmaren and Lake Mälaren (the four largest lakes of Sweden) are treated separately. Data on cormorant historic distribution were collected from the literature.

Results

Archaeological data

The history of the Great Cormorant in Sweden after the last glaciation has recently been examined by Ericson & Hernandez Carrasquilla (1997), and results from their study are summarised here. Cormorant remains, found at archaeological excavations, have been recorded from more than thirty places in southern Sweden, including the provinces of Bohuslän, Skåne, Blekinge, Öland, Västergötland, Gotland and Uppland. The oldest bone remains are ca 9000 years old. Some of the remains are from nestlings and juveniles (i.e. from Öland, Gotland and Uppland) which indicates the existence of breeding populations at that time. Based on bone sizes, the prehistoric Baltic cormorants appear all to have belonged to the nominate subspecies (*Ph. c. carbo*).

Recent history

In the literature, the presence of cormorants in Sweden was mentioned, probably for the first time, in 1555 (Olaus Magnus). Possibly, cormorants (*sinensis*?) bred in Sweden at that time. Later, in the 1690s, the famous naturalist Olof Rudbeck the Younger observed cormorants on several occasions at an expedition to northern Sweden (Brusewitz 1985). A cormorant in breeding plumage was also shot by this expedition in the Bothnian Bay. Neither Olof Rudbeck (1660–1740) nor Linnaeus (1707–78) mentioned any presence of breeding cormorants from their journeys in Sweden, and most likely, cormorants did not breed in Sweden during the 17th and 18th centuries.

In the 19th century, cormorants are known to have inhabited some lakes and coastal areas in the provinces of Skåne and Blekinge (Ekman 1922, Andersson et. al 1984 and references therein). In Blekinge, colonies were known from Saltärna (Ronneby archipelago), Dragsö (Hoby parish) and Tromtö (Karlskrona), and possibly they bred also at other sites. It is unknown when cormorants became established in Blekinge, but probably it occurred in the early 19th century. The distribution of cormorants in Skåne seems to have been somewhat more restricted than in Blekinge, and colonies are only known from Lake Krageholm and Lake Snogeholm. The colony at Lake Krageholm probably became established some time during the early 1870s. The total population within Skåne, and possibly also in Blekinge during the 19th century, most likely was small, breeding irregular, and never included any large concentrations similar to present day levels. For example, the colony at Lake Krageholm contained some 50 pairs after some years of existence. Two *Ph. c. sinensis* shot at Lake Krageholm in April and May 1881 (stored at Lund Zoological Museum) suggest that breeding cormorants in Skåne and Blekinge belonged to the subspecies *Ph. c. sinensis*. At Lake Krageholm, and probably Skåne as a whole, the cormorants seem to have disappeared at around 1881 due to destruction of nests and hunting (Neander 1918). However, Ekman (1922) mentioned breeding at Lake Krageholmssjön still in 1887. When the cormorant disappeared as a breeding species from Blekinge is unclear, but colonies may have existed until the early 20th century. Information from Vagnsö (Hoby parish, Blekinge) (Neander 1918) suggests that cormorants may have bred there in the cavity of an old oak-tree until 1909. Nevertheless, probably no breeding occurred in Sweden after 1909, at the latest, and the cormorant did not reappear as a breeding species in Sweden until the late 1940s.

Present distribution

The current distribution of Great cormorants in Sweden, as presented below, covers the period from the 1940s through 1999. Some data are also given for 2000. If not otherwise stated, population size data are from 1999. The number of breeding pairs for the different regions are presented in Table 1 and colony sizes in Table 2. Table 3 shows the number of disturbed and deserted colonies per province. Legal disturbance of colonies usually means egg pricking while illegal disturbance smashing of eggs, nest destruction and killing of young. The size distribution of deserted colonies is presented in Table 4 and the number of shot cormorants reported to the County Administration Boards is shown in Table 5.

Status in different provinces

Bohuslän and Halland

Along the Swedish West Coast cormorants commenced breeding in 1995. Three small colonies are currently known to exist: Flatskär (Askims fjord, Bohuslän, 70 pairs), Soteskär (Bohuslän, 7 pairs) and Vendelsöarna (Halland, 58 pairs). Unsuccessful breeding attempts are known also from three other places during 1990s. Fishery related conflicts is a growing problem along the West Coast, mainly due to increasing concentrations of non-breeding birds at summer, and over-wintering birds throughout the

Table 1. Number of breeding pairs (nests) of Great cormorants *Ph. carbo sinensis* per year and province, separated on lakes and coast, in Sweden 1948–1999. The far right column (%–99) shows proportion of pairs within each area. *Populationsutveckling, antal par (bon), för mellanskarv i Sverige 1948–1999. Kolumnen längst till höger visar andelen par per område.*

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	%-99
Lakes *sjöar*																
Halland*										6	1	1	?	?	0	0,0
Skåne**							107	483	842	1098	1007	1009	1305	1186	1312	5,1
Småland***										10	5	15	45	88	98	0,4
Östergötland****								16	150	211	334	532	668	953	1099	4,3
Västergötland			1	3	4	6	6	9	14	27	100	125	90	126	206	0,8
Lake Vättern										10	12	38	53	180	325	1,3
Lake Vänern					10	22	48	122	206	272	409	579	797	958	1094	4,3
Lake Hjälmaren												23	118	163	388	1,5
Lake Mälaren										4	32	60	79	185	379	1,5
Total inland (lakes)			1	3	14	28	161	630	1212	1638	1900	2382	3155	3839	4901	19,2
Change on %				200	367	100	475	291	92	35	16	25	32	22	28	
Coast *kust*																
Bohuslän											26	30	?	4	77	0,3
Halland												3	?	40	58	0,2
Skåne							3	143	680	1028	1234	682	479	663	793	3,1
Blekinge	1		7	69	183	350	543	700	650	1280	1761	1727	1233	1584	1389	5,4
Öland					10	62	?	14	12	199	519	522	?	?	12	< 0.1
Småland	1785	1861	2452	3098	3927	3878	4577	6654	6468	6841	5964	7443	5846	7027	8403	32,9
Östergötland				280	446	950	1064	1128	1905	2746	2573	2165	1818	1621	1852	7,2
Gotland								85	390	1005	1035	1221	1776	2587	2943	11,5
Södermanland					50	174	263	125	425	664	362	1615	2175	2389	3016	11,8
Uppland									30	100	290	332	573	1092	1422	5,6
Gästrikland	Småland													70	0	0,0
Hälsingland	1948	1955	1960	1965	1970	1975	1980		17	32	0	0	12	5	0	0,0
Medelpad	probable breeding	75	?	125	175	337	753						22	38	87	0,3
Ångermanland										3	2	137	300	451	615	2,4
Västerbotten															9	< 0.1
Total coast	1785	1861	2469	3447	4616	5414	6450	8849	10577	13898	13766	15877	14234	17571	20676	80,8
Change on %		4	33	40	34	17	19	37	20	31	-1	15	-10	23	18	
Total coast + lakes	1785	1861	2470	3450	4630	5442	6611	9479	11789	15536	15640	18226	17389	21367	25577	100
Total change in %		4	33	40	34	18	21	43	24	32	1	17	-5	23	20	

