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The birds of Ydre Kitsissut (Kitsissut Avalliit),
Southwest Greenland

Kaj Kampp and Knud Falk



Bioscience

42 · 1994

Meddelelser om Grønland

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*Kaj Kampp and
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The birds of Ydre Kitsissut (Kitsissut Avalliit), Southwest Greenland

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Kampp, K. and Falk, K. 1994: The birds of Ydre Kitsissut (Kitsissut Avalliit), Southwest Greenland. – Meddr Grønland, Biosci. 42, 25 pp. Copenhagen 1994-09-26.

Ydre Kitsissut (60°45–47'N, 48°25–29'W), an archipelago about 10 km off Nunarsuit in the district of Qaqortoq, is the only breeding reserve for birds in southern Greenland. However, it has only been visited by ornithologists four times: by F. Salomonsen on 3 July 1971, and by the authors for between 3 and 14 days in 1983, 1985, and 1992. Population sizes of the most abundant species in 1992 were: *Fulmarus glacialis* 125 occupied sites (32% with young); *Somateria mollissima* about 30 nests (and 500–1000 summering birds, together with c. 100 *Somateria spectabilis*); *Larus hyperboreus* at least 100 adults with 25–30 broods of young; *Larus marinus* 2 pairs, one brood (but 11 pairs in 1985); *Rissa tridactyla* 23 pairs, no young; *Uria aalge* 900 birds (about 630 pairs); *Uria lomvia* 9000 birds (6300 pairs); *Alca torda* 400–500 birds; *Cepphus grylle* 150 pairs (very rough estimate); *Fratercula arctica* 200 birds. Although numbers of *Uria* spp. in 1971 were reported as 61,200, there are good reasons to believe that this was a gross overestimate, and that actual numbers did not differ much from the more recent counts. Apparent population declines between 1983–85 and 1992 for *Fulmarus glacialis*, *Larus marinus* and *Uria* spp. may reflect a lower attendance at the colony in 1992 where the breeding success of these and most other species was low. The poor breeding performance was most likely a consequence of the cold and prolonged winter 1991/92, with persistent frost prevailing until after mid-June. In *Uria* spp., however, eggng and associated disturbance probably was the primary cause of breeding failure; residents of nearby villages habitually take eggs on Ydre Kitsissut in spite of its status as a bird reserve.

Key words: Greenland, seabirds, *Fulmarus glacialis*, *Larus hyperboreus*, *Uria aalge*, *Uria lomvia*, *Alca torda*, *Cepphus grylle*, *Fratercula arctica*.

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Introduction

Seabirds in Greenland have traditionally been exploited by the local inhabitants. Partly for this reason, most of the major breeding sites in West Greenland were well known before the middle of the present century, with rough population estimates for some species given by Salomonsen (1950). The seabirds of Ydre Kitsissut, however, were neither noticed or described before Salomonsen (1979) reported from his visit there in 1971, possibly because they occupied the islands relatively recently. Based on information from residents of the nearby settlements Arsuk and Qassimiut, Salomonsen (*l.c.*) deduced that the thick-billed murre *Uria lomvia* and the fulmar *Fulmarus glacialis* both colonized the islands shortly after 1945.

Salomonsen (1979) showed that Ydre Kitsissut, com-

pared with other seabird sites in Greenland, supported a rich and diverse seabird community. In 1982, it was discovered that the common murre *Uria aalge* bred there (F. Jensen, pers. comm.), a species which is otherwise rare in Greenland (Salomonsen 1950; Kampp 1985). Because of its importance for breeding seabirds, especially murre and other auk species, Ydre Kitsissut became a breeding reserve for birds in 1988, with a ban against approaching the islands closer than 500 m between 1 June and 31 August. Ydre Kitsissut was designated a Ramsar site in 1988.

The authors visited the islands in 1983, 1985 and 1992 (Kampp 1983, 1985). The visits (between 3 and 14 days) were too short to obtain detailed results, but sufficient to improve the estimates of seabird populations and information on their distribution significantly, compared with Salomonsen's (1979) data, which were collected within a few hours under less than ideal conditions. Our

visits were part of a country-wide survey since 1983 of the status of thick-billed murres in Greenland, initiated because alarming population declines in parts of Greenland were suspected and subsequently confirmed. The results of that survey are given in a series of informal reports and summarized in Kampp *et al.* (1990) and, more fully, in Kampp *et al.* (1994). In 1992 renewed interest in future oil prospecting in West Greenland waters had further strengthened the need for up-to-date information on seabird colonies, especially of species particularly vulnerable to oil spills (cf. GM & OC 1993). The murre species consequently received most attention during our work on Ydre Kitsissut, but general information was obtained of all species.

This paper presents the available information on the seabirds on Ydre Kitsissut, with emphasis on population size and trend but with supplementary notes on reproduction and breeding phenology. It thereby adds to our knowledge of an area of Greenland poorly known to ornithologists, and provides a baseline reference for detecting and evaluating future changes in bird numbers in the only breeding reserve existing in southern Greenland.

Study area

Ydre Kitsissut (60°45–47'N, 48°25–29'W) is a group of about 50 islands and skerries, situated about 10 km off Nunarsuit in Qaqortoq district, southern Greenland. The nearest human settlements are Arsuk, c. 50 km to the north, and Qassimiut, c. 70 km to the east. The name of the group is a mixture of Danish and Greenlandic, "ydre" meaning "outer" or "outmost" in Danish while Kitsissut is a common name for offshore groups of small islands in Greenland.

The seabirds of Ydre Kitsissut are mainly concentrated to a cluster of islands in the northwestern part of the group, referred to as the "central group" in this paper (Fig. 1). Since only the two largest islands carry official names all "interesting" islands are here identified by letters, used throughout the text. These identification letters are consistent with those used by Kampp (1985) but differ from the system used by Salomonsen (1979) because a larger number of islands had to be "named" for the present purpose.

The peripheral islands are a chain of six islands (and a number of skerries) to the west (the "western group" of Fig. 1), a "southern group" of four islands, and two low islands to the north.

The islands nowhere exceed 50 m in height, except for Thorstein Islænder which peaks at 116 m. Most of the seabird islands of Fig. 1 reach between 30 and 50 m, although some of the smaller (D, J, R, S) are only 20–25 m, L 15–20 m, and F about 10 m. Of the central islands not given letters in Fig. 1, most are low and washed over by the sea in rough weather, but the two westernmost

islands and a smooth dome-shaped rock to the north (600 m due north of the letter 'A' in Fig. 1) exceed 20 m.

Geologists consider Kitsissut's syenitic rocks a part of the Nunarsuit unit of the Gardar intrusive complex (Emeleus & Upton 1976). The surface of the rocks are quite eroded in some areas, providing boulders, narrow holes and crevices suitable for nesting black guillemots *Cephus grylle* and razorbills *Alca torda*.

Ydre Kitsissut is situated on the narrowest part of the shelf off West Greenland, just inside the 100 m isobath and close to the continental slope. Hydrographically, the area is dominated by the East Greenland Polar Current which, after passing Kap Farvel, brings cold low-saline water northwards along the coast of West Greenland. In southern West Greenland this current attains a velocity of 0.4–0.5 ms⁻¹ at the surface, with a salinity of 31–33‰ and temperatures below 2°C (in late summer up to 4°C) (Buch, undated). Below and beyond the Polar Current, and parallel to it, runs the Irminger Current of warmer, more saline Atlantic water. The annual primary production along the coast is generally high (about 160 g C m⁻² off Nuuk), due to winter cooling and subsequent vertical mixing of the water, while in the fiords the production is lower because the stratification of the water is more stable (Smidt 1979). Productivity is enhanced at fronts between current systems, e.g., outside the Polar Current (Nielsen 1958).

The sea off South Greenland is notorious for severe weather conditions with frequent gales and long periods with fog, rain and snow. In spring the Polar Ice drift, *Storisen*, usually reaches Southwest Greenland, causing foggy conditions and low temperatures at the outer coast.

The hyper-oceanic, low-arctic climate (Feilberg 1984), combined with frequent sprays of seawater, accounts for the very sparse vegetation on Ydre Kitsissut. Most of the islands are bare rock with only occasional patches of vegetation (Figs 2–3). A more or less complete coverage of grasses, willow *Salix* spp. and crowberry *Empetrum nigrum*, occasionally together with cloudberry *Rubus chamaemorus* (otherwise rare in Greenland), is only found in a few sheltered areas on Tupersuartaat and over much of the southern half of island L. Rose root *Sedum rosea* occurs on more exposed sites, and in some of the seabird colonies, patches of scurvy grass *Cochlearia officinalis* are conspicuous.

The Danish Meteorological Institute (DMI) erected an automatic weather station on Tupersuartaat in 1981.

Study periods and general methods

We visited Ydre Kitsissut in the periods 10–13 June 1983 (KK only), 25 July–8 August 1985, and 30 July–11 August 1992. At all visits our base was the weather station on Tupersuartaat.

The preceding winter had been unusually cold in 1983

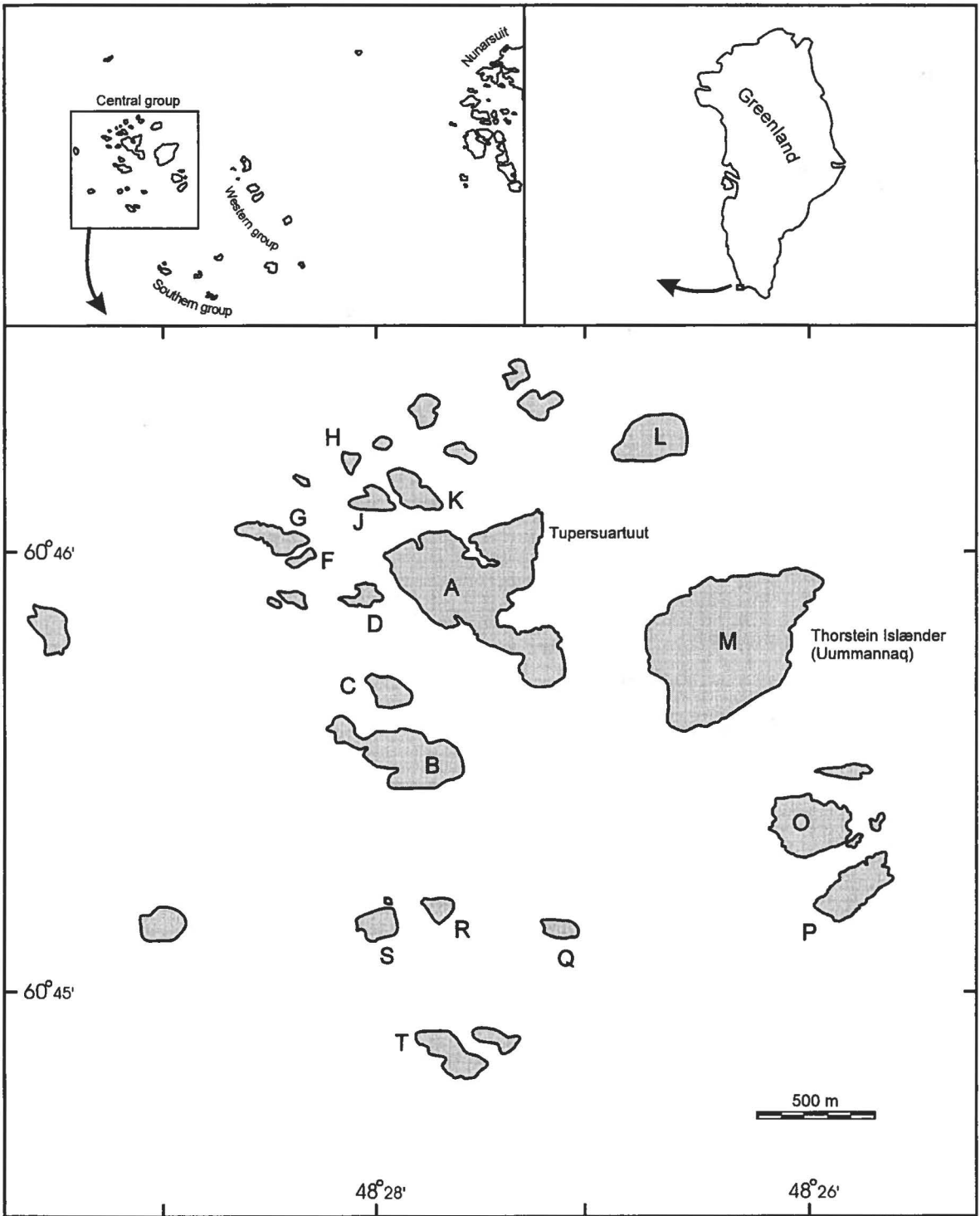


Fig. 1. Map of Ydre Kitsissut. Islands in the central group (to which the study was largely confined) are referred to in the text by letter codes as here defined.



