

# Breeding distribution and abundance of the great cormorant *Phalacrocorax carbo carbo* in Greenland

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The Greenland population of the great cormorant *Phalacrocorax carbo carbo* numbers 2000–3000 pairs which breed in about 110 colonies distributed along a 1000 km long coastline in central and northern West Greenland. The number of colonies has increased and the breeding range has expanded in recent decades. These trends are believed to be related to a reduced hunting pressure. The number of nests per colony is smaller than in European colonies. The population is of particular conservation concern to Greenland because of its small size and presumed discrete status.

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## Introduction

The subspecies *Phalacrocorax carbo carbo* is the North Atlantic representative of the widespread and polytypic species, great cormorant *P. c. carbo*. The Nearctic breeding range of this subspecies is restricted to Maine, the Gulf of St. Lawrence and Greenland. The Palearctic breeding range is more widespread, extending in the south from northwestern France northwards to Britain and Ireland, Norway, the Kola Peninsula of Russia and western Iceland (Cramp & Simmons 1977; Debout et al. 1995). The taxonomic status of the small population breeding on Sardinia in the Mediterranean remains unclear (J.-C. Thibault, pers. comm. 1996).

The great cormorant is the only cormorant occurring in Greenland, and the population is the northernmost in the world. The breeding colonies are found on steep sea-facing cliffs, occasionally on low islands and along exposed coasts as well as in fiords and inshore waters.

Early in the twentieth century cormorant populations were severely reduced because of persecution (Erskine 1972; Cramp & Simmons 1977); cormorants were considered pests by fishermen, eggs and birds were collected or shot for consumption, and skins were used for the manufacture of ladies' clothing (Salomonsen 1950; Erskine 1972). The Greenland population was so heavily exploited that many breeding colonies were exterminated. Local authors (Bertelsen 1921; Oldenow 1933, 1935) expressed grave concern for the future of the Greenland

population. Since the late 1970s, persecution has in general ceased throughout the Atlantic range and many populations have increased (Debout et al. 1995). Currently, cormorants are mainly breeding along the coasts of central and northern West Greenland between 65°30'N and 74°N. Before and at the turn of the century cormorants bred in southern West Greenland as well, although in small numbers (Salomonsen 1950). According to Helms (1926) only one colony was recorded in the Tasiilaq District in southeast Greenland, and it was abandoned before 1900.

This paper presents results from seabird studies conducted from 1992 to 1996 by the National Environmental Research Institute, Department of Arctic Environment (NERI-AE). These studies were initiated in response to increasing offshore hydrocarbon exploration in the Davis Strait and Baffin Bay. Based on these studies, this paper summarises the present distribution and population size of the Greenland great cormorant, with reference to the other North Atlantic populations.

## Study area

West Greenland (Fig. 1) is one of three administrative regions of Greenland. Ninety-three percent of the human population (total population about 55,000) live in this area. The climate is low arctic except for the high arctic northernmost part. The waters off the outer coast from Sisimiut District and southwards usually do not freeze during winter.