*Ottersjön; **Ellestadsjön, Vombsjön, Ringsjön, Rössjön och Ivösjön (+4 lakes with occasional breeding); ***Salen, Läen, Vidösten, Bolmen, Kösen, Möckeln och Virstadsjön;

winter, which are blamed for consuming large amounts of fish. The colonies of Flatskär and Vendelsöarna have been subjected to human persecution. (Data from: Tommy Järås, Jan Uddén, and Anders Hultfelt).

Skåne

The cormorant re-established in Skåne in 1991. Colonies were founded both along the coast and in freshwater. In 1999, coastal colonies were situated at Eskilstorps holmar (543 pairs) and Gråen (250 pairs), both in Öresund Strait. Six freshwater colonies exist, of which the largest are located at Lake Ellestadsjön (708 pairs), Lake Ivösjön (410 pairs in 2000) and Lake Ringsjön (173 pairs). All major colonies (except for Ringsjön) appear to have stabilised in size. Conflicts with the commercial fishery are pronounced in several of the lakes. Still, human disturbance has been low at the majority of the breeding sites. (Data from: Gunnar Andersson, Patric Carlsson, Hans Cronert, Greger Flyckt, Pauli Kananen, and Nils Kjellén).

Blekinge

By far, the largest colony in Blekinge is located at Fröstensskärv (Ronneby) and contained 1613 pairs in 2000. The colony established in 1987 and its peak size was reached in 1995. The island of Fröstensskärv is leased from the private landowner by the Swedish Ornithological Society to secure undisturbed breeding conditions for the cormorants. Small colonies are found also at Eneskärvet, Karlshamn (17 pairs) and Annaskär, Torhamn (20 pairs). Illegal disturbance has occurred at several of the colonies in Blekinge. In an attempt to hinder settlement of new colonies at some islands, potential nesting trees and shrubs have been cut down and sheep allowed to graze. It seems as if these actions have been successful in terms of reducing or hinder breeding at these islands. For unknown reasons the eastern part of

Table 2. Number of commorant colonies, per colony-size category and province/lake in Sweden in 1999. *Antal skarvkolonier per kolonistorlekskategori i Sverige 1999.*

	1–10	11–100	101–500	501–1000	>1001	Total
Lakes *sjöar*						
Skåne	1	2	3	1		7
Småland	3	2				5
Östergötland	2	5	5			12
Västergötland	2	1	1			4
Södermanland	1			1		
Lake Vättern	1	3	1			5
Lake Vänern	2	11	1	1		15
Lake Hjälmaren	2	6	1			9
Lake Mälaren	6	8	1			15
Total	20	38	13	2		73
%	27	52	18	3		100
Coast *kust*						
Bohuslän	1	1				2
Halland		1			1	
Skåne			1	1		2
Blekinge	2				1	3
Småland	2	3	3	3	3	14
Öland		2			2	
Östergötland	2	8	5			15
Gotland				1	1	2
Södermanland	1	7	9			17
Uppland	1	4	5			10
Medelpad	1	1				2
Ångermanland	2	1	2			5
Västerbotten	1			1		
Total coast	11	30	25	5	5	76
%	14	39	33	7	7	100
Total inland+coast	31	68	38	7	5	149
%	21	46	26	5	3	100

A further 5 colonies probably exist of which breeding pairs are unkown (Gotland: 2, Öland: 1, Södermanland:1, L. Mälaren: 1).

Blekinge is only sparsely populated by cormorants, and the population appears to be well below carrying capacity. Overall, conflicts with the fishery appear to be small in the area. (Data from: Lars Carlsson and Lars Möllersten).

Småland

The cormorant re-established as a breeding species at the island of Svartö in Southern Kalmarsund in the late 1940s, after having been absent for more than 40 years. The exact year of establishment is unknown but breeding is indicated from 1948 when a flock of cormorants was observed by Bengt Berg near a heronry at Svartö (Berglund 1956). From 1951, ca 30 pairs are known to have bred at Svartö (Berglund 1958).

Currently, in terms of number of breeding pairs, the coastal area of Småland is the most important breeding area for cormorants in Sweden. In 1999, three colonies exceeded 1900 pairs and the total number of pairs attempting to breed comprised 8400 (34% of the total Swedish population). In 1999, a total of 14 colonies were found on the coast and five in freshwater. The freshwater colonies are all very small and included altogether 98 pairs.

Human disturbance is common at many colonies in Småland and has conveyed rapid changes in size of some colonies. Moreover, disturbances have also contributed to the extinction of colonies, and the dispersal of individuals over the area. For example, during the last fifteen years, no less than 17 colonies have been subjected to human disturbance, of which 10 illegally. Ten colonies have vanished due to illegal persecution while 13 (mainly small) colonies are thought to have been deserted, seemingly without any clear human disturbance. The most well known colony destroyed illegally by humans is the colony at the island of Gåsö in northern Kalmar Sound. The whole colony, consisting of ca 3000 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 population size may partly be explained by the fact that two colonies with large numbers of cormorants have developed at islands (Norra Sandholmen-Svartö-Törnholmen and Svartingskär) where colonies have been undisturbed. Currently, management actions such as egg pricking are allowed at all colonies except for the protected sites at Kungsholmen, Norra Sandholmen-Svartö-Törnholmen and Svartingskär. During the period 1994–2000, a mean of 2065 cormorants were reported shot every year. (Data from: Roger Alman, Kjell Johansson, Sven Johansson, Tommy Larsson, Bo Lewander, Lars Lindell, Krister Wahlström and Åke Widgren).