Fig. 2. Rough seas and barren rock. Photo from Tupsuartaunut showing islands J and H on a stormy day in August 1985.



Fig. 3. The murre colony A4 on the west coast of Tupsuartaunut, 6 August 1992. The weather station is visible above the vegetated slope to the right.

and 1992, but fairly mild in 1985. The weather during our stay differed markedly between the three years: calm, sunny and cold (temperatures just above zero) in 1983; windy, with very few calm days in 1985; and rainy in 1992, although with a few fine days. Periods with fog occurred in all three years.

All observations were made from Tupersuartuut in 1983. In 1985 we brought an inflatable boat with us, but it was so small – and the weather so windy – that it could only be used for short trips on four different days. In 1992 we had a larger inflatable which improved our mobility considerably, but weather and swell still made all-day activities away from Tupersuartuut inadvisable, so the duration of our trips were generally kept within a few hours. Even on Tupersuartuut, fog or heavy rain interrupted observations for hours or days.

We visited all parts of the central group, but none of the peripheral islands. Most of these, however, were briefly examined from the ship bringing us to and from Ydre Kitsissut, the exception being the four islands comprising the southern group which we only saw from a distance of about 1500 m.

To estimate bird populations we used generalized counts combined with other types of information depending on the species concerned, as explained in the Species Accounts. Most colonies of murres can be viewed from Tupersuartuut, but some from unfavourable angles only, and others (including those on Tupersuartuut itself) only in part or not at all, or at a great distance. In such cases, colonies were counted from photos (Kodachrome 64 colour slides, focal length 180 or 400 mm) obtained during boat trips (especially in 1985), or by use of a telescope (20× or 25×) from a suitable point on a neighbouring island (1992). Since murres on Ydre Kitsissut are shy and easily scared off the cliff by a passing boat, the colonies had to be approached with caution. If necessary, counts were delayed for 10–15 min to allow time for the birds to return. Photos of all colonies are deposited at the Zoological Museum in Copenhagen.

The number of eggs and young in parts of seven murre colonies was determined in 1992 by climbing to the ledges. These subcolonies were selected so that both accessible and inaccessible sites were represented, since we knew that eggs were commonly taken on the islands. Whether sites were accessible to humans without special equipment had to be assessed on a subjective basis.

Species accounts

Red-throated diver *Gavia stellata*

A pair of red-throated divers bred on Thorstein Islænder (M) in 1985, in a small lake above the murre colony M1, where on 3 August a large unfledged young was found. We did not visit the lake in 1992, but a red-throated diver was seen flying from Thorstein Islænder.

Northern fulmar *Fulmarus glacialis*

1. Distribution and numbers

The distribution of the fulmar in Greenland has been summarized by Boertmann (1994). The colony on Ydre Kitsissut was established around 1945 (Salomonsen 1979).

Fulmars on Ydre Kitsissut breed solitarily or in aggregations of up to about 30 pairs. Apparent nesting sites in 1992 are mapped in Fig. 4, amounting to a total of 125 distributed over 11 islands. Late in the summer, sites may be attended by one or two adults, but may at other times be left unattended, so we probably missed a few sites without young and not visible from Tupersuartuut.

We made no counts of attending birds in 1985, but on 11–14 June 1983 (before egg-laying) numbers at sites visible from Tupersuartuut were 30–40% above maximum numbers in 1992. The difference does not necessarily reflect a population decline, however, since the counts were made much earlier in the season in 1983 than in 1992, at a time when the colony attendance of fulmars is likely to be high (e.g., Hatch 1989).

Salomonsen (1979), visiting the islands on 3 July 1971, noted 74 adult fulmars sitting on 4 islands, but as is the case in other species, a meaningful comparison of his figures with ours is not possible.

All fulmars on Ydre Kitsissut were white (type LL *sensu* Fisher (1952)), except for one dark bird (type D) found on island M in 1985, one (possibly the same bird) seen near island A, and another type-D bird that attended a site on island C in 1992.

2. Breeding success and phenology

Data on the fulmar's breeding phenology on Ydre Kitsissut are sparse owing to the relatively short duration of our visits. In 1983, none of the pairs on Tupersuartuut had laid by 14 June. In 1985, all chicks were still attended by an adult at our arrival on 25 July, and most had hatched about two weeks earlier, indicating that laying occurred around 25 May (incubation period about 49 days, Cramp & Simmons 1977). In 1992, laying must have taken place a little earlier than in 1985, judging from the slightly more advanced chicks present. Most other seabird species laid later in 1992 than in 1985, probably because winter conditions prevailed long into June, so the relatively early breeding of the fulmars is a little surprising. The absence of eggs on Tupersuartuut in June 1983, following another severe winter, suggests a considerably delayed breeding season that year, or perhaps a complete failure to lay; another possibility, however, is that all the eggs had been taken by humans in 1983 (see below).

Of the 125 occupied sites in 1992, 114 were seen at close range and only 37 (32%) held chicks. A reproductive success this low may not be unusual, however. Hatch (1987) found a mean breeding success of 41% over 9 years (range 7–72%) on Semidi Islands in the Gulf of

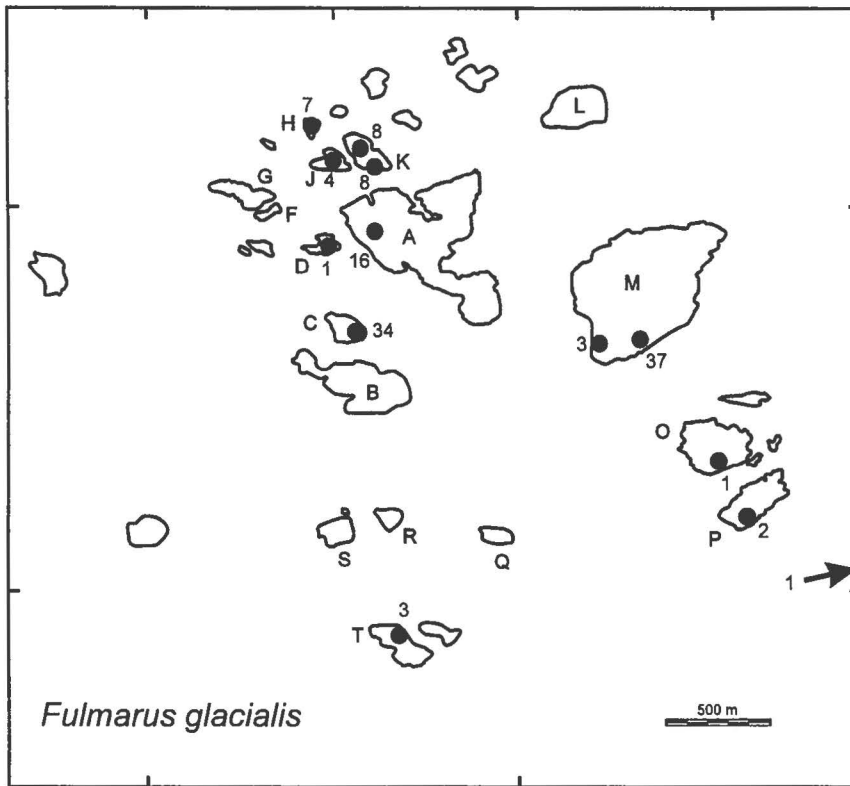


Fig. 4. Breeding sites of fulmar on Ydre Kitsissut in August 1992. Numbers indicate occupied sites, irrespective of whether a chick was present or not.

Alaska. A single-year study in Scotland gave a value of 54% (Mougin 1967). Egg and chick predation by gulls and corvids was an important cause of breeding failure in both areas.

More fulmar chicks were present on Ydre Kitsissut in 1985 than in 1992 at sites for which complete figures are available from both years: 14 in 1985 compared with 6 in 1992 on western Tupersuartuut (and 7 and 0, respectively, on the northeastern peninsula); 12 in 1985 and 9 in 1992 on island C (northeast slope); and, at the murre colony on island M, 13 in 1985 and 11 in 1992. The particularly low number on Tupersuartuut in 1992 may suggest that losses there were induced by humans, either through disturbance or by eggging (according to Salomonsen (1979), fulmar eggs were taken on Ydre Kitsissut until at least c. 1970).

Great cormorant *Phalacrocorax carbo*

This species probably does not breed on Ydre Kitsissut or elsewhere in Greenland south of Evighedsfjorden (66°N) (Boertmann 1994). In 1992, however, 2 adults and two immatures that might have been reared locally stayed in the murre colony M1, where also two birds were seen on 3 August 1985.

Common eider *Somateria mollissima*

A brood of 3 half-grown young were present at Tupersuartuut in 1985. In 1992, there were four flocks of 2, 3, 7 and 7 small young, respectively. All but the smallest flock in 1992 were sometimes attended by two or even three females and may have been crèches of 2–3 coalesced broods. Remnants of nests were found on Tupersuartuut (1) and island L (about 20) in 1992, and since suitable nesting habitat is virtually lacking on other islands the total population probably amounted to about 30 pairs. Based on the sparse data, the eiders bred later in 1992 than in 1985, as did most other bird species on Ydre Kitsissut. But since our visits took place late in the summer, it may be that we only saw the latest breeders both years; otherwise, the breeding success must have been low.

In addition to the breeding birds, Ydre Kitsissut is frequented by non-breeding or post-breeding eiders spending the summer and moulting there. Most recorded flocks contained less than 50 birds, but larger flocks were seen occasionally. Eiders in Greenland are extremely wary, and moulting flocks disappeared from the vicinity of Tupersuartuut soon after our arrival. In 1992, most eiders were seen on 30 July, three flocks around Tupersuartuut totalling 432 birds. In addition, 200 were seen

at island T on 6 August. In all, Ydre Kitsissut may support 500–1,000 moulting eiders during summer.

King eider *Somateria spectabilis*

Non-breeding king eiders moult at Ydre Kitsissut in late summer, occurring in somewhat lower numbers than common eiders. They may form pure flocks or mix in with common eiders. The largest number was recorded in 1992, about 100–130 in total.

Harlequin duck *Histrionicus histrionicus*

Offshore islets and skerries are typical summer habitat for post-breeding male harlequin ducks, and non-breeding birds of both sexes (Salomonsen 1967). We recorded it at Ydre Kitsissut during all three visits. Minimum numbers of birds were 6 in June 1983 and 15 and 20, respectively, in July–August 1985 and 1992. Females made up about 40% of the birds in 1983 and 1992, whereas no females were seen in 1985, possibly reflecting a lower breeding success in 1983 and 1992 than in 1985.

Gyrfalcon *Falco rusticolus*

Gyrfalcons often attend seabird colonies in Greenland throughout the summer (own unpublished data). Single birds were present on all our visits: white birds in June 1983 and August 1985, and a grey bird in 1992. The latter was seen only once, possibly owing to the presence of a pair of peregrine falcons *Falco peregrinus* that year. While peregrine pairs are unable to dislodge nesting gyrfalcons (Cramp & Simmons 1980), single gyrfalcons straying into peregrine territories may be attacked relentlessly and driven away (own unpublished data).

Salomonsen (1979) also saw a gyrfalcon, a white bird, when visiting the islands on 3 July 1971.

Peregrine falcon *Falco peregrinus*

Peregrine falcons were not observed in 1983 or 1985, but in 1992 a pair probably bred on Ydre Kitsissut. A female was seen almost daily at various islands and a male once, on 6 August. Late on 9 August, a flying juvenile was seen together with the female on Tupersuartuut, and a few minutes later two juveniles made mock attacks at each other in the air. We assume that the adults were a pair whose young fledged shortly before 9 August.

