THE STATUS OF BREEDING SEABIRDS IN MAINLAND NORWAY

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Barrett R.T., Lorentsen S-H. & Anker-Nilssen T. 2006. The status of breeding seabirds in mainland Norway. Atlantic Seabirds 8(3): 97-126. *Approximately 2.9 million pairs of 18 seabird species breed along the mainland coast of Norway. Of these, 1.4 million pairs breed along the Barents Sea coast and 1.3 million pairs along the Norwegian Sea coast. The commonest species are the Atlantic Puffin* Fratercula arctica *(1.7 million pairs), the Black-legged Kittiwake* Rissa tridactyla *(336,000 pairs) and Herring Gull* Larus argentatus *(233,000 pairs). Norway has a considerable responsibility for a large part of the world's seabirds as more than 10% of the total biogeographic population of all the present species breed on the Norwegian mainland, and seven of the twenty populations constitute (sometimes considerably) more than 25% of the world, Atlantic or European populations. While some species are increasing in numbers, those of the Atlantic Puffin, Black-legged Kittiwake, Common Guillemot* Uria aalge *and the northern subspecies of the Lesser Black-backed Gull* Larus fuscus fuscus *are all declining rapidly. It is feared that local populations of the Common Guillemot west of the North Cape will become extinct in the near future.*

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INTRODUCTION

The waters off the coast of Norway and in the Barents Sea are among the most productive in the world and are reputed to support *c.* 7.7 million pairs of breeding seabirds (or, when the non-breeding fraction is included, 26 million individuals) (Blindheim 1989; Sakshaug *et al.* 1994; Barrett *et al.* 2002). Previous studies reported that, of these, about 2.7 million pairs breed along the mainland coast of Norway north of the Arctic Circle and the remaining 5 million breed on Svalbard (which includes Bjørnøya), Franz Josef Land, Novaya Zemlya and the Russian mainland coast (Anker-Nilssen *et al.* 2000).

Marine production at all trophic levels is high and particularly favourable for seabirds off the Norwegian coast due to two major north-flowing ocean currents, the low saline Norwegian Coastal Current close to the shore and the North Atlantic Current, which transports warm, saline Atlantic water along the edge of the continental shelf. The two currents converge close to the coast of

