

## DIFFERENTIAL RESPONSES OF COMMON AND THICK-BILLED MURRES TO A CRASH IN THE CAPELIN STOCK IN THE SOUTHERN BARENTS SEA

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*Abstract.* Common Murres (*Uria aalge*) and Thick-billed Murres (*U. lomvia*) are common breeding birds in the Barents Sea, with complementary but overlapping distributions. Along the coast of North Norway, west of the North Cape, murre populations have been decreasing at least since 1965, probably as a result of breeding birds drowning in fishing nets. East of the North Cape and probably on Bear Island the populations have at least been stable until 1985. After 1985, numbers of breeding Common Murres decreased steeply in the entire area, by 70–85% in North Norway and ca. 90% on Bear Island, while populations of Thick-billed Murres decreased only slightly on the mainland and not at all on Bear Island. The numbers of murres wintering in the Barents Sea also decreased after 1986. It is thought that the differential decrease in numbers of breeding birds was a direct result of the sudden collapse of the Barents Sea capelin (*Mallotus villosus*) stock in 1985 and 1986, on which the Common Murres, but not the Thick-billed Murres, totally depended.

*Key Words:* Common Murre; Thick-billed Murre; *Uria aalge*; *Uria lomvia*.; capelin; population decline.

Common Murres (*Uria aalge*) and Thick-billed Murres (*U. lomvia*) are large alcids with partly overlapping holarctic distributions in the boreal, low- and high-arctic regions (cf. Nettleship and Evans 1985). Birkhead and Nettleship (1987a, b, c) have recently shown that the two species have a similar nesting biology, although with significant differences in timing of breeding and chick diet.

The Barents Sea is shallow and very productive (Zenkievitch 1963, Wassman and Sakshaug 1987) with a diverse, mainly subarctic seabird fauna (Norderhaug et al. 1977, Golovkin 1984). Both murre species breed in the area, with *U. aalge* more numerous along the coast of Europe and *U. lomvia* on the arctic islands (Fig. 1). Both species also winter in the area, although some Spitsbergen Thick-billed Murres move to Greenland in winter (Brown 1985).

This paper documents recent changes in the breeding populations of both species in what is considered to be a direct response to a collapse in the Barents Sea capelin stock.

### METHODS

In the 1960s and 1970s the sizes of the breeding populations of Common Murres and Thick-billed Murres in North Norway were estimated by Brun (1965, 1969, 1979). Brun repeated some of his counts at intervals of several years and documented large changes (Brun 1979). Since 1980 the breeding populations of Common Murres and Thick-billed Murres have been monitored on Hornøy (Fig. 1) through almost annual counts of individuals on selected plots, plus total counts of all individuals in the colony (see Folkestad 1984). In 1985, a similar monitoring scheme was initiated on Hjelmsøy and Syltefjord (Fig. 1), the then two biggest

Common Murre colonies in Norway. Data on the breeding success of murres and other seabird species breeding in the region were otherwise collected annually either through direct observations in the field or through reports sent to the authors.

A survey of the distribution of seabirds at sea in the Barents Sea north to 74°30'N was initiated in 1985. This survey was conducted through a series of at-sea transects and counts from ships and the air both during and, mostly, outside the breeding season (Strann and Vader 1987, Erikstad et al. 1990, Erikstad unpubl.).

Data on the diets of murres were gathered either through direct analyses of the contents of the stomachs of birds shot at sea, direct observations of fish either brought in to chicks or dropped on the breeding ledges, or through a literature review.

### RESULTS

Between 1965 and 1985 the numbers of Common Murres nesting in northern Norway, west of the North Cape, decreased, whereas they were stable (Syltefjord) or increased (Hornøy) at sites east of the North Cape (Table 1).

After 1985 there was a dramatic drop in the numbers of Common Murres breeding at all colonies, including the two eastern colonies, Hornøy and Syltefjord (Table 1). Numbers of birds in the monitoring plots on Hjelmsøy, Syltefjord and Hornøy dropped by as much as 90% between 1986 and 1987 (unpubl.), as did single counts of the total numbers at each colony (Table 1). Although the absolute numbers of Thick-billed Murres also decreased at some of these colonies, they did so to a lesser extent than for Common Murres (Table 1). On Bear Island, where the numbers of breeding murres had been counted for the first time in 1986, Common Murres de-