Iceland gull *Larus glaucooides*

We did not record Iceland gulls on Ydre Kitsissut, but Salomonsen (1979) reported three colonies in 1971. Two were on the southernmost two islands of the group and contained 20 and 50 birds, respectively. We only saw the southern islands from far off and could not find these colonies, although we noted a few gulls (believed to be glaucous gulls *Larus hyperboreus*). The third colony reported by Salomonsen, with 20 birds, was on the south side of island P, but no gulls were found there in 1985 and 1992; it is possible that Salomonsen confused islands P and O, because we did find a colony of about 20 glaucous gulls on the south side of island O, but if so, Salomonsen seems to have misidentified the birds.

Glaucous gull *Larus hyperboreus*

The glaucous gull is a fairly common breeding species on Ydre Kitsissut, occurring mostly as single pairs but occasionally in small loose colonies. In 1985, 21 pairs were recorded on 13 islands in the central part of the archipelago.

In 1992, all broods present in the central subgroup were mapped. In all, 23 broods occurred on 11 islands, the highest number on a single island being 5 (island L). The total number of adults present could not be counted precisely but it was about four times the number of broods; the biggest colony was on the south side of island O (22 adults, but only 4 broods). An additional 14 adults with at least one brood occurred on 5 of the peripheral islands here referred to as the western group (Fig. 1), which we only examined briefly from the cutter when leaving on 11 August. The southern group of peripheral islands were only viewed at a great distance; one held at least two pairs believed to be glaucous gulls, another a single bird. The total population on Ydre Kitsissut in 1992 probably comprised a little more than 100 adults, producing 25–30 broods of young.

In 1985 the young were newly fledged in late July, but in 1992 none had fledged when we left on 11 August. Since the incubation period is 27–28 days, and the fledging period probably 45–50 days (Cramp & Simmons 1983), egg-laying must have taken place in mid-May in 1985, and about two weeks later in 1992.

Of the 17 broods the size of which could be reliably determined in 1992, 6 had one, 8 had two, and 3 had three young, giving a mean of 1.8 young per brood.

Glaucous gulls attached to murre colonies are well known to prey on murre eggs and chicks (Cramp & Simmons 1983; Gaston *et al.* 1985). Such incidents were not recorded in 1985, except for a few unsuccessful attempts to take “fledged” chicks on the water. In 1992, one or a few gulls were regularly seen patrolling the murre colony K1, and at least twice one succeeded in snatching a chick from a ledge densely inhabited by

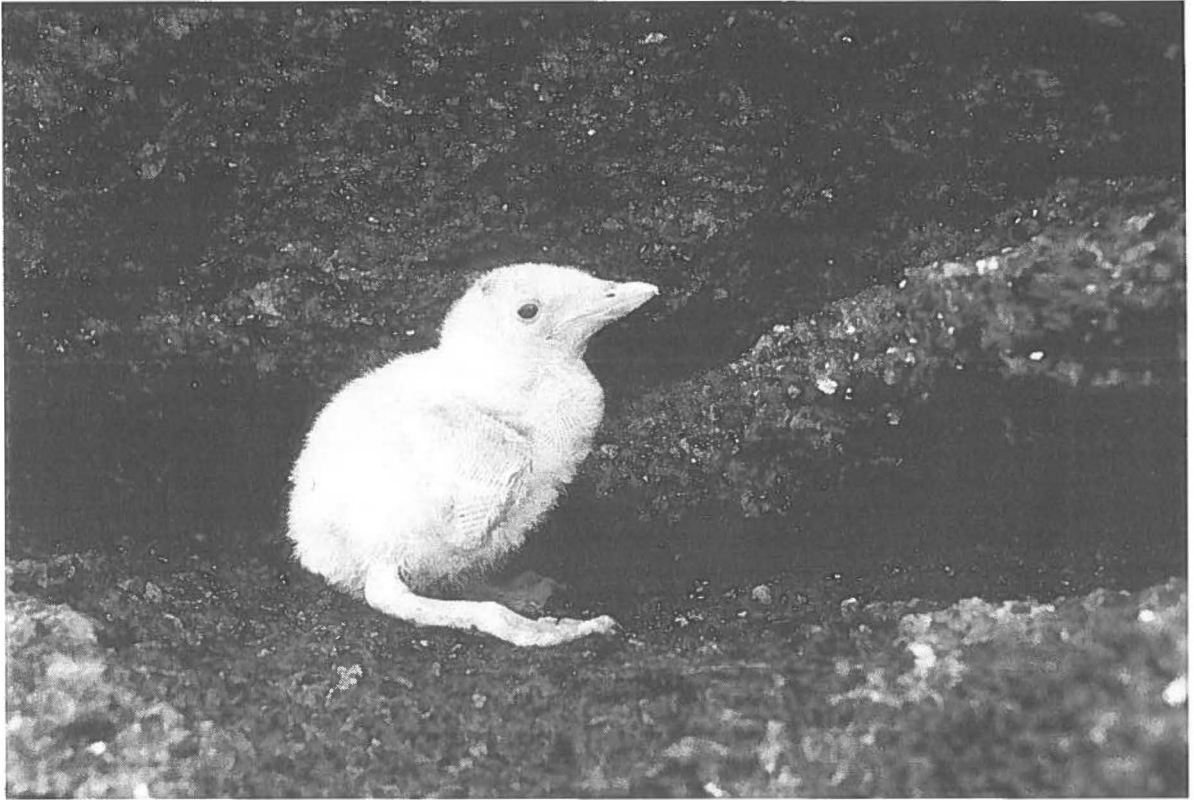


Fig. 5. Albino thick-billed murre chick photographed on island K (colony K2) on 9 August 1992.

common murres. The same individual gull (rearing a brood on island D) seemed to be involved in most patrolling at and attacks on colony K1, including the two successful attempts seen.

Great black-backed gull *Larus marinus*

A few pairs of great black-backed gulls breed on Ydre Kitsissut. Seven pairs were located on 6 islands in the central part of the archipelago in 1983, and 11 pairs in 1985. In 1992, however, only 2 pairs occurred on the islands, one without young and one with two young. The decrease in numbers between 1985 and 1992 may reflect a low breeding success in 1992 rather than a reduced population, since many other bird species on Ydre Kitsissut reproduced poorly in 1992.

An egg clutch was found on Tapersuartaunut on 13 June 1983. All young seen in late July 1985 had newly fledged. The incubation period is 27–28 days and the fledging period 7–8 weeks (Cramp & Simmons 1983), so egg-laying apparently took place in mid-May.

Like the glaucous gull, the great black-backed gull is known to prey on eggs and chicks of murres (Cramp &

Simmons 1983), but the only instances we recorded on Ydre Kitsissut were a few unsuccessful attempts to catch “fledged” murre chicks on the water in August 1985.

Black-legged kittiwake *Rissa tridactyla*

The kittiwake is a scarce breeder on Ydre Kitsissut. A total of 24–25 nests were found in 1983 and 1985, on islands G and K; in 1992 there were 18 nests at these two locations, and also one and four, respectively, in the murre colonies A4 and M1. The number of kittiwake nests in 1992 was uncertain because kittiwakes suffered a complete breeding failure that year. In 1985 the nests contained half-grown chicks about 3–4 weeks old (8 August), indicating that laying took place in mid-June.

Salomonsen (1979) recorded no kittiwakes in 1971, either because he missed the few pairs or because the species had not yet colonized Ydre Kitsissut.

Kittiwakes seem to reproduce very successfully in Greenland at present (own unpublished data), but breeding failure of entire colonies in seasons following unusually cold winters is known to occur. In 1984, following the coldest winter on record, very few kittiwakes laid and

no eggs hatched in any of the colonies we visited in Disko Bay and Uumannaq Fiord, at 69°–71°N in West Greenland.

Thick-billed murre *Uria lomvia* and common murre *Uria aalge*

Because the two murre species breed in mixed colonies on Ydre Kitsissut, and since discussion of one requires repeated reference to the other, they are best treated together.

The population of the thick-billed murre in Greenland has been reviewed by Kampp *et al.* (1990) and Kampp *et al.* (1994). It breeds in huge numbers in Avanersuaq district and in the northern part of Upernavik district. Formerly large populations in southern Upernavik, Uumannaq and Ilulissat districts are now much reduced or extinct. Further south, fairly large colonies exist in Maniitsoq district, and small colonies in Nuuk and Paamiut

Table 1. Murres present in colonies on Ydre Kitsissut, early August 1992 (counted 31 July and 1, 6 and 9 August). Numbers have been slightly rounded, generally to the nearest five. For island and colony designations, see Fig. 6. Totals (both species combined) from 1985 are from Kampp (1985) and given in boldface types if directly comparable to (of same accuracy as) totals from 1992.

Island and colony	<i>U. aalge</i> 1992	<i>U. lomvia</i> 1992	Total 1992	Total 1985
A 1	154	1	155	160
2	75	0	75	55
3	1	24	25	10
4	175	1725	1900	1100
5	75	445	520	580
B 1	0	10	10	10
C 1	0	200	200	190
F 1	0	80	80	30
G 1	80	1420	1500	1700
2	0	40	40	40
3	0	190	190	190
H 1	0	150	150	120
J 1	15	335	350	280
2	2	175	177	230
3	3	25	28	–
4	0	10	10	–
K 1	125	630	755	820
2	75	1425	1500	1500
3	0	25	25	–
M 1	120	1080	1200	760
O 1	0	640	640	840
2	0	145	145	75
Q 1	0	190	190	325
T 1	0	35	35	–
Total	900	9000	9900	9015

districts. Ydre Kitsissut is the southernmost known colony in Greenland.

A few common murres breed among thick-billed murres in Maniitsoq, Nuuk and Paamiut districts, but Ydre Kitsissut is by far the largest colony in Greenland (Kampp 1985, Boertmann 1994).

The murres colonized Ydre Kitsissut around 1950, according to local Greenlanders interviewed by Salomonsen (1979). When Salomonsen visited the islands in 1971 the distribution and numbers of murres probably did not differ much from what they are today (see Population Change for a discussion of the conflicting evidence). Salomonsen (1979) did not notice any common murres during his visit and may have overlooked them, although the possibility remains that the species colonized the archipelago after his visit. Their presence was first reported by F. Jensen (pers. comm.), who visited the islands in June 1982.

An albino murre chick (Fig. 5), almost certainly *U. lomvia* (J. Fjeldsø, pers. comm.), was found in colony K2 (see Fig. 6) on 9 August 1992. Albinos must be very rare in this species; according to A. J. Gaston (pers. comm. 1993), not one has been found among more than 20,000 ringed in Canada since 1980. However, Birkhead (1993) saw an adult albino thick-billed murre in the Cape Hay colony, Bylot Island in Canada, in 1978.

1. Distribution and numbers

A few of the murre colonies are not visible from Tupersuartuut, and others can only be viewed from unfavourable angles, so only provisional estimates of numbers could be obtained in 1983. These estimates were improved in 1985, and further so in 1992, when we had an inflatable boat.

The numbers obtained in 1992 are given in Table 1, with best previous estimate (mostly from 1985) shown as well. Colony locations are shown in Fig. 6. The estimates in 1992 were derived from direct counts, except in a few cases where a colony was counted from photos. Estimates from 1983 and 1985 were likewise based on a mixture of direct and photo counts, but relied more on photos than did the counts in 1992.