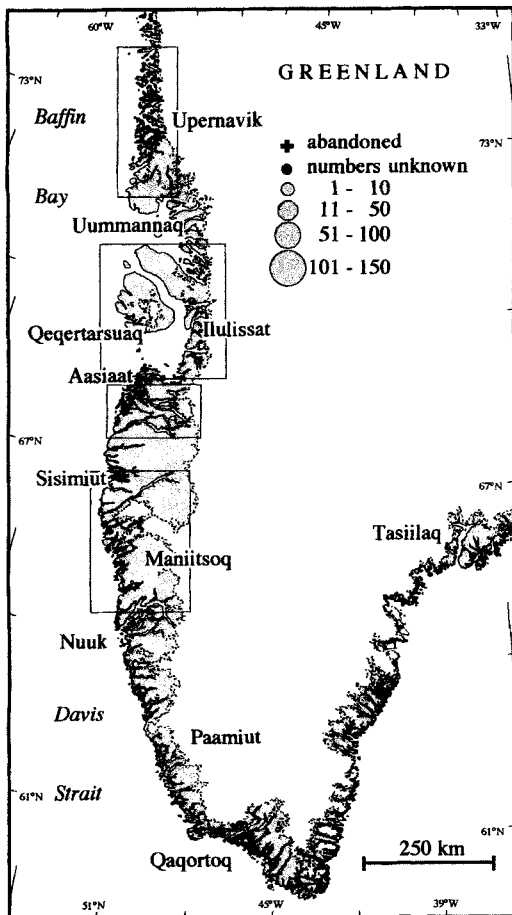


Fig. 1. West and southeast Greenland, with major localities and areas mentioned in text. The framed areas (Upernavik, Qeqertarsuaq, Nassuttooq, and Maniitsoq and Nuuk) are enlarged in Figs. 2–5. The legend applies to Figs. 2–5.

## Methods

NERI-AE maintains a Greenland seabird colony database, which was compiled in collaboration with Ornis Consult Ltd. This database currently contains information on 1232 Greenland seabird colonies and includes historical as well as up-to-date information (Boertmann et al. 1996).

The database includes 288 records of great cormorant colonies: 128 (44%) are from the unpublished field notes (1946–1980) of the Danish ornithologist Finn Salomonsen, 93 records (32%) are from our own (NERI-AE) surveys, 25 (9%) from the data collected during the “Greenland Guillemot Project” in the 1980s

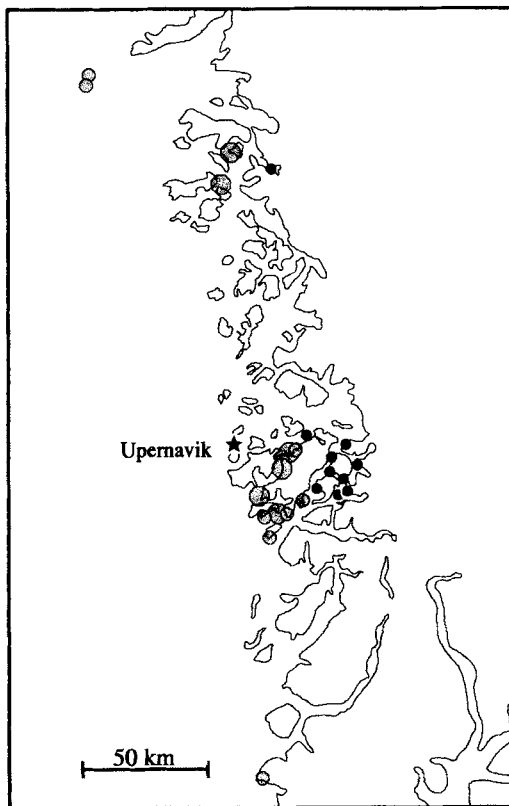


Fig. 2. The distribution and size of great cormorant colonies in the Upernavik area. See Fig. 1 for legend. Colonies not visited since 1975 are indicated with unknown numbers. Major towns are indicated with an asterisk.

(Kampp et al. 1994), 14 (5%) from the surveys of Joensen & Preuss (1972) in Upernavik District during 1965, 13 (5%) from surveys on Disko Island in 1990–1992 carried out by Ole Frimer (unpubl. data) and 15 (5%) were supplied by other observers. Other researchers (a. o. F. Wille pers. comm. 1995) have surveyed the fiords and outer coasts of Nuuk, Paamiut and Qaqortoq Districts without finding breeding cormorants.

The most recent information on great cormorant colonies is based on surveys carried out from a small ship by the authors in the summers of 1992 and 1994. As many as possible of the previously known seabird colonies were investigated and new colonies were searched for. In 1992, the outer coast from Aasiaat to northern Paamiut was surveyed between 22 June and 20 July; in 1994, the coast between Ilulissat and Upernavik was surveyed between 28 June and 20 July (Fig. 1).