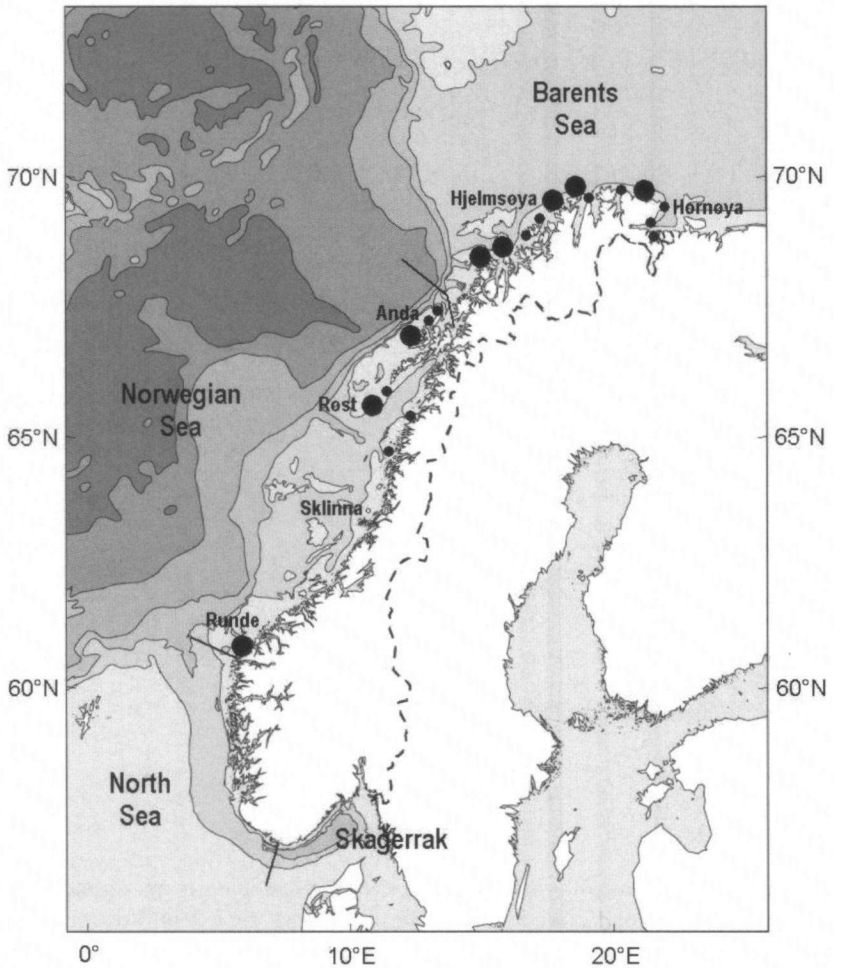


Figure 1. Map of Norway showing the positions of the largest seabird colonies (large symbols >100,000 pairs, small symbols 10,000 –100,000 pairs), the four major coastal ecoregions (Barents Sea, Norwegian Sea, North Sea and Skagerrak) and the six key seabird monitoring sites (Hornøya, Hjelmsøya, Anda, Røst, Sklinna and Runde). Bathymetric isolines are 200, 500, 1000, 2000 and 3000 m.

Figuur 1. Kaart van Noorwegen met de ligging van de grootste zeevogelkolonies (grote symbolen >100000 paar, kleine symbolen 10000–100000 paar), de vier belangrijkste ecoregio's (Barentszee, Noorse Zee, Noordzee en Skagerrak) en de zes belangrijke monitoringsgebieden voor zeevogels (Hornøya, Hjelmsøya, Anda, Røst, Sklinna en Runde). Bathymetrische isolijnen geven 200, 500, 1000, 2000 en 3000 m aan.

SW Norway but further north the mixing zone, where biological productivity is particularly high, follows the shelf edge relatively far offshore along most of the coast until it again approaches to within 10 km of the coast just north of the Lofoten Islands (Fig. 1). Nevertheless, where the continental shelf is relatively wide along the central Norwegian coast, deep channels and large, shallow banks cause gyres and mixing of water masses that increase retention time and boost productivity close to the shore (Rinde *et al.* 1998). Off the northernmost coast, production is further enhanced by increased tidal mixing and, in summer, continuous daylight.

Although Norwegian seabirds prey on a very wide variety of fish and invertebrates (Anker-Nilssen *et al.* 2000), two energy-rich, pelagic species have been highlighted as particularly important prey species - Norwegian spring-spawning Herring *Clupea harengus* (0- and 1-group, i.e. first- and second-year fish) and Capelin *Mallotus villosus* (all year classes) (Anker-Nilssen 1992; Barrett *et al.* 2002). Others, however, such as Saithe *Pollachius virens*, Haddock *Melanogrammus aeglefinus,* Cod *Gadus morhua,* and sandeels *Ammodytes* spp. may also comprise significant proportions of seabird diet but not always to the same degree and consistency as Herring and Capelin (Anker-Nilssen *et al.* 2000; Barrett 2002).

The mature stock of Norwegian spring-spawning herring resides primarily in the Norwegian Sea and the main part of the stock spawns in the southeastern Norwegian Sea in February-March. On hatching, very large numbers of larvae drift northwards with the coastal current reaching northern Nordland and Troms in late June or early July, by which time they have usually metamorphosed and reached an adequate size as prey for many seabirds. The young Herring drift onwards into the southern parts of the Barents Sea where they remain for 2-3 years before moving back into the Norwegian Sea to recruit into the spawning stock (Bakketeig *et al.* 2005). During their stay in the Barents Sea, the 1-group Herring (which are still small enough to be eaten by most seabird species) generally remain over coastal banks in the south and south-west and thus within the normal feeding range of breeding seabirds along the northeastern Norwegian coast (Loeng 1989).

The Capelin stock is restricted to the Barents Sea where it is the dominating pelagic species (Bakketeig *et al.* 2005). Because Capelin rarely grow longer than 14-15 cm, at which size they are mature, they are never too big to be eaten by seabirds. During the summer and autumn, the adult Capelin feed well offshore but move in late winter/early spring towards the coast of Finnmark to spawn. Here they become important food items during the early breeding period of seabirds. Some, however, also spawn in summer and are thus also available as food throughout most of the breeding season. Whereas in most years spawning occurs along much of the coast of Finnmark, it may in some

years be restricted to isolated sites further west in Troms, or far to the east in Varanger and/or along the Kola Peninsula (Gjøsæter 1998).