Two colonies of common murres breeding in shallow caves on Tupersuartuut (A1 and A2, Fig. 6) posed special problems since they could not be counted reliably from a distance. In colony A1, however, the cave could be entered and the birds counted as they were scared out. Further, the proportion between numbers at A1 and A2, respectively, could be estimated using a kind of capture-recapture technique. In colony A1, 18 birds were caught in 1992 of which 5 were among the 89 birds ringed in 1985; in A2, 23 were caught in 1992 of which 4 were recaptures from 1985 when 27 were ringed. The numbers are too low to permit a precise estimate, but they suggest that colony A2 was about half the size of colony A1 ($27 \times 23/4$ divided by $89 \times 18/5$ equals 0.48). Colony size could not be determined directly from the capture-recap-

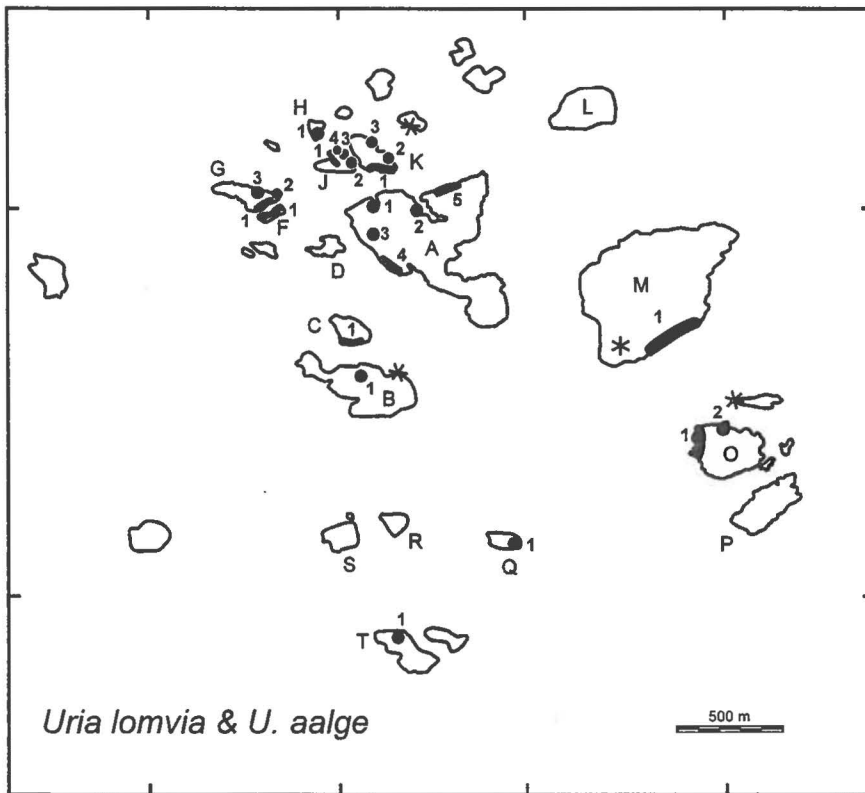


Fig. 6. Colonies of murre (both species) on Ydre Kitsissut. Each colony is assigned a code consisting of the island letter code followed by a number (cf. Table 1). Asterisks indicate watchpoints from where certain of the colonies were counted in 1985 (the one on island M) and 1992 (the other three).

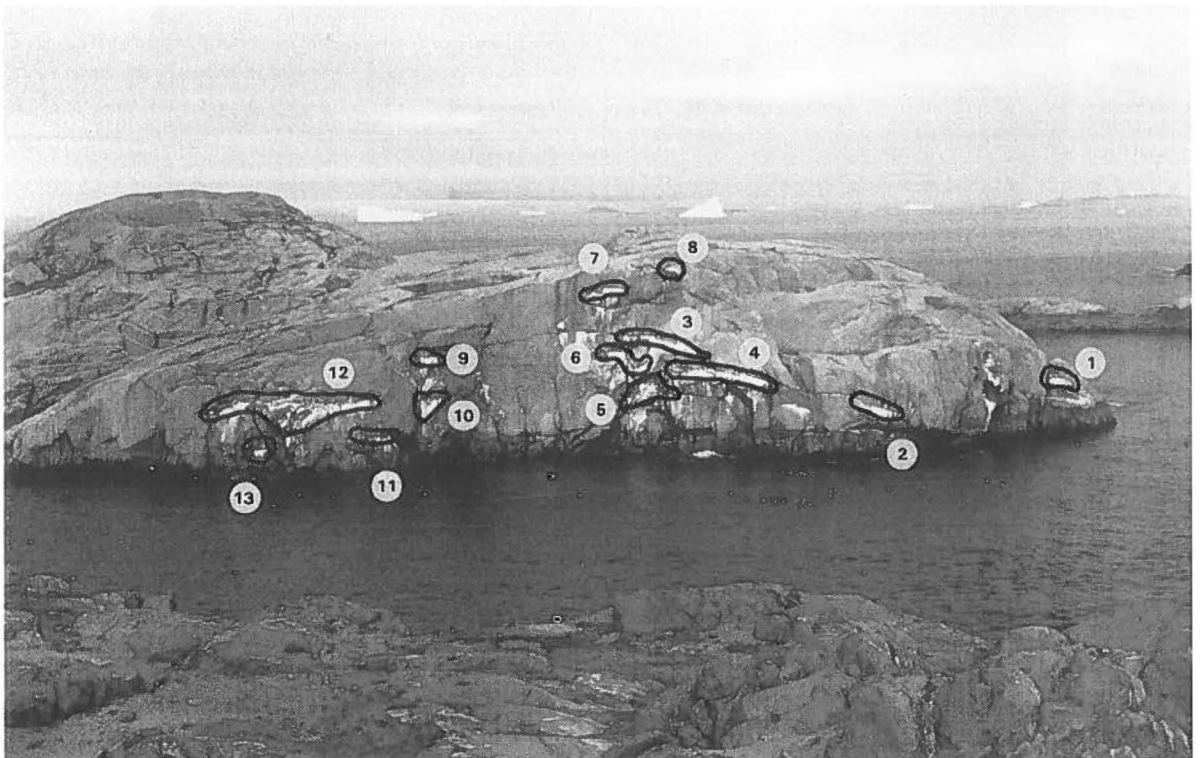


Fig. 7. The south cliff of island K showing the 13 counting plots of colony K1.

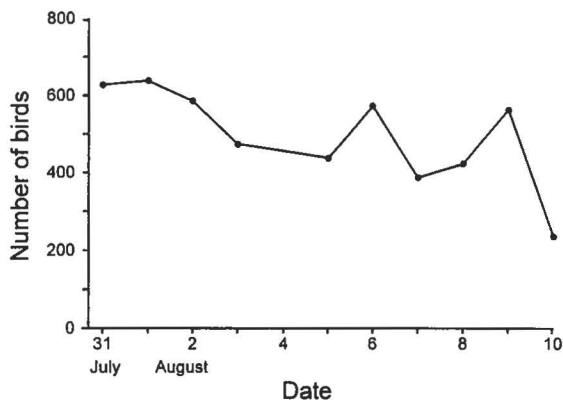


Fig. 8. Total numbers of murre (both species) present in the 13 plots of colony K1 (see Fig. 7) at noon counts, 31 July – 10 August 1992.

ture data because the estimate would represent the entire number of birds attached to the colony, not only those present at a given time as do the estimates of all the other colonies. Furthermore, allowance should be made for birds that died between 1985 and 1992, and reliable mortality estimates for these murre are lacking.

Table 1 suggests a total of 9,000 thick-billed murre and 900 common murre for Ydre Kitsissut in 1992, distributed on 12 islands. The numbers are birds present in the colonies in early August, i.e., the late incubating to early chick-rearing phase of the breeding cycle. The *k*-factor (breeding pairs divided by birds present; Birkhead & Nettleship 1980) is not well known, but if similar to the values found in other parts of the Arctic, about 0.7 (Gaston & Nettleship 1981, Gaston *et al.* 1985, Evans 1987, Kampp & Lyngs 1989), the breeding population of thick-billed murre on Ydre Kitsissut comprise c. 6,300 pairs, and the population of common murre c. 630 pairs.

The estimated numbers are subject to various sources of error, of which the most important is the natural variation in numbers of murre through the day and between days. Relative to this variation in colony attendance, counting errors are negligible, because the colonies are low and rather small, and because counts in 1992 (except for a few minor colonies) were made from land, using a telescope and viewing the colonies at favourable angles. However, in 1983 and 1985 some colonies had to be counted (directly or from photos) from an oblique angle, or from a boat.

Attendance patterns were investigated in 1992 by repeated counts of 13 plots, together covering 83% of colony K1 (Fig. 7). Total numbers of murre present (both species) at noon from 31 July to 10 August are shown in Fig. 8, and numbers throughout the day of 6 August in Fig. 9. The coefficient of variation (CV) of the daily noon counts is 26% for all plots combined, with individual plots varying between 17% and 85% (Table 2). This degree of variation is high compared with the 5–10% variation found by Gaston & Nettleship (1981) at

Prince Leopold Island in 1975–77, at the same phase of the breeding cycle. The main cause of the high CV in this study was the low number of murre on days with inclement weather (rain, strong wind), which in turn probably was an effect of the low breeding success in 1992, since birds without parental duties are free to leave the colony under adverse conditions. Hatch & Hatch (1989) found only a weak relationship between weather variables and overall murre attendance at Semidi Islands, Alaska, but showed that failed breeders and non-breeders spent less time in the colony than active breeders, and Birkhead (1993) noted that off-duty thick-billed murre left the colony during a spell of bad weather. This interpretation of the high CV values on Ydre Kitsissut is supported by the observation that the CV was inversely related to the proportion of birds on a ledge attending eggs or chicks (Fig. 10, Table 2). It follows that numbers recorded on days with mild weather are much more similar to what would have been recorded in a “normal” season than is the overall average. Since all the given colony estimates derive from counts made on 31 July and 1, 6 and 9 August, which all were mild days of supposed “normal” attendance, the accuracy should be better than suggested by the overall noon-count variation. Counts of the plots through the day of 6 August had a combined CV of 12% ($n=5$, excluding counts visibly depressed owing to the presence of a peregrine falcon; Fig. 9).

The estimates for each of the two murre species may be slightly less precise than the estimated total population of murre on Ydre Kitsissut, because the proportion of common murre could not be accurately assessed in all colonies.

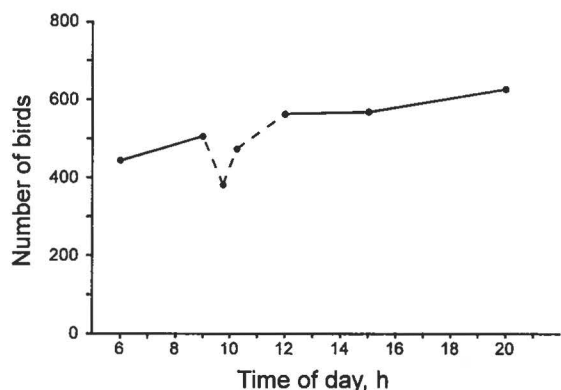


Fig. 9. Total numbers of murre (both species) present in the 13 plots of colony K1 (see Fig. 7) through the day of 6 August 1992. Time in Greenland summer time (1 h 14 min ahead of true local time). A peregrine falcon arrived at the colony at 09:35 hours and stayed for some time, causing several off-duty murre to leave the colony.

Table 2. Study plots in colony K1 (see Fig. 7): number of murres, proportion being common murres, and number of eggs and young. Also indicated is whether the plots were believed accessible to eggers.

Plot #	accessible	Percent <i>U. aalge</i>	No. of birds			No. dead eggs	No. live eggs	No. young
			Standard ¹	Mean	CV ²			
1	yes	32	34	26.4	0.18	0	17	0
2		17	23	18.7	0.23	–	–	–
3		57	22	10.0	0.83	0	1	0
4	no	41	173	156.8	0.17	30	55	31
5	no	0	43	37.6	0.28	4	5	4
6	?	7	71	60.4	0.29	20	5	20
7	yes	5	31	19.2	0.42	0	0	0
8		50	4	2.2	0.85	–	–	–
9	yes	14	14	9.8	0.34	0	0	0
10		0	16	12.7	0.35	–	–	–
11		0	36	29.9	0.18	–	–	–
12	in part	0	144	93.7	0.46	11	22	11
13	yes	43	17	17.4	0.24	0	8	0
Total		18	628	494.8	0.26	–	–	–
excl. #2,8,10,11		20	549	431.3	0.27	66	113	66

¹ Counts on 31 July and 1, 6 and 9 August (see text)

² Coefficient of variation

2. Population change

Comparison of the 1992 colony estimates with those from 1985 suggests a decline through the intervening seven years. The higher total in 1992 was mainly due to improved counts of a few important colonies (A4, M1), and the colonies where the most reliable counts were made in 1985 had lower numbers in 1992 (Table 1). These declines, however, barely exceeded the supposed uncertainty in the numbers, although the fact that all changes were negative was suggestive. Even if the decline was real, however, it is impossible to say whether it reflected an actual population decrease or a lower attend-

ance at the colonies in 1992, even on days with fine weather.