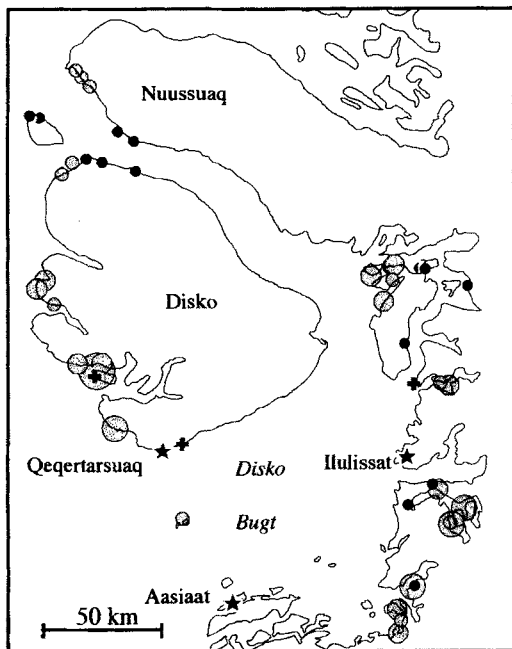


Fig. 3. The distribution and size of great cormorant colonies in the Qeqertarsuaq area (Disko Island, small islands to the north and south of Disko Island and Nuussuaq) and the Disko Bugt area (the eastern coast). See legend on Fig. 1 and caption to Fig. 2.

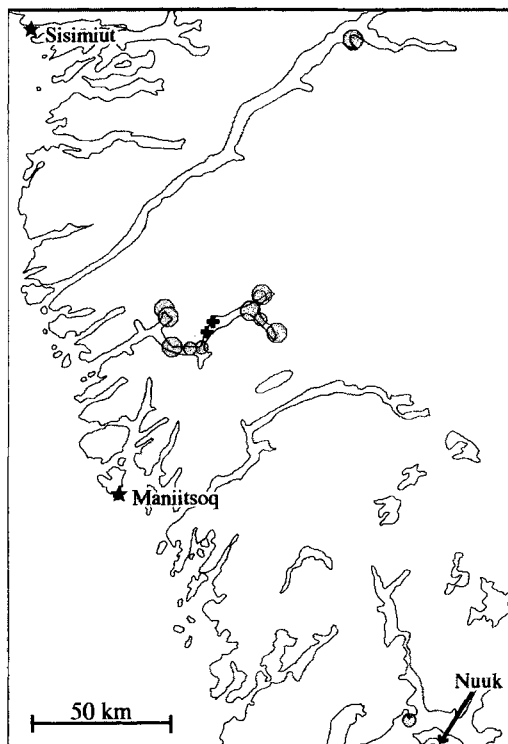


Fig. 5. The distribution and size of great cormorant colonies in the Maniitsoq and Nuuk areas. See legend on Fig. 1 and caption to Fig. 2.

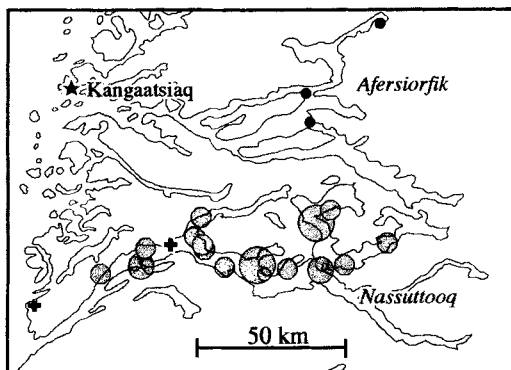


Fig. 4. The distribution and size of great cormorant colonies in the Nassuttooq area. See legend on Fig. 1 and caption to Fig. 2.

The other surveys mentioned above were carried out from mid-June to early August with the majority in July.

Supplementary information on great cormorant colonies was gathered during our aerial surveys for moulting ducks in the coastal waters of West Greenland during late August and early September in 1993, 1994 and 1995. However, it was often

difficult to differentiate colonies from resting sites this late in the season.

In summary, almost all West Greenland coasts have been searched for seabird colonies during the recent two decades. There are, however, a few significant gaps, such as the large Afersiorfik fiord, which has not been surveyed since 1954, and the interior parts of Uummannaq and Upernavik districts.

The colonies in Greenland, even the small ones, are very easy to locate due to the significant white guano staining and the conspicuous nests. A breeding colony is here defined as an association of cormorant pairs breeding on the same topographical feature, such as a cliff or a small island. Breeding numbers are presented as "apparently occupied nests" (aons), which are nests with chicks or attending adults. As great cormorant nests are easy to count, we assume that the historical accounts of the colonies equate apparently occupied nests (aons).