Öland

The first documented breeding at Öland occurred in 1989. Until 1999, colonies are known from at least four sites. The largest colony developed at the small island of Marskär (Löt) and reached 510 pairs in 1996. However, at around 1996, the nesting trees at Marskär were cut down by the landowner, and since then only a few pairs have bred at the island. An accurate figure for the current population on Öland

Table 3. Great Cormorant colonies (includ. 13 solitary pairs) of Sweden 1985–1999. The table shows number of disturbed (legally/illegally) and deserted colonies per province/lake.
Kolonier av mellanskarv i Sverige (inkl. 13 solitärhäckningar) åren 1985–1999. Tabellen visar antalet störda (legalt/illegalt) och övergivna kolonier (pga mänskl. störning/utan synbar mänsklig störning) för respektive landskap/sjö.

Province/lake *Landskap/sjö*	Known colonies 1985–99 *Kända häckningar 1985–99*	Colonies in 1999 *Kolonier 1999*	Legally disturbed *Legalt störda*	Illegally disturbed *Illegalt störda*	Deserted due to human disturbance *Övergivna pga mänsklig störning*	Deserted seemingly without any human dist. *Spontant övergivna*	Data lacking *Närmare uppgift saknas*
Lakes/*sjöar*							
Skåne	12	7		2		4	1
Småland	8	5		1		2	1
Östergötland	14	12	1	4	2		
Västergötland	6	4		1		1	1
Södermanland	1	1					
Lake Vättern	5	5					
Lake Vänern	16	15	1	1		1	
Lake Hjälmaren	11	9	3	2	1	1	
Lake Mälaren	19	16	1		1		2
Coast/*kust*							
Bohuslän	3	2		1		1	
Halland	3	1		1		2	
Skåne	4	2				2	
Blekinge	5	3	1	3	1	1	
Småland	34	14	7	10	9	11	
Öland	4	3	1			1	
Östergötland	23	15	5	12	8		
Gotland	6	4				1	1
Södermanland	19	18	1		1		
Uppland	11	10		3		1	
Gästrikland	1	0		1	1		
Hälsingland	4	0				4	
Medelpad	2	2					
Ångermanland	7	5				2	
Västerbotten	1	1					
Total lakes	92	74	6	11	4	9	5
Total coast	127	80	15	31	20	26	1
Total lakes+coast	219	154	21	42	24	35	6

is not available but amounts probably to no more than some ten pairs. The low population density at Öland is a bit surprising considering the large areas of shallow water suitable for feeding on the eastern side of the island. One explanation for the small number may be the lack of suitable breeding islands. (Data from: Lars Lindell).

Östergötland

In Östergötland cormorants commenced breeding in 1988 at Hanskären (in the outer mouth of Bråviken). In the 1990s, colonies became established at a great number of places and the number of pairs attempting to breed increased rapidly. Along the coast, peak numbers were reached in 1994 (2746 pairs). With an almost exponential population increase of 49% per year for the period 1990–1994 the population then decreased (-7% per year) in the period 1995–1999. In 1999, the coastal population consisted of 1852 pairs distributed over 15 colonies. Freshwater colonies have continued to increase and reached 1099 pairs in 1999. Only one colony has exceeded 500 pairs (Lilla Järknö with 642 pairs in 2000), but within Lake Roxen, six colonies fairly close to each other contained 894 pairs in 1999 (521 pairs in 2000). The first freshwater colonies were founded in 1992 and presently colonies are known within four lakes: Lake Roxen, Lake Glan, Lake Sommen and Lake Tåkern. The colony at Lake Tåkern, 10 pairs in 1999, was first established in a quagmire but was abandoned at an early stage.

Table 4. Size distribution of cormorant colonies in Sweden 1985–1999 that have been deserted either by human disturbance or spontaniously.
Storleksfördelning hos skarvkolonier som övergivits spontant eller pga mänsklig störning 1985–1999.

No. of pairs *Antal par*	With disturbance *Med störning*		Without disturbance *Utan störning*	
	N	%	N	%
1–9	4	17	27	77
10–99	10	43	5	14
100–499	7	30	2	6
500–	2	9	1	3
Total	23	100	25	100

Conflicts with the fishery are pronounced, both in freshwater and along the coast. On the coast, more colonies have been subjected to human disturbance than elsewhere else in Sweden. For example, in 1994 (peak year) 55% of all breedings (1635 pairs) were destroyed, mainly by egg pricking, either legally or illegally. For the period 1994–1999, an average of 707 (24%) of all commenced breedings were destroyed. Reported shooting includes a mean of 254 (max. 551) cormorants shot per year (1992–1999). Recently, control measures have involved also freshwater colonies, and in 1999 and 2000, 2 000 eggs were pecked each year in Lake Roxen while shooting numbered 141 and 300 birds, respectively. In total, along the coast, illegal disturbances have occurred in at least 12 colonies resulting in the disappearance of 8 colonies. Legal disturbances have involved five colonies. In terms of breeding pairs, the southern part of the coastal area most likely contains a population below carrying capacity due to systematic human disturbance. This disturbance may possibly have contributed to the strong increase observed in southern Södermanland in recent years, where disturbance has been low. (Data from: Göran Andersson, Göran Hector, Lars Hedenström, Lars Gezelius, Viking Olsson and Lars Svensson).

Västergötland

The first colony founded inland (after the disappearance of the cormorant in the early 20th century) probably took place in Lake Ymsen in 1987. This colony contained ca 135 pairs in 2000. Currently, Lake Vänern is the stronghold for the species in Västergötland (see below). Recently, breeding attempts with small colonies are known also from Lake Hornborgarsjön (76 nests), Lake Fävren (possible breeding), Lake Torpasjön and Lake Åsunden. Probably no chicks were produced in any of these colonies in 1999. (Data from: Kjell Andersson, Nils Eriksson, Gerard Gautier, Henri Engström and Peter Fäldt).