Salomonsen's (1979) figure of a total of 61,200 murres distributed on 6 islands in 1971 suggests that an enormous decline had taken place by 1983 (Kampp 1983), but Salomonsen's estimate may well have been inaccurate by an order of magnitude. His visit, during a few hours on 3 July 1971, took place in foggy weather, so he had difficulties orienting himself – most murre colonies are erroneously marked on his map (Salomonsen 1979) and cannot be identified today. Under those circumstances the cliffs could have appeared bigger than they actually are. Salomonsen took two photos during his visit, both subsequently published (Salomonsen 1979). Both were from the easily identified colony M1 and show a similar distribution and density of birds as found in 1992 (Fig. 11).

In conclusion, the available data are too fragmentary to permit anything to be said about population changes of murres between 1971 and 1983, and indications of a slight population decrease since then are inconclusive.

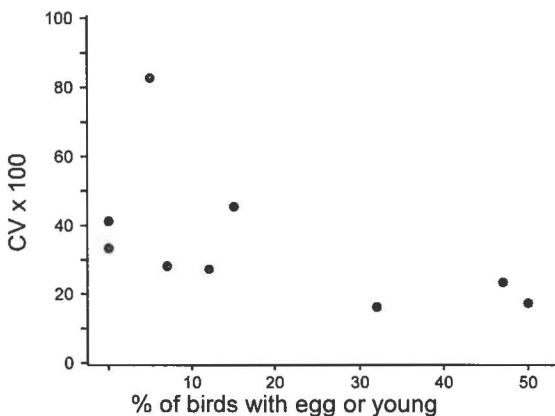


Fig. 10. Relationship between the variation of murre numbers in 9 of the plots of colony K1 (daily noon counts; CV = coefficient of variation) and the proportion of present birds attending eggs or chicks (see Table 2). Spearman rank correlation coefficient $r_s = -0.69$ ($P < 0.05$).

3. Human exploitation – eggng

The bird community on Ydre Kitsissut has long been exploited by Greenlanders from nearby settlements. Eggng is the most important way of utilizing the murres and takes place on occasion when a boat team passes by the islands or, more importantly, on a larger scale by teams visiting the islands for that purpose (Salomonsen 1979). Since eggng affects the breeding success as well as the phenology of the murres, it is appropriate to treat eggng before those topics.

The only quantitative indication of the scale of egg collecting on Ydre Kitsissut comes from F. Salomonsen's



Fig. 11. The murre colony M1 on the south coast of Thorstein Islænder. Top: 3 July 1971 (photo by F. Salomonsen). Bottom: 31 July 1992 (photo by the authors). The photo from 1971 only shows two thirds of the colony, viewed obliquely from the left.

field notes from 1971, and relates to 1970. In that year, according to a Greenlander interviewed by Salomonsen, the islands were raided by three boats from Arsuk and

one from Qassimiut. The latter “came first, and subsequently sold 3,000 murre eggs in the town of Qaqortoq.”

Although taking of murre eggs was prohibited in 1978, it is still practised on Ydre Kitsissut. Since the establishment in 1981 of the automatic weather station on Tupsuartaunut, a diary has been kept in the hut used by maintenance teams visiting the station once or twice annually. The hut is also used by visiting egg collectors, and since it usually needs cleaning up afterwards, such incidents find their way to the diary. According to entries herein, eggers visited the island in at least 1982, 1983, 1985, 1986, 1988 and 1990. Undoubtedly it is an annual occurrence, apart from the rare year when wind and pack ice hinder visits throughout the birds' incubation period. At our visit in 1992 we found a wire placed as a climbing rope down the cliffs of colony A4. It was also quite apparent that the timing of breeding of murres on accessible sites was delayed compared with those on inaccessible ledges (Greenlandic hunters do not use special equipment for climbing other than some rope from their boat). The only indication of the scale of egg-harvesting on Ydre Kitsissut after it was banned in 1978, however, is the information from D. Boertmann (pers. comm. 1985) that a boat-full of murre eggs was sold in Paamiut in 1985.

Murres losing their egg soon after laying will often relay. But the success of late breeders is generally below average (Birkhead & Harris 1985, Harris & Birkhead 1985), and delayed fledging may furthermore affect the survival of the chicks, since less time is available for the completion of body and feather growth before the feeding conditions deteriorate in the autumn. Data on common murres in the Baltic Sea do not indicate any disadvantage for late-hatched chicks (Hedgren 1981), but the situation might be different in the Arctic. If that is the case, the effect could be particularly pronounced in the case of Ydre Kitsissut where murres lay markedly later than in other South Greenland colonies (see below). Low survival of young birds could impair recruitment and, possibly, the population's ability to maintain itself. Any population decline in long-lived species such as murres would be slow if caused by a reduced recruitment rate, and a slow population decline was suggested – although not proven – by our count figures from Ydre Kitsissut.

4. Breeding phenology

Data on the breeding phenology of the murres on Ydre Kitsissut are sparse, and their interpretation was not made easier by the fact that two of the three seasons from which they derive (1983, 1992) followed extremely cold and prolonged winters, as well as the complication arising from egg-harvesting by man.

Laying in 1983 had not started by 14 June. In 1985, many pairs in two presumed inaccessible colonies had newly hatched chicks on 25 July and a few chicks had left by 8 August (the first on 1 August), whereas about half of the pairs in accessible (and probably egged) colonies still had eggs. Hatching in 1992 was even later than in 1985,

and no chicks left before 10 August. On 9 August the pairs in two inaccessible colonies had eggs : chicks in the proportion 18 : 85, with 47 chicks about one week old and 38 older than one week. Three accessible colonies had 299 : 126 eggs : chicks on the same day, with 90% of the chicks less than one week old. Two colonies which appeared to be partly accessible had intermediate egg : chick proportions and chick ages (45 : 57; 35% chicks newly hatched, 56% one week old, 9% older).

In order to estimate what the breeding phenology of murres on Ydre Kitsissut would be in the absence of human disturbance and eggging, and thus how it is affected by these activities, some assumptions must be made. The absence of newly hatched chicks on sites which we supposed had escaped egg-collecting may hint that the eggs here, still not hatched on 9 August, were relays, and that the chicks all came from first eggs. A proportion of 17% relays (18 out of 18+85=103) may seem high, but eggging activities at nearby sites and associated traffic must undoubtedly have meant a high level of disturbance and some loss of eggs, even at inaccessible sites.

The incubation period of murres is 32–33 days (Gaston & Nettleship 1981, Birkhead & Nettleship 1987a), so on the given assumptions, the median laying date in 1992 would have been around 1 July. Laying in 1985 may have been 1–2 weeks earlier than in 1992, while in 1983 it was apparently at least as late as in 1992. The average breeding schedule of murres in the presumably accessible colonies was delayed by at least 10 days, and more likely by two weeks or even more.

The breeding schedule of common murres seemed to be slightly advanced relative to thick-billed murres in both 1985 and 1992, but the sparse data do not permit a rigorous test of this. Birkhead & Nettleship (1987a) found that common murres laid slightly but consistently earlier than thick-billed murres on Gannet Islands, Labrador.

In other murre colonies in West Greenland south of the Arctic Circle (Arsuk Fiord and Maniitsoq district), peak fledging occurs between 25 and 30 July (own unpublished data). These colonies are placed on south-exposed cliffs in fiords, far from the outer coast. The late laying of murres on Ydre Kitsissut must in some way be associated with the extremely exposed position of the islands and the harsh climatic conditions prevailing. For the North Atlantic as a whole, Birkhead & Harris (1985) found a close relationship between sea-surface temperatures and time of breeding in auks. But even though the surface waters of fiords in southern Greenland may be warmer than the Polar Drift water surrounding Ydre Kitsissut, it is not clear why the relationship between water temperature and breeding phenology should be valid at such a fine scale, because the link was supposed to be food availability (Birkhead & Harris *l.c.*), and murres breeding in Greenland fiords appear to forage out at sea (own unpublished data). Some murres on Ydre Kitsissut may be prevented from laying until mid-June or later by snow remaining on

Table 3. Number of surviving murre eggs and chicks in parts of four colonies, Ydre Kitsissut, 9 August 1992.

Colony ¹	Percent <i>U. aalge</i>	No. adults	No. eggs	No. chicks	No. eggs & chicks per adult
A1	99	155	28	18	0.30
A3	4	25	3	3	0.24
A5	14	500	17	81	0.20
K1	20	549	53	61	0.21
Total	27	1229	101	163	0.21

¹ see Fig. 6 for colony positions

the breeding ledges, as was the case in 1983; but most breeding sites will be free of snow much earlier.

5. Breeding success

The term breeding success is usually defined as the ratio of fledged young to laid eggs, or to pairs that laid. Since in murre true fledging – attainment of flight – takes place at sea, “fledging” for practical reasons means departure from the colony of the partially grown chick accompanied by the male parent.

In order to measure breeding success, i.e., to determine both the number of eggs and the number of “fledglings”, the colony should be watched closely from laying begins to all chicks have departed. The *k*-factor (the number of pairs laying relative to the number of present birds) can then be calculated if regular counts are made in the colony. Since such a study was not made on Ydre Kitsissut, breeding success in the usual sense cannot be determined. In 1992, however, we counted the number of surviving chicks and eggs in some colonies until the date we left the islands and thereby obtained a measure of the number of offspring produced per bird present.

From Table 3 it appears that the number of surviving eggs and chicks in four colonies or subcolonies on 9 August 1992 amounted to only 21% of the number of present birds (“standard” values, cf. Table 1). Breeding performance was much higher in thick-billed murre at Prince Leopold Island, high-arctic Canada (Gaston & Nettleship 1981) and Digges Island at the junction of Hudson Strait and Hudson Bay (Gaston *et al.* 1985), and

in both murre species at Gannet Islands, Labrador (Birkhead & Nettleship 1987b). If murre at Ydre Kitsissut in 1992 had performed as well as in those studies, the 1,229 birds in Table 3 would have produced about 580–670 hatchlings and 525–625 fledglings. The breeding success of the sample in Table 3 hence seems to be at least 50% below normal.

Qualitative evidence from 1985 (own observations) suggests a much higher breeding success than in 1992, so that the murre performed poorly in 1992 not only compared with other arctic populations, but also compared with Ydre Kitsissut in other years. The depressed breeding success in 1992 was probably connected with the extremely cold and prolonged winter, although the details of this connection are unknown. Neither was it known whether many pairs failed to lay or the breeding attempt failed later. The presence in the colonies of Table 3 of at least 93 abandoned eggs (not included in the table) suggested the latter. Widespread loss of eggs could, for example, be a consequence of human disturbance during the incubation period.

6. Food

The only information on the food of the murre on Ydre Kitsissut comes from a small sample of prey dropped on the ledges by the birds, and from prey seen carried by murre at the colonies (Table 4). These prey items were meant for the chicks and tell nothing about the food of the adults.

Despite the small sample sizes, Table 4 suggests some difference in the prey composition of the two murre species. The common murre almost exclusively took capelin, a pelagic species, whereas the diet of thick-billed murre was more varied and included some benthic species (blennies, sculpin). This difference between the murre species accords with the general pattern found all over their range (Bradstreet & Brown 1985). On the Gannet Islands in Labrador, another Northwest Atlantic mixed colony, Birkhead & Nettleship (1987c) found that more than three quarters of the prey items brought by common murre were capelin, and more than two thirds of those brought by thick-billed murre were daubed shanny. In the pure thick-billed murre colony at Coats

Table 4. Prey (number of items) of murre collected on ledges or (marked by asterisks) seen carried by birds.

Prey species	<i>U. aalge</i>		<i>U. lomvia</i>	length (mm)
	1985	1992	1992	
Fish				
Capelin <i>Mallotus villosus</i>	3	22*	3+6*	112,122,130;77,79,83
Arctic rockling <i>Onogadus argentatus</i>	1	–	–	75
Daubed shanny <i>Leptoclinius maculatus</i>	–	–	4	85,117,119,131
Slender eel-blenny <i>Lumpenus fabricii</i>	–	–	1	92
Two-pronged sculpin <i>Icelus bicornis</i>	–	–	2	70,83
Crustacea, Amphipoda				
<i>Parathemisto</i> sp.	–	–	1	43

Island, Hudson Bay, the chicks were fed benthic and mid-water fishes in proportions 1 : 2 by weight (Gaston *et al.* 1987).