Due to the skewed frequency distribution of aons among the colonies (Fig. 6), the median

Table 1. Summary of great cormorant colonies in West Greenland 1976–1995.

| Area         | No. of colonies surveyed | No. of aons | Other active colonies* | Colonies not surveyed later than 1975 | Additional probable colonies | New colonies recorded since 1986** | Abandoned colonies |
|--------------|--------------------------|-------------|------------------------|---------------------------------------|------------------------------|------------------------------------|--------------------|
| Upernavik    | 16                       | 143         | 7                      | 4                                     | 14                           | 9                                  | 0                  |
| Disko Bay    | 15                       | 399         | 4                      | 3                                     | 13                           | 0                                  | 1***               |
| Qeqertarsuaq | 14                       | 301         | 5                      | 1                                     | 9                            | 4                                  | 2                  |
| Nassuttooq   | 18                       | 672         | 1                      | 4                                     | 3                            | 0                                  | 2                  |
| Maniitsoq    | 11                       | 157         | 0                      | 0                                     | 0                            | 1                                  | 2                  |
| Nuuk         | 1                        | 8           | 0                      | 0                                     | 0                            | 1                                  | 0                  |
| Qaqortoq     | 0                        | 0           | 0                      | 0                                     | 1                            | 0                                  | 0                  |
| Total        | 75                       | 1672        | 17                     | 12                                    | 40                           | 15                                 | 7                  |

\* Nests not counted

\*\* Included in first column

\*\*\* Before 1960

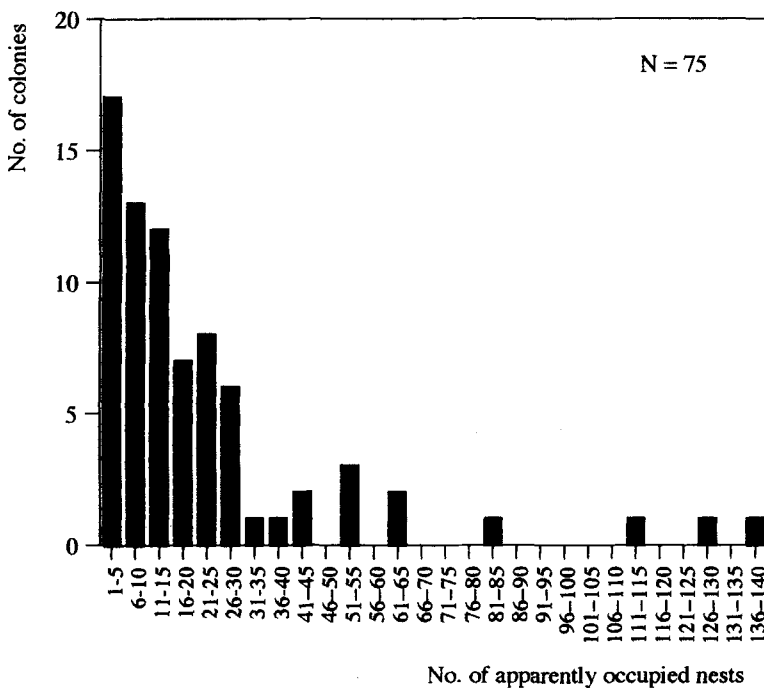


Fig. 6. Frequency distribution of size of Greenland great cormorant colonies. Colonies surveyed 1976–1995. If colonies were surveyed more than once, the most recent figure is given.

number of aons is used for estimating the total number of aons in colonies with unknown numbers.

Differences among median numbers of aons in the cormorant areas were tested using resampling simulation (Simon 1995). The areas were compared in pairs. The simulated difference in medians between two areas was calculated by selecting at random with replacement from the combined number of aons of the two areas. This procedure was repeated 1000 times to obtain the

bootstrapped distribution. The likelihood (P) of the observed difference in medians is calculated from this distribution.