Gotland

In 1992, cormorants re-established at the island of Lilla Karlsö with nests placed among breeding guillemots on cliff shelves. A second colony with nests placed in trees was founded in1995 at Laus Holmar at southeastern Gotland. Small ground breeding col-

Table 5. Number of shot cormorants reported to County Administration Boards in Sweden 1992–2000. Hunting also occurred at Lake Glan but figures not available.
Antal skjutna skarvar rapporterade till länsstyrelserna 1992–2000. Jakt förekom även vid Glan, men siffror ej tillgängliga.

Year	Coast Bohuslän	Coast Blekinge	Coast Småland Öland	Coast Öster-götland	Coast Uppland	L. Krage-holmssj., Ellestadsj.	Lake Ivösjön	Lake Roxen	Lake Hjälm-aren	Lake Mälaren	Totalt
1992			?	132							132
1993			?	229							229
1994			788	107							895
		95–99:					95–99:				
1995		<10/year	1740	157			200 (tot.)				1897
1996			2915	176		132		2			3225
1997			2296	no permit				few			2296
1998	153		2739	439				few			3178
1999	100		1548	541	111			141	554		2895
2000	82		2430	478	112			300	511	33	3864

onies also existed (1998) at Northern Gotland: Avagrunn (7 pairs) and Askugrunn (60 pairs). 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. The Lilla Karlsö colony contained 2268 pairs in 2000 and that at Laus Holmar 1120 pairs in 2000. Both colonies are situated within protected bird areas. (Data from: Stellan Hedgren, Björn Hjernqvist and Kjell Larsson).

Södermanland

In recent years coastal populations in Södermanland have increased considerably in size and during the period 1995–1999 the number of breeding pairs increased by 74% annually. The total number along the coast included 3016 pairs distributed over 18 colonies in 1999. Conflicts with the fishery appear to be low in the area. Disturbance (legal) is known only from one colony. Most colonies are of medium size and no colony exceeded 500 pairs in 1999. Inland colonies exist at Lake Mälaren (see below) and Lake Näsnaren, Katrineholm (15 pairs in 2000). (Data from: Åke Andersson, Henri Engström, Björn Lundberg, Agne Swenzén and Bengt Söderlund).

Uppland

In the province of Uppland cormorants breed only at scattered localities. Cormorants established for the first time in the area in 1993 and the area is not saturated. Current colonies are concentrated in two main areas. In the south: Svartlögafjärden – Gälnan – Furusundsleden (five colonies) and in the north, Lövsta and Gävle Bays (three colonies). In between these two areas at least two small colonies exist east of Hargshamn (Galtfjärden) but parts of the area are not very well censused. The coastal colonies have increased with an average of 77% per year during the period 1995–1999. The three most northern colonies in Lövsta Bay and Gävle Bay were all subjected to severe human persecution in 1999, and production of young was probably close to zero at these colonies. In the northern area conflicts with the fishery is currently intense and fishermen blame both cormorants and seals to cause damage to the fishery. About 1400 pairs initiated breeding in Uppland in 1999. (Data from: Martin Amcoff, Henri Engström, Lars Gustavsson and Roland Staav).

Gästrikland

One colony initiated breeding on the island of Klubbstenarna in 1998 (70 pairs) but failed to produce any young. This failure was most likely due to human persecution. No breeding attempts are known from the area in 1999. (Data from: Per Aspenberg).

Hälsingland

Occasional breeding is known at four islets (Fisket, Storhällen, Korvgrund, Remmarharet) during the period 1993–1998. For unknown reasons, the cormorants have failed to establish permanent colonies within the area. The colonies were all very small and never reach more than a few pairs each. (Data from: Mats Axbrink).

Medelpad

The first documented breeding occurred in 1993. Currently two colonies exist at Rödskäret (Tynderöd parish, 82 pairs) and Skallandsskäret (an islet near Rödskäret, 5 pairs). (Data from: Lars Olausson).

Ångermanland

Breeding is known from at least seven sites during the period 1994–1999. The two largest colonies at Gnäggen (282 pairs) and Långskärsklubb (301 pairs) are found on rocky islets surrounded by fairly deep water. (Data from: Kurt Holmqvist).

Västerbotten

One colony consisting of nine pairs established on a rocky islet (Römselögrundet) in 1999. No breeding occurred at this site in 2000. This colony probably was the most northern breeding site ever for *Ph. c. sinensis* in Sweden. (Data from: Urban Grenmyr). However, in 2000, a colony holding 31 pairs was established in Finland in the far north of the Bothnian Bay. Most likely these cormorants belong to the *sinensis* subspecies (Timo Asanti, Finnish Environmental Institute, pers. comm.).

Status in major lakes

Lake Vänern

Lake Vänern is the largest lake in Sweden (570,000 ha). In 1989, cormorants established for the first time at the small islet of Ruskskär near Lurön. Currently (2000), 17 fairly evenly distributed colonies containing 1140 pairs are found over the lake except in the north-eastern part (i.e. Dalbosjön). All colonies but one are small and consist of less than

150 pairs. The largest colony is situated on western Kållandsö (620 pairs) and is the largest genuine freshwater colony in Sweden. The population increase of Lake Vänern has declined from a yearly average of 99% in 1990–1994 to 33% in 1995–1999. Conflicts with the fishery are intense in many parts of the lake, particularly in the south-eastern part. Bite-marks on fish inflicted by the cormorants in fyke and gill nets are common problems. However, reports of human disturbance at colonies are few. In an attempt to locally reduce cormorant breeding output, and thus damage to the fishery, local authorities in collaboration with fishermen and ornithologists treated eggs with paraffin oil at the colony of Dagskär, Kinneviken, in 1999 (Landgren 2000). The effort, which also included a follow-up of other bird species and neighbouring cormorant colonies, will be evaluated first within a few years time. (Data from: Thomas Landgren).

Vättern

Cormorants started breeding in Lake Vättern in 1994 at the rocky islet Jungfrun. The colony decreased from 25 pairs in 1999 to one pair in 2000. Currently, the largest colony is located at the island of Erkerna in the outer Motala Bay and nests are placed in mature forest. The colony held 220 pairs in 2000. In 1999, a total of five colonies were found in Lake Vättern of which three colonies were situated in the Motala Bay area and two colonies in the very northern part of the lake. Conflicts with the fishery appear to be low in the area and there are no reports of any human disturbance within any of the colonies. (Data from: Lars Gezelius and Ola Strand).