Both the Herring and Capelin stocks have fluctuated greatly over the last 50-60 years (Fig. 2). The spawning stock of the herring declined rapidly in the 1950s and 1960s from more than 14 million tonnes in 1950 to near zero in the early 1970s but, after a fishing moratorium, recovered in the late 1980s reaching 6.7 million tonnes in 2004. The Capelin stock has also fluctuated greatly (Fig. 2) with minima in 1986/87, 1994/95 and 2003/04, and peaks in 1991/92 and 2000/01 (7.3 and 4.3 million tonnes respectively; Bakketeig *et al.* 2005).

Although Norway has long been recognized as being responsible for a significant part of the NE Atlantic seabird populations (Brun 1979), a comprehensive study of their numbers and population trends along the coast, the Norwegian Seabird Project, was not initiated at a national level until 1979 (Røv *et al.* 1984). Before this, the little knowledge concerning the population status and trends of Norwegian seabirds was based on total counts in a few selected colonies at irregular intervals. These were often limited in their accuracy, and their irregularity precluded detailed documentation of annual changes (Brun 1979). Large changes were, however, revealed, especially the overall decline of Common Guillemots *Uria aalge* at an alarming rate of approximately 5% *p.a.* between 1964 and 1974. At the largest colony, Hjelmsøya (Fig. 1), numbers decreased from 110,000 pairs in 1964 to 70,000 pairs in 1974 (Brun 1979).

The Norwegian Seabird Project ended in 1984 and some of the population data were summarized by Barrett & Vader (1984). It was, however, immediately followed by various mapping and monitoring projects, and much more detailed data concerning overall numbers, distribution and population trends have since been collected using international standards (e.g. Lorentsen 2005). Most of these data are now stored in The National Seabird Registry at the Norwegian Institute for Nature Research (NINA), Trondheim, from where all seabird monitoring is co-ordinated. The national monitoring programme for seabirds, which was established in 1988 and revised in 1996, now addresses population changes in 17 species of breeding seabirds along the coast, including the three key species (Atlantic Puffin *Fratercula arctica*, Black-legged Kittiwake *Rissa tridactyla* and Common Guillemot) and six key sites (Runde, Sklinna, Røst, Anda, Hjelmsøya and Hornøya, Fig. 1) (Røv *et al.* 1984; Anker-Nilssen *et al.* 1996; Lorentsen 2005). In 2005, the SEAPOP programme was launched (www.seapop.no). Its aim is to co-ordinate a long-term, comprehensive, standardised and cost-effective study of the most important aspects of seabird numbers, distribution, demography and ecology in Norwegian waters to satisfy the needs of the offshore industry, fisheries management, nature management, the scientific community and society at large in their

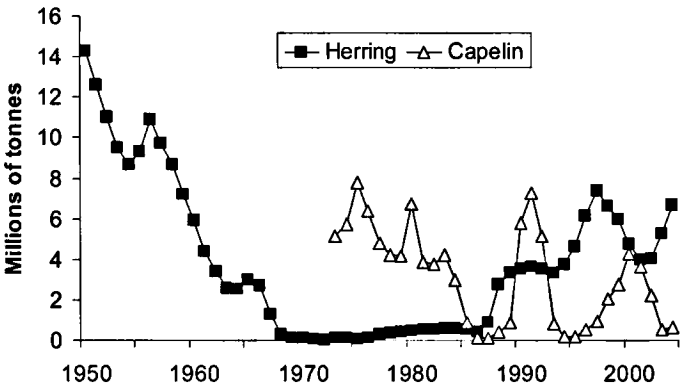


Figure 2.Changes in stock sizes of Capelin and mature spring-spawning Herring in the Norwegian and Barents Seas. (Source ICES 2005 a,b).

Figuur 2. Veranderingen in grootte van de 'voorraad' lodde en volwassen in het voorjaar paaiende haring in de Noorse en de Barentszee (Bron: ICES 2005 a,b).

various roles as exploiters, protectors and researchers of the marine environment (Anker-Nilssen *et al.* 2005). The earlier established monitoring activities, which include the national programme and long-term studies of seabird ecology on Røst and Hornøya, will be continued as integrated parts of the SEAPOP programme (Anker-Nilssen *et al.* 2005).

Although documentation of numbers breeding in the north of the country (and the remainder of the Barents Sea) has recently been reviewed (Anker-Nilssen *et al.* 2000), and local and regional effects of large fluctuations in both the Herring and Capelin stocks on some seabird populations have been published (Barrett & Krasnov 1996; Anker-Nilssen *et al.* 1997; Durant *et al.* 2003), this paper presents the first overall synthesis of the status of breeding seabirds in mainland Norway since those published in 1984 (Røv *et al.* 1984; Barrett & Vader 1984).