## Results

### *Distribution and abundance*

Presently 110 great cormorant colony sites are known in West Greenland, abandoned colonies included (Table 1). The colonies are distributed

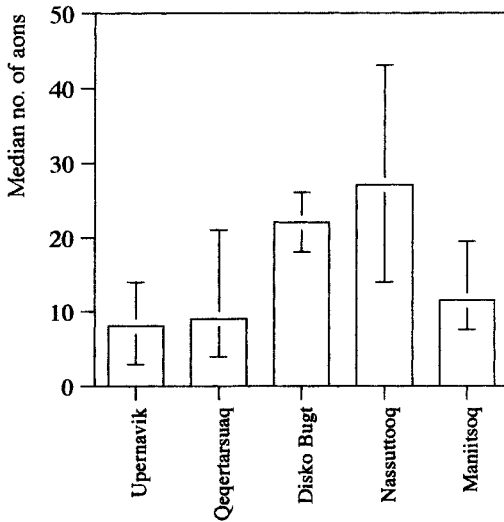


Fig. 7. Median number of nests per colony in the five areas with great cormorant colonies. Based on survey results 1976–1995. Error bars indicate 95% bootstrap (1000 times) confidence intervals (Simon 1995). Statistically significant differences in median number of nests per colony are found only between Upernavik and Nassuttooq (resampling simulation (see Methods section),  $P = 0.009$ ). Aons = apparently occupied nests.

among five areas: Upernavik (Fig. 2), Qeqertarsuaq (Disko Island, adjacent islands and Nuussuaq peninsula) (Fig. 3), Disko Bugt (Fig. 3), Nassuttooq (Fig. 4) and Maniitsoq (Fig. 5). A single colony is located in the Nuuk area (Fig. 5). There are counts from 75 colonies in the period 1976–1995, an additional 17 colonies were recorded as being active, but nests were not counted. Moreover, during aircraft surveys 40 probable breeding colonies have been observed (Table 1).

The great cormorant colonies in Greenland are small (Fig. 6). The 75 colonies surveyed over the past 20 years range from 1 to 138 aons, the average size being 22.4 aons, and the median size 15 aons. The variation in median numbers among the five cormorant areas is presented in Fig. 7.

#### Population trends

Among the new colonies found by the authors in Upernavik District in 1994, six were located on coasts, previously surveyed in 1965 (Joensen & Preuss 1972). Four of these six colonies were found north of the previous range. However, great

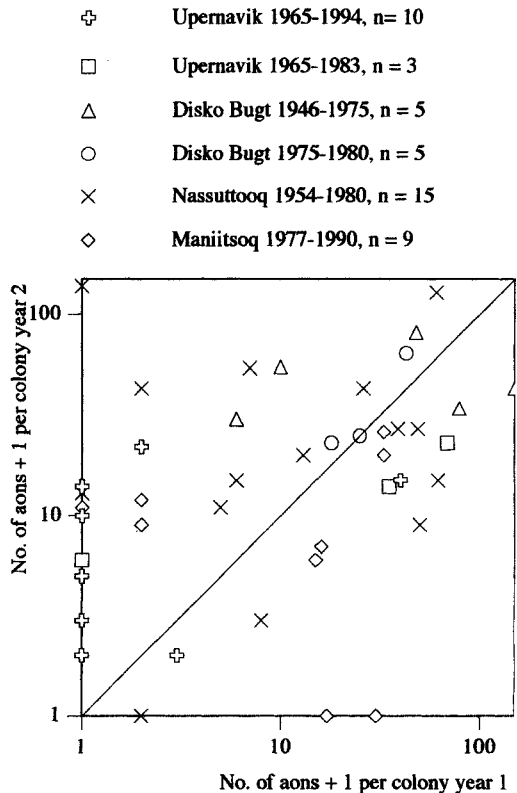


Fig. 8. Log-log plot of sizes of colonies counted twice during surveys in different years (1 has been added to all results to include 0 counts). Colonies in the upper left part had increased and those in the lower right part decreased between counts. Included are areas with three or more colonies surveyed both years. Aons = apparently occupied nests.

cormorants were reported breeding in this part of Upernavik District in the late 1800s (Salomonsen 1950).