Hjälmaren

Cormorants settled in Lake Hjälmaren in 1996. The population increase was rapid, and in 1999 the population consisted of 388 pairs distributed over nine colonies. All colonies except one (Pjukstenarna, 172 pairs, 2000) contained less than one hundred pairs. At the moment, conflicts with the fishery are intense and damage to fish in fishing gears is the largest problem. Five colonies have been subjected to human persecution of which two illegally. In autumn 1999, fishermen and hunters, with permission from local authorities, organised common 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, and altogether 554 cormorants were shot. This large-scale hunting procedure was repeated in 2000, this time involving more than 100 hunters at each time during three occasions. With the same hunting pressure 242, cormorants were shot on 21 August, 80 cormorants on 28 August and 61 on 1 September. In total 750 birds were allowed to be shot in 2000. The hunters noted that the cormorants behaved differently at the three hunting occasions, e.g. some cormorants were very shy whilst others were not, indicating birds of different origin. This hypothesis of different origin was confirmed also by ringing recoveries. (Data from: Ola Strand, Bo Andersson).

Mälaren

Cormorants commenced breeding in Lake Mälaren in 1994 and the population reached 379 pairs in 1999. The colonies show many similarities with those of Lake Hjälmaren. For example, cormorants nest only in trees and the colonies are distributed over many (16) and small colonies. The largest colony is situated at the island of Grönsö and contained 110 pairs in 1999. Human disturbance has not been documented in any of the colonies. However, the nesting-trees were cut down on the small island of Bogstenen (Galten) where three pairs bred in 1998. The cormorants did not return to the site in 1999. Legally organised hunting (cf. Lake Hjälmaren) was carried out in late August to early October 2000 at six occasions, and a total of 33 birds were shot (300 birds were allowed to be shot) (data from: Gillis Aronsson, Thomas Pettersson, Roland Staav and Pekka Westin).

Discussion

Historic populations

Archaeological data indicate that the Great Cormorant has a long history in Sweden and inhabited the Baltic region since the last ice-age. Although the precise geographical distribution and the numerical abundance of these cormorants cannot be determined, it is highly probable that the populations seen today are larger and cover a wider area than at any time before. When the former breeding subspecies *Ph. c. carbo* became extinct and replaced by present day *Ph. c. sinensis* is unknown, but the youngest remains of *Ph. c. carbo* found at archaeological excavations are from ca 800 – 975 AD (nestlings) and for adults ca 1300±50 AD (Ericson & Hernandez Carrasquilla 1997). It seems therefore to me that breeding populations of *carbo* must have become

extinct at the earliest around 1000 AD, and no later than ca late 1600 AD. The cormorants observed (and also shot) by Rudbeck in the late 17th century most likely were *Ph. c. carbo*, coming from the coast of Barents Sea or the White Sea where this subspecies breeds. The occurrence of breeding *Ph. c. sinensis*, for the first time in the early 19th century, indicates a minimum time period of at least 100–200 years when most likely no cormorants bred in Sweden.

In the early 19th century *Ph. carbo sinensis* became established probably for the first time in Sweden. Cormorants established also in Denmark around this time (Jespersen 1949 in Berglund 1958). In the 19th century the population of *Ph. c. sinensis* of southeastern Sweden appears to have been small. Did the low population size depend on natural limitations or was the population kept low by hunting and/or human persecution? That question cannot safely be answered, but according to e.g. Nilsson (1858) and Neander (1918) (some) people hosted a very negative attitude towards the birds, and actions against the cormorants appear to have been frequent and organised. For example, the colony at Lake Krageholm disappeared in the early 1880s due to human persecution (Neander 1918). Probably, the population was prevented from expanding due to repeated hunting and human persecution. At a European level, most of the few existing colonies during the 19th and early 20th century in the Netherlands and Denmark were subjected to human persecution (Zijlstra & van Eerden 1989; Gregersen 1989). Although the existing information being fragmentary, human persecution presumably was an important factor in determining cormorant number and distribution, and probably also was the main factor responsible for the disappearance of the cormorant as a breeding species in Sweden sometime in the late 19th or early 20th century.

Recent population development

The recent history of the cormorant in Sweden begins at Svartö in southern Kalmar Sound where cormorants became established in the late 1940s (Berglund 1956, 1958). How the colony was founded has been debated, and it has been proposed that the colony resulted from an introduction of cormorant eggs taken from Denmark and placed in heron nests at Svartö. However, since no evidence seems to exist for this theory, other than oral reports, it is more realistic to think that the cormorants established spontaneously at Svartö. The latter explanation is supported by a correspondence in time with the founding of Svartö (and Danish cormorant colonies) and large numbers of cormorants driven away from a colony at Rügen in Germany during the 1940s (Jonsson 1977).

The cormorant colony of Svartö remained small for a long time. The slow increase of the colony may partly be explained by hunting, and every year about a third of the cormorants at the colony were shot (Edling Olsson pers. comm.). The hunting came to an end in 1965, when the manor got a new tenant who was less hostile towards the cormorants (Edling Olsson pers. comm.). Interestingly, also after hunting at Svartö had ceased, the rate of population increase continued to be low for more than a decade, and obviously other factors than hunting must have been responsible for the slow increase of the colony. Also the colony at Gåsö in Northern Kalmar Sound, establish in the early 1960s, remained small for more than two decades before it went through a rapid population development. Until 1986, Svartö and Gåsö were the only cormorant colonies in Sweden. A dramatic change in the population development occurred at around the mid 1980s when the population suddenly increased dramatically in size. For example, between 1986 and 1987, the population rose by 33% and new colonies were founded in Blekinge, Västergötland, the year after also in Östergötland, and at several sites in Småland (Tables 1 and 2). The population increase continued to be high until 1994 (mean annual increase 31%), but then the population in the core areas started to fluctuate about an even level. The observed increase in the total population size occurring after 1994 can to a large extent be ascribed to an increase in several of the inland lakes, at two sites at southern Gotland and the establishment of colonies along the coast from Södermanland and northwards. During the period of exponential increase (i.e. 1986 to 1994) the number of pairs increased from 1861 to 15,536 pairs (Table 1). During the same time period, the number of colonies increased from two to forty-six. Little is known about the mechanisms behind colony formation. However, in general, it is obvious that new colonies formed long before "core" colonies were saturated, and sometimes at a long distance from the colony of origin. At about 1994, cormorants had reached most of its present range.