Invertebrates form a minor portion (up to 7% by number) of the diet of thick-billed murre chicks in many colonies but are only occasionally recorded in the diet of common murres (Bradstreet & Brown 1985). In general, as is also reflected in the food of adult murres, common murres seem to specialize in pelagic schooling fish whereas thick-billed murres are better adapted to switch to bottom and invertebrate feeding (Bradstreet & Brown *l.c.*). This difference may influence the distribution of the two species (Springer 1991) and probably also explains why common murres were affected much more strongly than thick-billed murres by a crash in the capelin stock in the Barents Sea in 1985–86 (Vader *et al.* 1990).

7. Bridled murres

The common murre occurs in two forms in the North Atlantic, normal and bridled, the latter being distinguished by a white eye-ring and auricular groove. A frequency of 5.5% bridled common murres on Ydre Kitsissut has previously been reported (Kampp 1985, and in Birkhead 1986). This was based on numbers of birds ringed in 1985 (11 bridled among 200 ringed totally, giving a 95% confidence interval of 3.1–9.0%). In 1992, 2 of 31 common murres ringed were bridled, giving a similar frequency (6%). This is similar to the proportion of bridled common murres in northern Iceland (4–10%), but lower than the proportion found elsewhere in Iceland (13–52%) or in Labrador (17–25%) (figures from Birkhead 1984). This might indicate that Ydre Kitsissut was colonized from northern Iceland. Alternatively, the low bridling frequency on Ydre Kitsissut could be a result of the founder effect (Mayr 1954), i.e., due to chance, since the population was established relatively recently and may well have remained genetically isolated since then.

8. Migration

Of 504 adult thick-billed murres ringed on Ydre Kitsissut in 1985, 10 have subsequently been recovered, all shot (see Appendix for details): one in mid-May in Arsuk Fiord about 60 km from Ydre Kitsissut, 8 during winter (between 26 September and 19 February) along the open-water region of southern West Greenland (Nuuk 6, Maniitsoq 1, Sisimiut 1), and one off Newfoundland in January. Of 39 ringed pulli, one was shot off Newfoundland in January 1986. Of 200 ringed adult common murres three have been recovered; two were shot at Maniitsoq, in October and December respectively, and one near Paamiut in November. Finally, one of 53 ringed common murre chicks was shot near Sisimiut in late September 1985. Curiously, the two northernmost recoveries, from Sisimiut 700 km north of Ydre Kitsissut, were also those

found earliest after the breeding season (26 and 29 September, respectively).

We ringed 36 common murres (31 adults, 5 chicks) and 26 thick-billed murres (14 adults, 12 chicks) in 1992. One thick-billed murre chick was shot near Sisimiut on 16 October 1992.

It appears that the murres (both species) move northwards along West Greenland immediately after the breeding season. Many spend the winter between Nuuk and Sisimiut, but some continue across the Davis Strait and move south to winter off Newfoundland. This fits well with the general migration pattern of arctic-breeding murres in the North Atlantic (Kampp 1988). Characteristically, the autumn migration of virtually all populations follows the surface currents of the ocean, at least initially. The same is the case in auk species whose young are capable of flight when leaving the breeding site (Brown 1985). The reasons are not fully understood, but moving “downstream” could be energetically economical, as long as the foraging conditions are adequate and the birds end up in a favourable wintering area.

Razorbill *Alca torda*

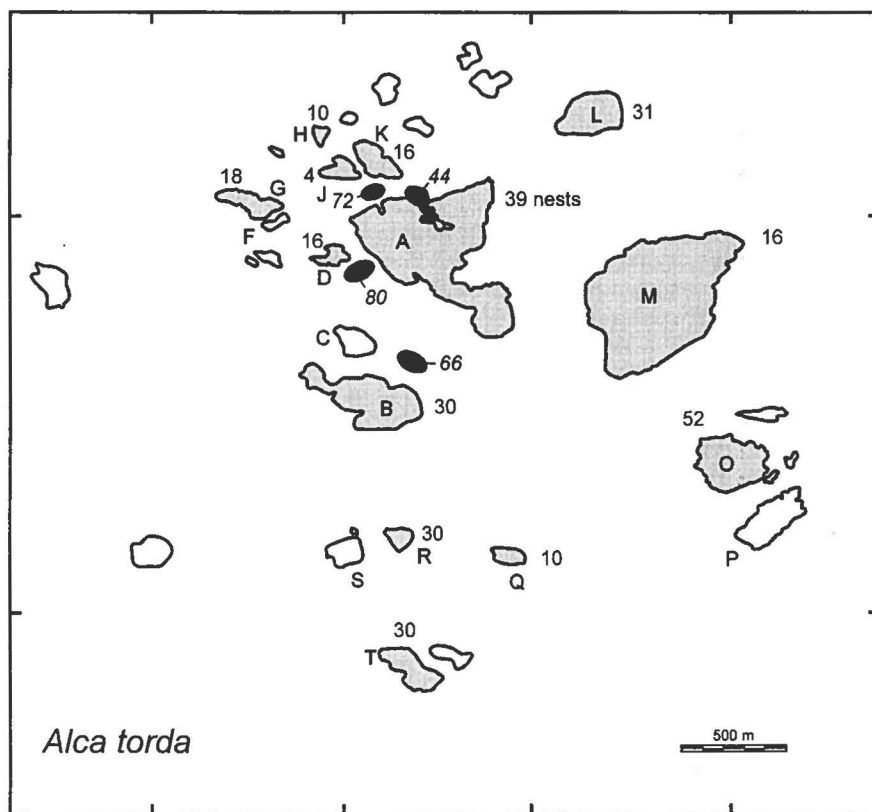
1. Distribution and numbers

In its breeding biology the razorbill resembles the murre species in that a single chick is raised in the colony until about three weeks old, by which time it is feathered (although still without remiges) and has reached 25–30% the weight of an adult (Cramp 1985). The chick then departs the colony accompanied by the male parent and completes its growth and development at sea. Razorbills breed much more dispersed than murres and mostly choose concealed nest sites under boulders or in crevices (Cramp 1985; Harris & Birkhead 1985).

Dispersed nesting at concealed sites makes the razorbill a difficult species to count. Almost all active nests on Tupersuartuut were probably found, but visits to other islands were too short to permit extensive nest-searches. Instead we counted razorbills scared out while we walked through an area or sailed past along the coast. How the counts relate to breeding numbers is not clear, however (Harris 1989).

In case of Tupersuartuut and surrounding islands we also counted rafts of off-duty razorbills which often formed in the narrow straits there. These rafts were usually found in the same limited areas, and the impression was that birds rafting in a particular area belonged to a fairly well-defined stretch of coast, so in principle maximum counts of rafting razorbills could be used to estimate subpopulations attached to certain parts of the islands. In practice, however, additional assumptions must be made because birds from neighbouring islands appeared to raft together with birds from Tupersuartuut, and the nest count on Tupersuartuut was incomplete because nests that failed prior to our arrival went undetected.

Fig. 12. Breeding distribution of razorbill on Ydre Kitsissut in 1992. Islands on which razorbills were seen are hatched; adjacent numbers indicate birds seen on each of these islands (or nests, in case of island A). Recurrent rafts of razorbills on the water are shown in black, with maximum numbers given in italics.



The distribution of razorbills in 1992 is shown in Fig. 12 with maximum numbers of individuals counted, except for Tapersuartaq where the number of nests found is given. The positions of recurrent rafts of razorbills on the water are also shown, with maximum counts recorded.

The total number counted on the islands in 1992 was 263 individuals plus 39 nests on Tapersuartaq. The summed maximum number of four rafts was 262; these apparently comprised most – but not all – birds attached to islands A through K, where 94 individuals (B-K) plus 39 nests (A) were found. If all birds on islands B-K were counted, if all nests on A (Tapersuartaq) were found, and if the entire local population (except one nest-attending adult per surviving nest) from islands A-K was at times rafting together, these islands would have a total of 317 birds and 55 nests. But although these numbers appear quite reasonable, they can at most be regarded as crude approximations. The same holds true for the figures obtained for all islands combined using the same bird : nest proportion, 486 individual razorbills and 85 nests.

In conclusion, 13 islands of the Ydre Kitsissut group seem to support a population of 400–500 razorbills, of which about 100 pairs bred in 1992. A few pairs may have bred on the peripheral islands without being detected, but that would not affect the estimate, given its range. Ydre Kitsissut comprises one of the largest concentrations of razorbills in Greenland, where the total

population is estimated at 1,500–5,500 pairs (Boertmann 1994).

Razorbill numbers apparently did not change much between 1983 and 1992, although estimates in 1983 and 1985 were even more uncertain than in 1992. The population may have grown considerably since 1971, when Salomonsen (1979) saw only two razorbills at Ydre Kitsissut. It is difficult to believe that Salomonsen could have overlooked as conspicuous a bird as the razorbill, but as discussed under the murres, observation conditions during his visit appear to have been extremely difficult so that it is hardly possible to deduct anything firm about razorbill numbers from his report.

2. Breeding phenology

Of 35 nests found on 6–9 August 1992, mostly on Tapersuartaq, 21 contained eggs and 14 contained chicks up to about one week old. An additional six nests were deserted and contained cold eggs. It is possible that even a few of the presumably living eggs were in fact deserted, but most were warm or seen with an adult in attendance, so the median hatching date cannot have been earlier than about 10 August. Assuming that razorbill eggs are not often taken by humans, considering the dispersed and concealed nesting sites, the average hatching date is not

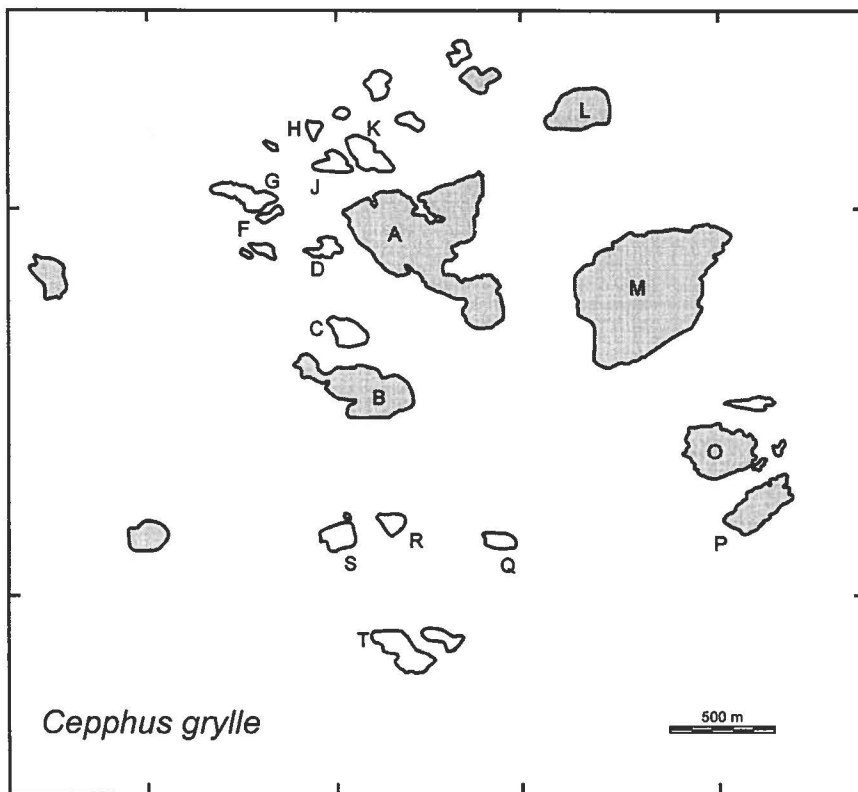


Fig. 13. Islands with breeding black guillemots, Ydre Kitsissut, August 1992.

much affected, so the razorbills (incubation period 35 days; Cramp 1985) apparently laid about one week later than the murres in 1992. Even in 1985, razorbills appeared to breed later than the murres.