New colonies in the northern part of the Qeqertarsuaq population are probably also the result of a northward range expansion. This area apparently lacked colonies before 1989 (Salomonsen 1974a, 1979b; Bennike 1990).

Southward range expansion has also occurred, with a colony in the Nuuk District having been re-established. This colony is situated about 150 km to the south of the nearest colonies in the Maniitsoq area. A few cormorants nested in this colony until 1928 and perhaps also as late as 1936 (Nicholson 1930; Oldenow 1935; Salomonsen 1950). No cormorants were present in 1974, but eight pairs nested in 1986 (Boertmann et al.

1996). Another indication of a southwards range extension is the observation of two adults in company with two newly fledged juveniles in an archipelago in Qaqortoq District in 1992, 600 km south of the Maniitsoq colonies. These birds may have been local breeders, but conclusive evidence was lacking (Kampp & Falk 1994).

Changes in numbers of aons in colonies in areas surveyed twice are shown in Fig. 8, which includes 10 colonies established and 3 abandoned between surveys. Although more colonies in this sample have increased (23) than decreased (20) and the total number of aons increased from 1007 to 1118, this trend is not statistically significant (Wilcoxon matched-pairs signed-rank test,  $P > 0.05$ ).

#### *Population numbers*

The most recent surveys of active colonies (1976–1995) amounts to a total of 1672 aons. Another 17 colonies were recorded active in the period. These colonies may contribute 255 aons if they have the same median number of aons as the sample of surveyed colonies (15 aons). If the colonies not surveyed after 1975 ( $n = 11$ ) are still active, they may contribute a further 165 aons. Moreover, the 40 colonies mainly recorded from aircraft without certain breeding evidence may contribute with a maximum of 600 aons (same median numbers as above), but perhaps much fewer as the general impression was that they were small with less than 10 pairs. This totals 2692 aons, and a conservative estimate of the current population in Greenland would therefore fall in the range of 2000–3000 pairs.

## Discussion

#### *The Greenland population*

The estimate of 2000–3000 pairs in West Greenland is crude, mainly because the data are derived from several surveys in different areas and over a 20-year period. The considerable between-year variation in aons within colonies can be another source of error. This can be exemplified by five colonies counted in 1975 and again in 1976: three colonies increased by 6, 19 and 33%, while two decreased by 17 and 20%. This error may to a some degree be counterbalanced by fact that the

surveys are distributed over 20 years. The timing of the breeding season compared to the survey period may in some years contribute to the source of errors. The majority of the surveys were carried out in July, which is appropriate as chicks usually hatch in July (Salomonsen 1967). However, in early breeding years, such as 1994 when chicks hatched in late May in Ilulissat and Upernavik (author's observation), surveys tend to underestimate the aons because some nests may have failed or have fledged young when colonies were visited. Finally, the population estimate is based on the assumption that all the colonies surveyed during the period 1976–1995 are still active. The oldest colonies recorded in the database have been known for more than 50 years. However, there is a natural turnover in colonies, which is difficult to quantify. This turnover probably will not influence the total number of breeding pairs, but may imply that some colonies were not recorded in the surveys. Such colonies seem to be small, because the seven colonies known to have been abandoned in Greenland were in the range of 1–30 aons (average 12 aons, median 8 aons).

The Greenland great cormorant population in the mid-1980s was estimated at 750–1500 pairs (Evans 1984) and at 1000–2500 pairs in the late 1980s (Boertmann 1994). However, these numbers should not be used as evidence of an increase in population size over the last decade, as they were based on much more fragmentary information than presented in this paper.

The sizes of Greenland colonies (Fig. 2) with an average of 22.4 aons per colony are considerably smaller than those reported for three sample areas in Norway (31–179 aons, Røv & Strann 1987) and one in Iceland (70 aons, Petersen & Ingvarsson 1995).