Present population

The current (1999) number of great cormorants breeding in Sweden comprises 25,200–26,000 pairs distributed over ca 154 colonies. This means that

Sweden currently holds about 25% of the total northwestern European population of *Ph. c. sinensis*. Except for Sweden, the main countries of northwestern Europe holding large cormorant populations include Denmark (42,000 pairs), the Netherlands (20,000 pairs) and Germany (15,000 pairs) (in 2000). Countries holding smaller, but increasing populations, include Poland (ca 14,000 pairs), the Baltic States (ca 7,400 pairs) and Finland (336 pairs) (in 2000). During the 1990s the population size within the core areas of the Netherlands, Denmark, Germany and southern Sweden seem to have reached an upper limit, and now fluctuate in numbers.

The present distribution of the breeding population of the Great Cormorant in Sweden is more or less contiguous along the whole south Swedish Baltic Sea coast from Blekinge in the south to northern Södermanland in the north. From Uppland and northwards there are large gaps in the distribution and most colonies are small. The reason for the low abundance along the Bothnian Gulf coast (<3% of the total Swedish population) may be linked to unfavourable foraging conditions and climate. In the early 1990s, cormorants attempted breeding on at least fifteen sites along the Bothnian Gulf, but only two colonies grew to considerable size (ca 300 pairs each), whereas seven colonies disappeared after only some years of presence.

For unknown reason the Swedish west Coast has not been inhabited by other than some few and small colonies. This is a bit surprising since large number of cormorants use the area for feeding during the winter (Bengtsson 1999). The absence is probably not related to marine salinity because *Ph. c. sinensis* obviously breed successfully in the marine environment in Denmark.

Cormorants settled inland, probably for the first time in 1987. During the 1990s growth and dispersal of inland populations have been rapid. For example, in 1995, 12% of the total population bred in lakes versus 19% in 1999. The cormorants seem to prefer the larger lakes, and currently, 45% of the inland colonies are located in the four large lakes of Sweden: Vättern, Vänern, Hjälmaren and Mälaren. Other important breeding areas include lakes at Skåne (27%) and Östergötland (22%). No inland colony is known to exist north of latitude 60°N, probably partly because of the long period of ice-cover which makes it difficult for the birds to accomplish the long breeding cycle. Colony size differs much between areas. The largerst colonies (1 500–3 000 pairs) are found in Blekinge (1), Kalmar Sound (3) and on Gotland (1). The largest colony in Europe, located at Katy Rybackie Gulf of Gdansk, contained ca 8000 pairs in 2000. The main factor determining colony sizes is probably related to the productivity and amount of food available to the cormorants near the colonies (van Eerden & Gregersen 1995). Human disturbance may also affect colony size.

The total number of Great Cormorant colonies known to have existed during the last fifteen years amounts to 215. At least thirty-five of these colonies are thought to have been deserted seemingly without any clear human disturbance. Most (77%) of the colony sites that have been abandoned spontaneously had less than ten breeding pairs (Table 4), and usually cormorants bred at the site only for a few years, at most five years.

Factors behind the population development

Several factors are though to have contributed to the recovery and strong increase of *Ph. c. sinensis* during the last decades. For example, recent studies indicate an exceptional high survival of immature and adult birds during the period of strong increase (i.e. 1970–1990), and in Denmark it was shown that first year survival was much higher (0.42–0.75) than for the fairly stable population of *Ph. c. carbo* breeding along the Norwegian coast (0.19–0.38) (Frederiksen & Bregnballe 2000).

The success of the Great Cormorant in Europe shows many similarities with the closely related and equally successful Double-crested Cormorant *Phalacrocorax auritus* of North America (Hatch 1995). Protection is thought to have played a central role, and the European population of *sinensis* began to increase after the species had been protected in the Netherlands in 1965. In Denmark the cormorant was given partial protection in 1971 and full protection in 1977. In 1980, the Great Cormorant was given full protection in all the member states of the European Union according to the EU Birds Directive. In Sweden, before the EU association in 1995, there was an open hunting season from 21 August to 28 February. This hunting, however, probably had little effect on the population since a majority of the cormorants had left Sweden for their winter quarters at that time.

During the last century many aquatic systems have been strongly influenced by human activities, such as nutrient leakage from agriculture, emission of acidic substances from industry and traffic, fish farming, canalisation to avoid floods, and dams to produce electricity etc, and hence contributed to e.g. eutrophication, pollution and acidification. However, some of these influences have undoubtedly been

favourable to the cormorants. For example, eutrophication may have lead to changes in composition of fish communities and increased productivity (Persson et. al 1991). High productivity means more fish available to the cormorants and compositional changes means a trend towards larger populations of e.g. perch *Perca fluviatilis*, ruff *Gymnocephalus cernua*, roach *Rutilus rutilus*, bream *Abramis brama* and other cyprinids which are easy to exploit for the cormorants (De Nie 1995, van Eerden & Voslamber 1995). Cormorants do well also because of fish farming, which has increased considerably in Europe and North America (Glahn et. al 2000) in recent decades. In Europe, carp is the principal species, and fishponds are frequently utilised by foraging cormorants which may sometimes cause substantial economic losses to the fishermen (Osieck 1991). Fish at fishponds appear to be particularly vulnerable to cormorant predation during the winter, and cormorants breeding in Sweden presumably benefit by good foraging conditions at fishponds in connection with their migration through Europe. In recent years, increasing concentrations of cormorants have been observed over-wintering in South Swedish waters (Bengtsson 1999). This may be due to saturation in traditional over-wintering areas (Suter 1995a), but possibly also related to improved foraging conditions, and less severe winter climate in northern areas.

The effect of hunting and human disturbance

Probably few other birds in Sweden have in recent years been subjected to more intense persecution than the cormorant. Illegal actions have been frequent and involved destruction of eggs, killing of young and deliberate disturbance at potential breeding sites. For example, during the period 1985–1999, a total of at least 42 colonies (19%) were subjected to occasional or repeated illegal actions (Table 3). Of these colonies, 23 are thought to have vanished due to persecution. In 19 cases illegal actions have involved birds breeding within protected areas. Moreover, the actual amount of illegal actions probably is higher than shown here, since less severe actions probably only rarely are observed. Legal measures to control cormorants have involved shooting of birds at or near standing fishing gears and egg pricking at colonies. Up to now egg pricking is known to be carried out in at least 19 colonies, and reported shooting involved between 895 and 3864 birds per year (1994–2000) (Table 5).