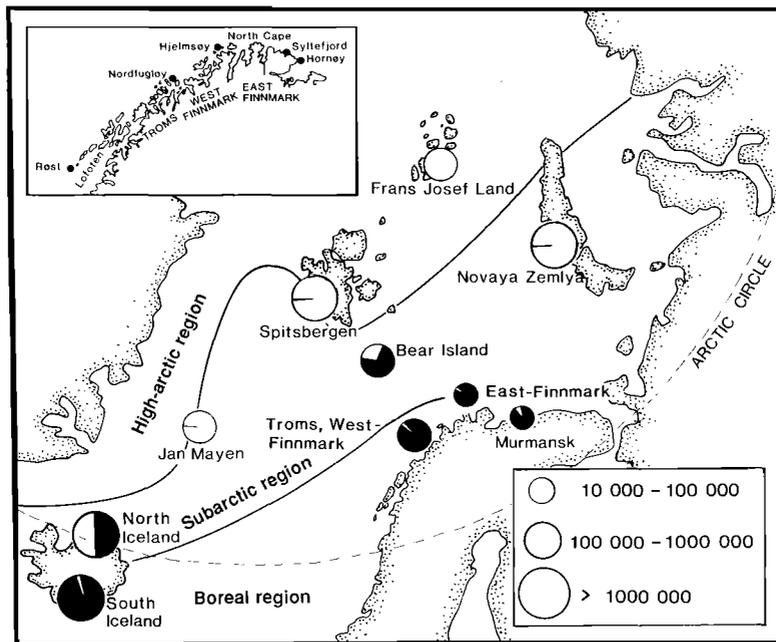


FIGURE 1. Approximate numbers and relative frequency of Common Murres (shaded circles) and Thick-billed Murres (open circles) breeding in the Barents Sea and adjacent N.E. Atlantic (Data from Einarsson 1979, Barrett and Vader 1984, Golovkin 1984, Mehlum and Fjeld 1987, and V. Bakken, pers. comm.). The boundaries of the boreal, low- and high-arctic regions are from Nettleship and Evans (1985).

creased by about 90% from 1986 to 1987, while numbers of Thick-billed Murres remained at least stable (Bakken and Mehlum 1988).

Data collected at sea in the Barents Sea in January–February 1986 and 1987 also show that the numbers of both murre species decreased, each by ca. 70% between the two surveys, and they were nearly completely missing from the traditional capelin (*Mallotus villosus*) areas in 1987 (Erikstad unpubl.).

## DISCUSSION

It is thought that the decline in Common Murre numbers in North Norway has occurred as a result of two major negative factors and in two stages: before and up to 1985, and post-1985.

### PRE-1985

In the Lofoten Islands, west of the North Cape, Common Murres have suffered from food shortages at least since 1970. This, together with a complementary increase in predation pressure through netting, may partly explain the decline on Røst from ca. 11,000 pairs in 1960–1964 to fewer than 1000 pairs in 1988 (Tschanz and Barth 1978, Folkestad 1984, Bakken 1989). In this same area Atlantic Puffins (*Fratercula arctica*) were equally hard hit (Lid 1981, Anker-Nilssen 1987,

Barrett et al. 1987). What little data exist on the food situation and breeding success farther north, on Nord-Fugløy and Hjelmsøy, suggests that murres there have not suffered from food shortages to the same degree shown on Røst. We attribute the steep decline in murre numbers at these colonies more to drowning in fishing nets than to reproduction failure. In early spring, cod (*Gadus morhua*) fisheries occasionally kill very large numbers (> 100,000 in 1985), whereas large summer driftnet and, until the early 1970s, long-line fisheries for salmon regularly drown thousands of local breeding birds (Brun 1979, Vader and Barrett 1982, Strann et al. 1990).

East of the North Cape, where salmon driftnets are not permitted, the size of the murre colonies increased between 1975 and 1985 (Table 1).

### POST-1985

Between 1985 and 1987, the numbers of breeding murres on all colonies suddenly declined very steeply, on both sides of the North Cape, thereby ruling out salmon fishing as the only cause. Circumstantial evidence points towards a sudden food shortage being the major factor.