3. Food

The diet of the razorbill chick chiefly consists of pelagic fish (Bradstreet & Brown 1985; Cramp 1985). The only information we have from Ydre Kitsissut is the composition of two food loads: one, dropped by an adult in 1985, consisted of one capelin (103 mm) and one arctic rockling (77 mm), and another, carried by a swimming adult in 1992, consisted of four capelin.

Black guillemot *Cepphus grylle*

1. Distribution and numbers

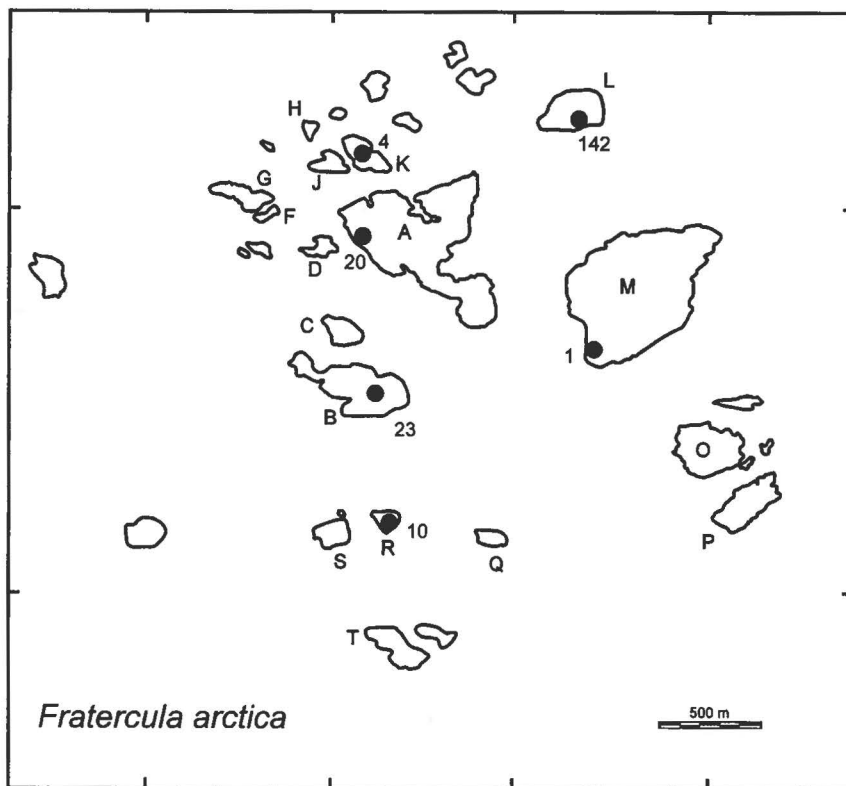
The black guillemot is even more difficult to census than the razorbill because, while also using concealed nest sites, it rarely congregates in large rafts on the water. Large flocks do occur occasionally, but by no means so regularly as in the razorbill. It is therefore difficult to assess the status of the flocking birds, and to determine

the coasts with which they are associated. Otherwise, black guillemots were censused much like the razorbills, by nest counts on Tupersuartaunut and counts of individual birds on other islands, either from a distance from Tupersuartaunut or during brief visits.

The central islands on which black guillemots bred are marked in Fig. 13. The numbers counted in 1992 amounted to 42 nests on Tupersuartaunut and 65 individuals off presumed breeding sites elsewhere in the central group. An additional 10 birds were seen at the western group of peripheral islands. Flocks of between 14 and 52 were seen on various occasions around Tupersuartaunut, and sometimes flocks were also seen at locations without breeding colonies (most notably 80–100 at the north coast of Thorstein Islænder on 30 July). These numbers say little of the actual population on Ydre Kitsissut, however. Not only is the species difficult to census, and little time was used to count black guillemots in 1992, but it also suffered a low breeding success in that year (see below). The species does seem to be lacking on many of the central islands, however. The peripheral islands were only examined superficially by us, and we never got close to the southernmost island of the group where Salomonson (1979) counted 70 black guillemots in 1971.

On the given data, the total black guillemot population on Ydre Kitsissut can only be estimated very roughly at 50–75 pairs for Tupersuartaunut and two-three times this number for the entire group.

Fig. 14. Breeding sites of puffins on Ydre Kitsissut, August 1992. Numbers indicate maximum numbers of birds recorded at each site.



2. Breeding phenology and breeding success

The black guillemots bred late in 1992. Of 34 nests examined, 10 held eggs and 24 held chicks, although a few of the nests containing eggs may have been deserted. Only 5 of the broods appeared to have hatched before 1 August. The contrast to the situation in 1985 was striking: ten nests found between 25 July and 8 August that year all contained chicks, which apparently had hatched between 12–22 July.

Judging from the small sample of 10 nests, the black guillemots also reproduced very successfully in 1985, because 8 of these nests had two chicks, giving a mean of 1.8 young per nest. In 1992, the situation was very different: 18 nests contained a total of only 22 surviving chicks (1.2 per nest), together with 6 dead chicks and 5 cold eggs. The poor breeding performance of the black guillemot in 1992 undoubtedly was connected with the severe winter conditions prevailing until late June.

3. Food

Black guillemot chicks are fed a diet of benthic inshore fish (Bradstreet & Brown 1985; Cramp 1985). We noted a few prey carried by adult black guillemots in 1992: 2 capelin, 2 butterfish *Pholis fasciatus*, and 3 sculpins (probably *Icelus bicornis*).

Atlantic puffin *Fratercula arctica*

Like the razorbill and black guillemot, the puffin uses concealed nesting sites. It is also a relatively shy species in Greenland and will usually leave the nest when approached by a human on foot. Birds scared off in this way will often congregate on the sea off the colony, but these flocks will normally comprise only a proportion of the puffins present. As activity above ground at colonies also seems to be low, at least late in the summer, counts tend to underestimate true numbers. This was made clear particularly in the afternoon of 7 August 1992 when the puffins were extraordinarily active, sitting and running on the ground in the colonies and flying to and fro. The weather at the time was mild and calm with a slight drizzle. Counts from a distance made on this day exceeded previous estimates at all colonies, and some small colonies were detected for the first time.

Total maximum numbers in 1992 add up to 200 puffins distributed on 6 islands (Fig. 14). There is no basis for estimating numbers of breeding pairs. Puffins often nest in inconspicuous crevices and almost all nests are inaccessible. Furthermore, puffins at Ydre Kitsissut may breed late, or suffer low nesting success; no fish-carrying birds were seen in 1985, and only one was recorded in 1992.

There are no indications of either an increase or a

decrease in the population between 1985 and 1992. In both years the number of puffins recorded in the colony on island A was 20, and except for 7 August 1992, maximum counts from Tupersuartuut of the colony on island L were 42 and 40, respectively, in 1985 and 1992. Salomonsen (1979) saw only one puffin in 1971, but as discussed previously (see murre and razorbill), observation conditions were so poor during his visit that this cannot be considered an indication of an increased puffin population since then.

Puffin colonies in Greenland are generally small, rarely comprising more than 100–200 birds (Nettleship & Evans 1985, GM & OC 1993). The total population is estimated at 1,500–3,000 pairs (Boertmann 1994).

Raven *Corvus corax*

A few ravens frequent Ydre Kitsissut in summer but probably do not breed there. At least two birds were seen on several occasions in June 1983, and single birds in both 1985 and 1992. In addition, a dead raven was found on Tupersuartuut in 1992.

Snow bunting *Plectrophenax nivalis*

The snow bunting is a scarce breeder on Ydre Kitsissut. Two pairs stayed on Tupersuartuut on 11–14 June 1983. Likewise on Tupersuartuut, a pair attended fledged young at our arrival both in 1985 and in 1992, on 25 July and 30 July respectively, and another family party was found on Thorstein Islander on 3 August 1985.

Other species

Several other bird species have been recorded on Ydre Kitsissut, but their occurrence there is accidental and none can be said properly to belong to the bird community of the islands. Some are seabirds commonly occurring at sea around Ydre Kitsissut, of which we recorded arctic skua *Stercorarius parasiticus* (two birds in 1992), long-tailed duck *Clangula hyemalis* (one bird in 1992) and little auk *Alle alle* (two corpses found in 1992, apparently killed by a gyrfalcon during winter or spring). Others are migrants such as purple sandpiper *Calidris maritima* (2 in 1983, 5 in 1985, 1 in 1992), red-necked phalarope *Phalaropus lobatus* (4 in 1992), and Lapland bunting *Calcarius lapponicus* (3–4 on 13 June 1983). More surprising, perhaps, was the presence on Tupersuartuut of 6 single American pipits *Anthus rubescens* on 11–14 June 1983. These birds must have been late spring migrants. The species is usually thought of as rare in Greenland, with only three confirmed breeding records, all from Qeqertarsuaq on Disko Island (cf. Kampp 1985). It has, however, been observed in presumed breeding

habitat along the entire west coast, from the Qaqortoq area (own observations) to Avanersuaq district (Best & Higgs 1990). It appears to prefer coastal areas and may be fairly common locally (e.g. southwestern Svartenhuk, Bennike 1990), as is also suggested by the frequent sightings of autumn migrants in August and September (Salomonsen 1967; own observations).

Discussion

Our coverage of the peripheral islands of Ydre Kitsissut was incomplete and superficial, but sufficient to show that most breeding seabirds are concentrated to the central islands. One reason may be that the coasts of the central islands are partly sheltered from waves and swell. This is particularly true of the narrow straits north and west of Tupersuartuut, where some breeding ledges of murre are only 1–2 m above the water. It may also be that the availability of steep cliffs restricts the distribution and numbers of murre. Most of the apparently suitable cliffs are already occupied, although it is never easy for an observer to tell if unoccupied cliffs would be suitable for birds.

Apart from nesting habitat, sufficient food within foraging range is a precondition of successful colonization by seabirds anywhere. Detailed knowledge of productivity and marine food webs in the waters surrounding Ydre Kitsissut is lacking, but food availability must obviously be sufficient to support the various species at, at least, their present population levels. The main attraction of Ydre Kitsissut to seabirds may simply be that they are situated in productive waters and farther out at sea than other islands in the area. The extraordinary diversity of this seabird community is probably favoured by the proximity of deep waters, combined with the existence of extensive areas of shallow water between and around the islands.

Fulmars as well as murre colonized Ydre Kitsissut shortly before 1950. Salomonsen (1979) regarded the fulmar's colonization of southwestern Greenland as a late episode in the dramatic expansion of Atlantic boreal fulmars over the past 250 years (Salomonsen 1965).

The thick-billed murre were believed by Salomonsen (1979) to be immigrants from other colonies in the area that, due to excessive hunting, disappeared at roughly the same time Ydre Kitsissut was colonized. As described previously, murre on Ydre Kitsissut are not safe from egg (although they are not known to be hunted there), but remoteness, rough seas and pack ice probably offer some protection, making boat trips to the islands relatively infrequent. Adult auks generally display a high degree of fidelity to their breeding sites (Birkhead *et al.* 1985; Hudson 1985), and no instances of colony interchange of established breeders are known even in the well-studied British population of puffins (Harris 1984; Harris & Wanless 1991). Young birds, however, may

settle as breeders away from their natal colony; this may be the case for as much as half of the puffins hatched on the Isle of May in Britain (Harris & Wanless 1991) and is known to occur also in the common murre, although less frequently (Lyngs 1993). Ydre Kitsissut could thus have attracted recruits born in other colonies where disturbance and predation from humans occurred frequently. It may even be that Ydre Kitsissut in turn supplied recruits to another new colony founded around 1970 in Arsuk Fiord (cf. Salomonsen 1979).

There are no indications that dramatic changes in seabird populations on Ydre Kitsissut have occurred during the last 25 years. Salomonsen (1979) did report many more murrelets in 1971 than were present in 1983 and later, whereas other species (common murre, razorbill, puffin) were seen in very low numbers or not at all. But as mentioned previously, observation conditions during Salomonsen's visit were difficult, and the single colony photographed by Salomonsen did not look much different from its present appearance (Fig. 11). It is therefore not acceptable to use Salomonsen's count figures as evidence for changes in bird populations between 1971 and 1983.

Population changes between our 1983 and 1992 visits are not obvious either. The main difficulties in making valid comparisons between counts from different years were the different parts of the breeding season covered, the different observation conditions during the visits and the low breeding success of most species in 1992. The apparent decrease in 1992 compared with 1983 and 1985 of fulmars and great black-backed gulls, and to a lesser extent of murrelets, could be due to a greater number of birds being free of parental duties and staying away from the colony.