For many years, management actions against cormorants have been most intense in the provinces of Småland and Östergötland. However, with expanding cormorant populations legal and illegal actions have increased, and permits to shoot cormorants in order to protect fishing gears and fish therein, and/or egg pricking are currently issued by 11 of 16 local authorities where cormorants breed. No simple relationship exists between the amount of damage caused by cormorants to the fishery and the measures taken against cormorants (see also Engström 1998).

Modelling the effect of hunting on population size

How would cormorant populations have developed if no hunting or other actions against the cormorants had taken place? Probably the best information currently available comes from population models. These models aim at studying the interaction between hunting and density-dependence in regulating population sizes. Frederiksen et al. (2001) studied the effect of hunting on the whole North-west European cormorant population and modelled different scenarios with varying assumptions about the strength of density dependence in adult survival and proportions breeding. The most well-supported scenario indicates that the effect of hunting at the present level (17,000 cormorants reported shot in 1998/1999) was small (<10% reduction in population size when at equilibrium). In this model the total European population consisted of 500,000 individuals (100,000 pairs). However, when shooting was increased to 65,000 birds per year a critical level was reached and the population started to decrease in size. Converted to the Swedish situation, an estimated 127,000 individuals (25,600 pairs times a correction factor of 4.7–5.2 equals 120,000–133,000 individuals), the critical level (13%) appears at 16,000 – 17,000 birds shot per year. In their model Frederiksen et al. (2001) used values from a stable population, while the actual number needed to be shot to stabilise or to decrease bird numbers in an expanding population (such as in Sweden) would probably be even higher. Data from Sweden indicate that hunting in no year probably have exceeded 4000 shot cormorants (Table 5). Hence, it seems as if the local reductions carried out, in terms of number of shot birds, so far can have had only a marginal effect when the whole Swedish population is taken into account.

Effects on a regional level

What do we know about the effects of hunting and egg pricking on populations on a regional scale? It is obvious that the colonies subjected to human inter-

ference in many cases are severely affected. For example, of five known sites where cormorants nested in trees and the trees were felled, the cormorants did not return, or returned only with some few pairs in the following year(s). However, when cormorants nest on ground and eggs are picked, the cormorants seem to be more reluctant to leave their sites (at least so for old colonies) and cormorants sometimes continue to use the sites for several more years. However, when colonies are subjected to repeated disturbance, year after year, numbers are usually much reduced and sites finally abandoned (e.g. the islands of Bockskär and L. Gjusbådan in Östergötland).

What happens to birds that are forced to leave a former breeding site, for example when nesting trees have been cut? In the case of the colony at Gåsö (exterminated when holding ca 3000 pairs), most birds seem to have switched to other neighbouring colonies. This is supported by the fact that the total number of breeding pairs within a radius of 20 km from Gåsö changed only marginally when counts are compared for the years before and following the destruction. In 1992, 2971 pairs bred at four colonies, in 1993 (the year of destruction), 2855 pairs at seven colonies, and in 1994, 2776 pairs at six colonies.

In recent years, large ground-breeding colonies on the islets of Millgrunden, Mannegrund and Södreskär in Northern Kalmar Sound have repeatedly been destroyed (legally) through egg pricking. In 1999, a colony at the nearby island of Pata Eneskär increased considerably in size from 185 pairs in 1998 to about 2100 pairs in 1999. The most probable cause behind this sudden and strong increase is movements of birds from the disturbed colonies. The above example, and experiences also from other colonies, indicate that disturbance or measures to control cormorants locally by egg pricking in general only have had small effects on population size within regions. In some cases, disturbance may even have contributed to accelerated dispersal of colonies (e.g. the colony Gåsö). In the light of present actions, it seems as if the cormorants, when disturbed, most likely will move to another site, as long as there are some protected and/or undisturbed sites available to them. Only when such safe sites are limiting to the birds (or when cormorants are regulated by other means, e.g. by food availability) the number of birds within a region could be expected to level off or decline. At present, cormorants in Sweden appear, in general, not to be limited by the amount of suitable sites for breeding, and when disturbed cormorants can, more or less freely, move to other sites.

Thus hunting and egg pricking seem to have had only small effects on population size. Moreover, when areas with low disturbance (e.g. the coastal areas of Skåne and Blekinge) are compared with areas with extensive disturbance (e.g. the coastal areas of Småland and Östergötland), populations stabilised at about the same time (1995–1996, Table 1), and most likely other factors than hunting and disturbance are responsible for the stabilisation in population numbers.

Conclusion

The spectacular population development of the Great Cormorant in Sweden during the last fifteen years has now partly come to a halt. However, in Lake Mälaren, Lake Hjälmaren and some coastal areas including the provinces of Södermanland and Uppland, cormorant numbers continue to increase at a high rate. The population, which currently covers most of South Sweden (except for a sparse occurrence on the west Coast), and some scattered colonies along the coast of the Bothnian Gulf, is vigorous and no obvious threat appears to exist at the moment. The actions currently carried out to limit population sizes are small in relation to amount of actions needed, according to a population model, to decrease cormorant numbers. Since problems related to cormorants generally are largest during the summer (i.e. damage to fish in fishing gears), I consider present actions to reduce cormorant numbers to be of limited value. This is because cormorants are very mobile at this time of the year and birds that cause damage to fishery only partly comes from local populations.

Finally, it is important to continue to follow the population development in the different regions, to study the effects of control measures (both legal and illegal) on population sizes, and to develop non-lethal methods to reduce cormorant induced damage to fishery.