Belopol'skii (1957), working in the eastern Barents Sea, classified the Common Murre as a

TABLE 1. CHANGES IN NUMBERS OF COMMON MURRES (*Uria aalge*) AND THICK-BILLED MURRES (*U. lomvia*) BREEDING AT FOUR COLONIES IN NORTH NORWAY, 1965–1987 (FROM BRUN 1965, 1969, 1979; BARRETT AND VADER 1984; THIS STUDY)

	No. of individuals					% change	
	1965	1975	1985	1986	1987	1965–1985	1985–1987
<b>Common Murre</b>							
Nord Fugløy <sup>1</sup>	30,000	8000	200	<100	—	–99	No data
Hjelmsøy <sup>1</sup>	220,000	140,000	22,000	10,000	2000	–99	–80
Syltefjord <sup>2</sup>	25,000	18,000	22,000	18,000	3000	–12	–83
Hornøy <sup>2</sup>	1450	1000	7500	—	1600	+500	–79
<b>Thick-billed Murre</b>							
Hjelmsøy <sup>1</sup>	>2000	1700	740	220	275	–ca. 60	–63
Syltefjord <sup>2</sup>	(present)	180	1600	2000	1000	+ca. 800	–37
Hornøy <sup>2</sup>	110	—	450	—	300	+310	–33

<sup>1</sup> West of North Cape.

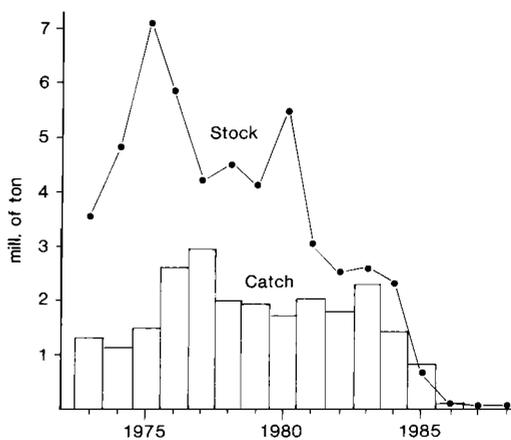
<sup>2</sup> East of North Cape.

stenophagous fish-eater and the Thick-billed Murre as polyphagous, with a tendency toward stenophagy during the nesting period. This view has been strengthened by later diet studies in the North Atlantic (Bradstreet and Brown 1985). While both feed on pelagic fish when locally abundant (Tuck 1961, Erikstad and Vader 1989, Tables 2 and 3), the Thick-billed Murre is better adapted to bottom exploitation and invertebrate feeding than the Common Murre (Spring 1971).

Until 1985, the smelt-like capelin was one of the dominating pelagic fish species in the Barents Sea and was a key species in this sea's ecosystem (Hamre 1986). Likewise, the coastal stocks of sand lance (*Ammodytes* spp.) were important prey for predatory fish (e.g., cod) and seabirds in North Norway (Furness and Barrett 1985, Pethon 1985, Haug and Sundby 1987). Between 1985 and 1987, the Barents Sea stock of capelin collapsed completely (Fig. 2), and in 1987 fishermen noted a near complete absence of sand lance along the coast of West Finnmark (pers. obs., T. Haug pers. comm.). The latter resulted in a complete breeding failure at a large colony (>2000 pairs) of Shags (*Phalacrocorax aristotelis*) in West Finnmark, where Shags are normally totally dependent on sand lance during the breeding season (pers. obs.). Fisheries scientists do not fully understand why the capelin vanished so quickly, but causes probably include overfishing, uncommonly large year-classes of the predatory cod after 1983, and a reduction in recruitment due to changes in the physical oceanography of the Barents Sea (Hamre 1986, Ushakov and Ozhigin 1986).

In January 1987, several thousand dead Common Murres were washed ashore along the coast of North Norway. Analyses of organochlorine and heavy metal levels in their livers ruled out

death by poisoning. The birds were emaciated and it is thought that they died of starvation. Dead Common Murres were also reported washed ashore in East Finnmark during the early summer of 1987, but no samples were taken for pollution analysis. No Thick-billed Murres were reported dead in the two incidents. In March 1987, Thick-billed Murres shot in the central Barents Sea were in good body condition, the majority having a fat index (measured according to Jones et al. 1982) of 2–3 (Erikstad 1990). Virtually no Common Murres were seen. It appears that during the winter 1986/1987, Common Murres either died of starvation or left the Barents Sea, while Thick-billed Murres fared better.



Capelin *Mallotus villosus* in the Barents Sea 1970–1987

FIGURE 2. Estimated stock and total catch of the capelin (*Mallotus villosus*) in the Barents Sea, 1973–1987 (Hamre 1986 and pers. comm.).