#### *The global population of subspecies *P. p. carbo**

Debout et al. (1995) present data on sizes and trends for all national populations of great cormorant subspecies *P. p. carbo*. However, more recent information on some of the populations has appeared. In Iceland, where great cormorants breed only in the western part of the island, the total population has recently (1995) been estimated at 2200 pairs and it seems presently to be declining (A. Petersen, pers. comm.). The Canadian population is found along the coast of the Gulf of St. Lawrence and on the southern part of Newfoundland. The most recent account of the

seabirds of Atlantic Canada gives an estimate of about 6300 pairs of great cormorants (Lock et al. 1994). There are local estimates of 5300 pairs in Nova Scotia and on Prince Edward Island (information from 1986–1990, Erskine 1992), 3700 pairs in Nova Scotia in 1992 (Milton et al. 1995), about 1000 pairs in Quebec in 1990 (Brousseau 1995) and at least 100 pairs on Newfoundland during the 1980s (Lock et al. 1994). The recently (in 1983) established population in Maine, USA, numbers about 200 pairs (265 in 1992 and 165 in 1995 J. Drury, pers. comm. 1996). The size of the Russian population breeding on the Kola Peninsula recently numbered 1281 pairs in 14 colonies (T. Paneva & J. Krasnov, pers. comm. 1996 communicated via V. Bakken). The population on the Faroe Islands was exterminated during the middle of this century, and a recovery has not occurred, although the species is a winter visitor to the islands (Salomonsen 1963; Bloch & Sørensen 1984; S. Sørensen, pers. comm. 1996). The insular population of the western Mediterranean (Sardinia) numbers about 45 pairs (Grussu 1995), but this population may not belong to the subspecies *P. c. carbo*.

If all these national population figures are added (Norway, Britain, Ireland and France contribute with 37,300 pairs (Debout et al. 1995)), the current total breeding numbers of subspecies *P. c. carbo* approximates 50,000 pairs, of which the Greenland population may account for 4–6%.

#### *Protection and threats in Greenland*

Currently the great cormorant in Greenland is protected from hunting from 1 April to 30 September, ten weeks more than most other seabirds (1 June–15 August). This extended protection period was adopted because the population was small and declining when the hunting regulations were revised in 1971 and because great cormorants are easy to shoot during winter (Salomonsen 1974b).

We have made inquiries about cormorant hunting with local residents in the districts of Paamiut, Nuuk, Sisimiut, Ilulissat and Upernavik. These people agreed that today great cormorants were hunted on a very limited scale in Greenland. Great cormorants are rarely and only in small numbers offered for sale at the local markets for hunting products. For example, only 13 were

offered for sale in Nuuk during the winter 1988/89 when thousands of eiders *Somateria mollissima* and *S. spectabilis* and Brünnich's guillemots *Uria lomvia* were sold (Falk & Kampp 1992). Indirect evidence indicates that at present the hunting pressure on the great cormorant is low. Many nests are situated close to sea level where birds could easily be shot. When colonies are approached by boat, many adults remain on their nests or on the breeding ledges. This contrasts with the descriptions of cormorant behaviour observed by Salomonsen (1950, 1967), who stated that the birds placed their nests as high as possible on the cliffs beyond the range of a shotgun, and that they were extremely shy, leaving the colonies when a boat approached.

The Greenland great cormorants stay within West Greenland during the winter. They move gradually southwards or out from the fiords to the open water areas south of Disko Bugt (Salomonsen 1967). Of 1500 great cormorants ringed in Greenland, all recoveries (267 until 1979) have been from West Greenland waters (Salomonsen 1979a). Moreover, no birds ringed abroad have been recovered in Greenland. Thus the available evidence suggests that the Greenland population is isolated from the other North Atlantic great cormorant populations, of which the nearest are found in Iceland and the Gulf of St. Lawrence, eastern Canada.

There are no current threats to the Greenland cormorant population as long as hunting pressure does not increase. Oil spills will be a potential threat if offshore exploration and exploitation activities are commenced. An oil spill during the breeding season would probably only affect a small proportion of the population because the birds are dispersed along an extensive coastline. Moreover, the birds breeding in the fiords far from the outer coast are protected, because an off-shore oil spill will not extend far into the fiords. However, during winter a significant proportion of the population is concentrated along the outer coast, and consequently it would be more exposed to oil spills. Because of its small size and presumed discrete status, the great cormorant population is of particular conservation concern to Greenland.

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