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Sammanfattning

Förekomsten av storskarv Phalacrocorax carbo *i Sverige med särskilt tonvikt på den sentida populationsökningen*

Som få andra fågelarter har det svenska beståndet av mellanskarv genomgått en anmärkningsvärd populationstillväxt och spridning under senare år. Populationsutvecklingen har varit så kraftfull att beståndet idag, med stor sannolikhet, är större och täcker ett vidare geografiskt områden än någonsin tidigare i historien. Storskarv av rasen *Phalacrocorax c. carbo*

har funnits i Östersjöområdet sedan minst 9000 år – och förmodligen även häckat här under större delen av den tiden. När exakt storskarven försvann som häckfågel och ersattes av nuvarande mellanskarven *Ph. c. sinensis* går inte att fastställa. Olaus Magnus (1590) antyder att skarven (mellan-) möjligen häckade i landet, men varken Carl von Linné eller Olof Rudbeck d.y. omnämner häckande skarvar. Arkeologiskt material som indikerar häckande storskarv är som yngst från 900-talet. Från omkring början av 1800-talet finns säkra belägg för häckande mellanskarv i Skåne och Blekinge. De små och geografiskt begränsade populationerna i Skåne och Blekinge utsattes regelmässigt för sabotage. Detta motverkade troligen spridning och mot slutet av 1800-talet, eller möjligen något senare, försvann arten som häckfågel i Sverige. Mänsklig förföljelse berörde beståndet kraftigt även i andra delar av Europa och antalet skarvar förblev under lång tid mycket litet. Mot slutet av 1940-talet började skarven ånyo häcka i Sverige på Svartö i Södra Kalmarsund. Uppdykandet på Svartö sammanfaller väl i tiden med borttvingandet av en koloni på ön Rügen i Tyskland samt expanderande skarvbestånd i Danmark. Fram till och med 1965 utsattes Svartöskarvarna för liten men begränsad jakt. Märkligt nog, även långt efter det att jakten upphörde, förblev tillväxten mycket låg – och rimligen måste även andra faktorer än jakt spelat roll för populationsregleringen.

Så småningom, med stärkt naturvårdssyn, gavs skarven ett ökat skydd i delar av Europa och fridlystes i kärnområdena i Nederländerna (1965) och Danmark (1971). År 1979 gavs skarven ett omfattande skydd genom att arten uppfördes på EU:s så kallade Fågeldirektiv. Det västeuropeiska beståndet bestod då av ca 5000 par Vid sidan om skydd antas förbättrade födoförhållande varit avgörande för skarvbeståndets gynnsamma utveckling. Detta har skett bl.a. genom ett ökat antal fiskodlingar, uppdämningar och kanaliseringar och av floder, samt eutrofiering – faktorer vilka bidragit till rikare och för skarvarna mer lättexploaterade fiskbestånd.

I Sverige var beståndsökningen särskilt kraftfull mellan 1986 och 1994 (31% per år) och antalet par ökade från 1800 till 15.500. Efter 1994 har en uppbromsning skett i kärnområden i Skåne, Blekinge, Småland och Östergötland. Kring mitten av 1990-talet nådde skarven i princip sin nuvarande geografiska utbredning. Under andra halvan av 1990-talet har ökningen fortsatt att vara kraftig i glest besatta och perifera områden, d.v.s. kustområden i Södermanland, Uppland och Gotland samt i flera insjöar. År 1999 hade beståndet stigit till ca 25.600 par fördelade på ca 154 kolonier (inkl. fyra solitärhäckningar). De största kolonierna finns i östra Blekinge (Fröstensskärv 1613 par 2000), i Kalmarsund (Svartö/Törnholmen/N Sandholmen 2303 par, Svartingskär 1900 par och Pata Eneskär 2100, samtliga 1999), och på Gotland (Lilla Karlsö 2268 par 2000). Största genuina sötvattenskolonin finns i Vänern (627 par, Kållandsö, 2000).

Efter att Sverige blev medlem i EU 1995 upphörde den allmänna jakten på skarv. Länsstyrelserna kan dock bevilja undantag från det generella jaktförbudet enligt Artikel 9 i Fågeldirektivet. På grund av ökade populationstätheter och de skador skarven anses orsaka på fisket, och skador i vissa fall på naturmiljön, tillåter ett flertal länsstyrelser (11 av 16 med häckande bestånd av skarv) skyddsjakt idag i någon form. Mest omfattande har jakten hittills varit i kustområden i Småland och Östergötland, men i takt med att bestånden ökat har jakt på skarv kommit att beröra allt fler områden. Exempelvis har omfattande jakt bedrivits i Hjälmaren under 1999 och 2000. Utöver legal jakt är skarven utsatt för omfattande illegal förföljelse främst genom sabotage på skarvarnas häckningsplatser. Till exempel, mellan 1985 och 1999 utsattes inte mindre än 17 kolonier i Kalmar län för störning varav 10 illegalt. I Östergötland var motsvarande siffra 22 varav 17 illegalt. Den mest omtalade störningen ägde rum 1993 på Gåsö i Norra Kalmarsund då några upprörda yrkesfiskare sågade ner samtliga boträd med omkring 3000 häckande par. Hur stor påverkan störningar haft på lokala bestånden är svårbedömt då störningarnas omfattning i många fall inte varit möjliga att kvantifiera. Likaså är kunskapen om täthetsreglerande mekanismer på populationsnivå begränsad. Populationsutvecklingen för de olika områdena antyder dock att påverkan varit förhållandevis liten. I flera fall finns tydliga indikationer på att skarvarna vid störning(ar) flyttat till närliggande kolonier och påbörjat häckning där.

Frederiksen et al. (2001) har använt en populationsmodell för att studera effekterna av jakt på populationsnivå och först vid en avskjutning av omkring 13% nåddes en kritisk gräns och beståndet började minska. Omräknat till det svenska beståndet, omfattande en sommarpopulation av ca 120.000–133.000 individer, krävs en årlig avskjutning av minst ca 16.000–17.000 individer för att långsiktigt minska beståndet. Den rapporterade jakten av skarv i Sverige har inget år överstigit 4000 fåglar och effekterna av nuvarande jakt är troligen små. Då problemen med skarvar generellt är störst under sommaren (skador på fisk i redskap) är min bedöm-

ning att åtgärder för att begränsa häckande bestånd (i form av äggprickning och jakt) vanligen är av liten betydelse eftersom de fåglar som orsakar problemen delvis härrör från andra bestånd. Populationsutvecklingen i Sverige under de senaste åren antyder att beståndet som helhet nu är nära mättnad. Omkring en fjärdedel Nordvästeuropas mellanskarvar häckar i Sverige som näst efter Danmark (42.000 par 2000) har flest häckande skarvar i Europa.