The low breeding success in 1992 was probably due to the unusually cold weather that prevailed until late June, combined with eggging. Black guillemots (breeding in inaccessible crevices) and gulls (being scattered over many islands) would probably not lose many eggs to humans, so in these species the cold spring is the most likely explanation for low reproduction. Murre eggs, however, are taken in most years, apparently in large numbers, and the birds might be less likely to relay if in relatively poor condition.

The taking of eggs did seem to delay the breeding schedule of the murrelets, as indicated by the relatively fewer eggs and more advanced chicks on ledges believed by us to be inaccessible to humans. However, a generally reduced breeding success on accessible ledges, compared with inaccessible ledges, was not apparent in the K1 colony (Table 2), and in the presumably inaccessible colony A5 the success was just as low as in other colonies (Table 3). This failure to relate eggging to low breeding success was probably a consequence of our rough measure of breeding success (eggs or chicks per present adult), combined with the high level of disturbance caused by eggging activity and associated traffic in both accessible and inaccessible parts of the colony. When murrelets are scared off their ledges, there is a risk that eggs

will roll away and either drop off the cliff or end up in pools or cracks from where they cannot be retrieved by the birds. The risk that eggs will be lost in this way depends on the local topography (e.g., width and slope of the ledges) rather than the accessibility of the site, and disturbance effects therefore tend to blur the relationship between eggging and breeding failure, especially if the sample of sites available for examination is small.

Even though we cannot measure the effect of eggging on Ydre Kitsissut precisely, it is an illegal activity that grossly violates the bird reserve status of the islands and the hunting regulations of the country. It is a little ironic that a photo from Ydre Kitsissut was chosen to exemplify the biologically important sites needing protection, according to a book on nature conservation in Greenland produced in cooperation with the Home Rule government (Egede 1991: 23). As discussed more fully in Kampff *et al.* (1994), modern and perhaps adequate regulations of bird hunting in Greenland were introduced in 1988, although – as is to be expected in a traditional hunting community – they are still rather liberal and unrestrictive. But enforcement is weak, and there is an urgent need of public education aimed at changing people's concepts and attitudes towards wildlife and wildlife management.

Acknowledgements

We wish to express our gratitude to the Danish Meteorological Institute (DMI) for permission to use the hut and other facilities at the weather station on Ydre Kitsissut, for letting one of us (KK) join the maintenance team during its visit in June 1983, and for providing meteorological data. To Forsvarskommandoen (the Danish Defence Ministry) and the Naval Command of Greenland for transport to and from Ydre Kitsissut and free flights between Denmark and Greenland. To the crew of the various inspection vessels on which we had the pleasure of being guests. To Anders Schwägermann for identifying fish specimens. To Flemming Jensen of the DMI for providing information and maps at the initial stage of this project. And to Søren Møller for assistance and good company during the field work in 1985. The manuscript benefitted greatly from helpful comments from Martin Heubeck and an anonymous referee. The work in 1985 was supported by a grant from the Commission for Scientific Research in Greenland, and the work in 1992 by a grant from the secretariat of the Inuit Circumpolar Conference in Nuuk. Permission to work in the bird reserve was obtained from the department for Environment and Wildlife Management in Nuuk by the kind assistance of Peter Nielsen.

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Appendix

Recoveries of *Uria* spp. ringed at Ydre Kitsissut. All 16 birds were shot.

U. lomvia

Number ringed:

1985: 504 adults, 39 young; 1992: 14 adults, 12 young

4135110	27/7	1985	adult
	20/1	1989	Bonavista Bay, Newfoundland 49°01'N 53°30'W
4135119	27/7	1985	adult
	21/10	1989	Angisunnguaq, Nuuk 64°02'N 51°44'W
4135620	26/7	1985	young
	20/1	1986	Quirpon, Newfoundland 51°35'N 55°20'W
4136033	3/8	1985	adult
	26/9	1987	Sisimiut 66°55'N 53°40'W
4136511	27/7	1985	adult
	14/1	1986	Atammik, Maniitsoq 64°48'N 52°12'W
4136522	27/7	1985	adult
	15/12	1991	Kookøerne, Nuuk 64°02'N 52°10'W
4136548	27/7	1985	adult
	15/5	1986	Kangilinnuguit, Ivittuut 61°14'N 48°08'W
4136585	29/7	1985	adult
	19/2	1994	Nuuk 64°11'N 51°45'W
4136662	31/7	1985	adult
	11/1	1986	Nuuk 64°15'N 51°40'W
4136694	2/8	1985	adult
	21/1	1989	Kangeq, Nuuk 64°06'N 52°05'W
4136706	31/7	1985	adult
	26/10	1993	Kangeq, Nuuk 64°05'N 52°05'W
4137072	9/8	1992	young
	16/10	1992	Amerloq, Sisimiut 66°50'N 53°30'W

U. aalge

Number ringed:

1985: 200 adults, 53 young; 1992: 31 adults, 5 young

4135148	28/7	1985	adult
	18/10	1993	Kangaamiut, Maniitsoq 65°50'N 53°20'W
4136111	5/8	1985	young
	29/9	1985	Amerloq, Sisimiut 66°55'N 53°30'W
4136136	5/8	1985	adult
	3/12	1990	Maniitsoq 65°25'N 52°55'W
4136146	6/8	1985	adult
	23/11	1992	Saattuarsussuaq, Paamiut 61°58'N 49°45'W

Meddelelser om Grønland, BIOSCIENCE

An annotated checklist to the birds of Greenland

DAVID BOERTMANN

Boertmann, D. 1994. An annotated checklist to the birds of Greenland. – Meddr Grønland, Biosci. 38, 63 pp. Copenhagen 1994-03-28.

The most recent total account of the birds of Greenland was published in the late sixties (Salomonsen 1967). Since that, major changes have been recorded in the status and occurrence of several species. One species have disappeared (Barrow's Golden eye) and 28 new vagrants have been added to the list.

This checklist gives a current account on the birds occurring in Greenland. 235 species have been recorded. About 58 are well established breeders, c. 17 are regular (some numerous) visitors and the rest are more or less rare vagrants. Some of the visitors may breed occasionally and some are probably in the initiating phase of an immigration to Greenland. Although many vagrants have only been recorded once, some of them may occur more commonly or even annually.

The present status is described for each species and if possible also population numbers and trends. When relevant, issues as subspecies, habitats and migration are discussed or described briefly.

Keywords: birds, Greenland, status, distribution, population trends, population numbers, phenology.

BIOSCIENCE 38 . 1994
ISBN 87-601-4129-8

David Boertmann, Greenland Environmental Research Institute, Tagensvej 135, 4., DK-2200 Copenhagen N, Denmark.

Overview of the special issue “Studies of white whales (*Delphinapterus leucas*) and narwhals (*Monodon monoceros*) in Greenland and adjacent waters”

RANDALL R. REEVES, RUNE DIETZ and ERIK W. BORN

Reeves, R. R., Dietz, R. & Born, E. W. 1994. Overview of the special issue “Studies of white whales (*Delphinapterus leucas*) and narwhals (*Monodon monoceros*) in Greenland and adjacent waters”. – Meddr Grønland, Biosci. 39: 3–11. Copenhagen 1994-04-22.

This overview introduces the collection of papers on the Distribution and abundance; Exploitation and status; Habitat use and behaviour; and Life history, stock identity and toxicology of white whales (*Delphinapterus leucas*) and narwhals (*Monodon monoceros*) in Greenland and adjacent waters. It includes brief summaries of the 19 included papers and calls attention to ongoing and future studies on the same or related subjects.

Key Words:

White whale, beluga, *Delphinapterus leucas*, narwhal, *Monodon monoceros*, Greenland, eastern Canadian Arctic, Svalbard.

Randall R. Reeves, Okapi Wildlife Associates, 27 Chandler Lane, Hudson, Québec, JOP 1H0 Canada. Rune Dietz, Greenland Environmental Research Institute, Tagensvej 135, DK-2200, Copenhagen N, Denmark. Erik W. Born, Marine Mammal Section, Greenland Fisheries Research Institute, Tagensvej 135, DK-2200, Copenhagen N, Denmark.

BIOSCIENCE 39 . 1994
ISBN 87-601-4130-1

The Atlantic walrus (*Odobenus rosmarus rosmarus*) in West Greenland

ERIK W. BORN, MADS P. HEIDE-JØRGENSEN and ROLPH A. DAVIS

Born, E. W., Heide-Jørgensen M. P. & Davis, R. A. 1994. The Atlantic walrus (*Odobenus rosmarus rosmarus*) in West Greenland. – Meddr Grønland, Biosci. 40: 3-33. Copenhagen 1994-05-30.

In the early part of the 20th century Atlantic walruses (*Odobenus rosmarus rosmarus*) occurred abundantly between approximately 66°N and 70°45'N in Central West Greenland from September until mid June. Between September and December several hundred walruses hauled out on small islands and promontories between the entrance to Nassuttooq (Nordre Strømfjord, approx. 67°30'N) and approximately 67°45'N, south of the settlement of Attu. From 1911, the hunt for walruses at terrestrial haul out sites was intensified, and by the late 1930s the walruses had abandoned the terrestrial haul outs in this area. Between 1911 and the early 1940s, the catches of walruses in western Greenland (excluding the Avanersuaq/Thule area) increased rapidly, reaching a maximum of more than 600 animals reported for 1938 and 1940. Mainly reproductive females were caught and the proportion of unretrieved kills was high. Between the early 1940s and the mid 1960s catches decreased rapidly, apparently reflecting a decrease in the stock of walruses wintering off Central West Greenland. Between 1965 and 1987, the recorded annual catch in western Greenland south of 76°N averaged 56 walruses (SD = 19.7; range 19–101 animals). It is estimated that during this period the total number of walruses removed by hunting was about 100 per year. Comparisons of the results of systematic aerial surveys conducted in early spring of 1981, 1982, 1984, 1990 and 1991 over the walrus wintering grounds at Central West Greenland revealed no trend in abundance. The line transect methods used in the 1990 and 1991 surveys gave higher and more robust estimates of abundance than the strip censuses used in the previous surveys, and resulted in estimates of abundance of about 500 walruses (not corrected for submerged animals). The stock structure of the total walrus population in the Baffin Bay and Davis Strait regions is obscure. However, this study has shown that the numbers of walruses in Central West Greenland are much lower than historical levels, and that walruses in this area are vulnerable.

Key words:

Atlantic walrus, *Odobenus rosmarus*, West Greenland, distribution, catch, aerial surveys, line transect.

Erik W. Born and Mads P. Heide-Jørgensen, Greenland Fisheries Research Institute, Marine Mammal Section, Tagensvej 135, DK-2200 Copenhagen N, Denmark. Rolph A. Davis, LGL Ltd. Environmental Research Associates, 22 Fisher Street, P.O. Box 280, King City, Ontario, L0G 1K0 Canada.

BIOSCIENCE 40 . 1994
ISBN 87-601-4290-1

Studies on Freshwater Entomostraca in Greenland VI

The Entomostraca of the Kap Farvel Area, Southernmost Greenland

ULRIK RØEN

Røen, U. 1994. Studies on Freshwater Entomostraca in Greenland VI. The Entomostraca of the Kap Farvel Area, Southernmost Greenland. – Meddr Grønland, Biosci. 41, xx pp. Copenhagen 1994-xx-xx.

Freshwater crustaceans of the groups Cladocera, Ostracoda and Copepoda were investigated in the Kap Farvel area, the southernmost part of Greenland. Collections were made at 158 freshwater localities, and 42 species were found. Maps of the distribution of the species in the area are given. On the basis of distribution, number of species and specimens per locality, and the water chemistry and temperature, a zoogeographical boundary is suggested between the eastern and the western parts of the area.

Key words: Southernmost Greenland, freshwater, Crustacea, zoogeography.

BIOSCIENCE 41 . 1994
ISBN 87-601-4255-3

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Tarling, D. H. 1967. The palaeomagnetic properties of some Tertiary lavas from East Greenland. – Earth and Planetary Science Letters 3: 81–88.

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