TABLE 2. WINTER DIETS OF COMMON MURRES (*Uria aalge*) AND THICK-BILLED MURRES (*U. lomvia*) IN AREAS IN THE NORTH ATLANTIC WHERE THEY ARE NORMALLY SYMPATRIC

Area	Common Murre	Thick-billed Murre	Source
Finnmark coast April 1986	100% capelin	100% capelin	Erikstad and Vader 1989
Troms coast April 1985	Mostly capelin	Mostly capelin	Strann et al. 1990
S. Barents Sea March 1987	not present	Mainly gadids and crustacea	Erikstad 1990
Newfoundland Winter ca. 1955	90% capelin	90% capelin	Tuck 1961
Newfoundland Winter 1981-1983	not studied	Mostly young cod, squid, crustacea	Gaston et al. 1983

Those collected in March had remains of gadids and crustaceans in their stomachs (Erikstad 1990).

There are few data on adult murre diets from localities where both species occur (Table 2). Tuck (1961) found capelin to be absolutely dominant in both species wintering off Newfoundland, but later data have shown that at least within 10 km of the Newfoundland coast young cod, squid and crustaceans are also important winter prey of the Thick-billed Murre (Gaston et al. 1983). In East Finnmark, during the 1986 capelin spawning season, both species fed exclusively on capelin (Erikstad and Vader 1989), as did the very large concentrations of Common Murres drowned in fishing nets in Troms in spring 1985 (Strann et al. 1990) (Table 2). Thick-billed Murres collected near the ice-edge at 77-80°N, 18-23°E in July-August 1986 had mainly fed on amphipods (Lønne et al. MS), whereas stomachs of birds collected farther south, at ca. 75°N, 30°E, contained mostly gadid fish (cod and arctic cod *Boreogadus saida*) and krill (Erikstad 1990).

Although these North Atlantic studies (see also Bradstreet and Brown [1985] and Blake et al.

[1985]) plus several from the Pacific (Springer et al. 1984, 1986; Ogi et al. 1985) support the notion that adult Common Murres specialize on small pelagic, schooling fish and that Thick-billed Murres eat both fish and crustaceans, Ogi et al. (1985), Blake et al. (1985) and Sanger (1987) show that at certain times and in certain areas Common Murres can rely heavily on invertebrates. The general picture, however, supports Spring's (1971) conclusion that both species will feed on any readily available, pelagic organism, but that, unlike the Common Murre, the Thick-billed Murre is better adapted to switch to bottom and invertebrate feeding in the absence of pelagic food sources.

The chick diets of murres breeding sympatrically in the North Atlantic consist exclusively of fish for both species (Table 3; Bradstreet and Brown 1985). Nevertheless there is a clear difference; Common Murres catch pelagic, schooling fish, whereas Thick-billed Murres also take many demersal organisms (Bradstreet and Brown 1985). On Hjelmsøya, West Finnmark in 1983, before the crash in the capelin stock, Common

TABLE 3. CHICK DIETS OF SYMPATRICALLY BREEDING COMMON MURRES (*Uria aalge*) AND THICK-BILLED MURRES (*U. lomvia*) IN CANADA AND THE BARENTS SEA

Area	Common Murre	Thick-billed Murre	Source
Labrador 1982-1983	75% capelin 10-15% gadids 10-15% <i>Lumpenus</i>	20-30% capelin 65-70% <i>Lumpenus</i>	Birkhead and Nettleship 1987c
Hornøy 1983	60% capelin 40% sand lance	25% capelin 75% sand lance	Furness and Barrett 1985
Hjelmsøya 1983	99% capelin <sup>1</sup>	33% capelin <sup>2</sup> 22% sand lance 24% squid	This study
Seven Islands 1938	86% sand lance 18% herring	80% sand lance 16% herring	Kaftanowski 1938 (in Tuck 1961)

<sup>1</sup> % of 79 food items.

<sup>2</sup> % of 49 food items.

Murres fed their chicks on capelin, while Thick-billed Murre chicks had a more varied diet, including small squid (*Gonatus fabricii*) (Table 3).

We contend that a food shortage, a direct result of the collapse in the stocks of capelin, a pronouncedly pelagic schooling fish, exacerbated by the reduction in sand lance, is the most plausible cause of the sudden drop of Common Murres at North Norwegian colonies in 1987. The breeding population of Common Murres either died the preceding winter, or food resources were so adverse that they were unable to build up energy reserves necessary for egg formation and therefore abandoned any breeding attempt (Wiens 1984). Thick-billed Murres, although also lower in numbers than previous years, had fared better, either due to their ability to utilize alternative food sources or because of the tendency for at least some birds to migrate north to the ice edge (where no Common Murres were seen in 1987–1988) or west, and out of the Barents Sea during the winter (Spring 1971, Brown 1985, Bakken and Mehlum 1988).

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