METHODS

Species selection Although the scope of this review is restricted to marine birds "dependent on marine food items during most of the year", thereby including the Common Eider *Somateria mollissima*, other true seabirds such as the large gulls *Larus* spp. are also included. However, we exclude partially marine species such as the Red-breasted Merganser *Mergus serrator* and the Black-headed Gull

Larus ridibundus because they regularly occupy inland-breeding habitats. This review covers 18 species of seabird breeding along the Norwegian coast (Table 1), all but one (Black Guillemot *Cepphus grylle*) of which are included in the national monitoring programme for seabirds.

Population estimates Most population estimates are assessed from the latest data in the national seabird registry after taking into account the most recent population trends. Most of the data were collected during dedicated mapping projects, e.g. assessment studies in relation to petroleum activity, supplemented by *ad hoc* counts provided by researchers and others. Most counts were of apparently occupied nests (or, for Atlantic Puffins, burrows) and were considered equivalent to numbers of pairs, whereas guillemots were counted as numbers of individuals and early counts were converted to numbers of pairs using a conversion factor of 0.61 birds/pair (Bakken 1986). In general, the estimates are much more uncertain for the highly dispersed *Larus* and *Sterna* species (many of which also breed inland) than for the typical colony-nesting species (Northern Fulmar *Fulmarus glacialis*, Great Cormorant *Phalacrocorax carbo*, Black-legged Kittiwake and all auks except Black Guillemot).

In this review, we have divided the coastline into four ecoregions: the Barents Sea, the Norwegian Sea, the North Sea and Skagerrak (Fig. 1). The southwestern limit of the Barents Sea is defined as the continental slope which approaches the coast just north of Andøya (Blindheim 1989; Loeng 1989; Barrett *et al.* 2002; Skjoldal 2004). The boundaries between the Norwegian Sea, North Sea and Skagerrak are otherwise in accordance with Skjoldal (2004) and Moy *et al.*'s (2003) definition of Norwegian marine ecoregions. We have also allocated each species to a specific ecological group based on their primary feeding areas (pelagic or coastal) and behaviour (diving, plunge-diving, surface-feeding or benthic-feeding).

Population trends Population trends in colonies of different sizes were considered equally important when calculating overall trends for the different ecoregions, but colonies that contained less than 1% of the population within a specific region were omitted. The data were analysed in two steps using TRIM 3.4 for Windows (Pannekoek & van Strien 2005). TRIM (available at www.cbs.nl) is a program for analysis of time series with missing observations, and estimates the missing data based on site and year indices. In order to produce only one time series for each colony, TRIM was first used at the individual colony level to merge data for different study plots. The procedure was then repeated at the regional level by entering the different colony series to produce one time series for each ecoregion. At both levels, three models were run in TRIM: 1) No time effect (counts vary only across sites and not across

time-points); 2) linear trend (site effect and a log-linear time effect); and 3) effects for each time-point (site effect and different effects for each time-point). Serial correlation between successive counts was assumed for all models. The

Table 1. Estimates of total numbers of pairs of seabirds breeding in four regions along the Norwegian coast in 2005. Ecological groups: P = Pelagic, C = Coastal, Su = Surface-feeding, Pd = Plunge diving, Di = Diving, Be = Benthic-feeding.

Tabel 1. Schattingen van aantal paar broedende zeevogels in vier regio's langs de Noorse kust in 2005. Ecologische groepen: P = pelagisch, C = kustgebonden, Su = oppervlakte foeragerend, Pd = stootduikend, Di = duikend, Be = benthos foeragerend.

	Estimated population size (pairs)						
						Total (rounded)	
	Ecological group	Barents Sea	Norwegian Sea	North Sea	Skagerrak	pairs	%
Northern Fulmar	P Su	100	7,500	1,500	20	9,000	0.3
Northern Gannet	P Pd	1,750	2,750	0	0	4,500	0.2
Great Cormorant[1]	C Di	10,000	20,000	0	0	30,000	1.0
Great Cormorant[2]	C Di	0	0	0	800	800	<0.1
European Shag	C Di	6,000	13,000	5,000	0	24,000	0.8
Common Eider	C Be	35,000	100,000	40,000	15,000	190,000	6.5
Great Skua	C Su	20	90	5	0	115	<0.1
Common Gull	C Su	10,000	75,000	30,000	20,000	135,000	4.6
Lesser Black-backed Gull[3]	C Su	< 300	*c.* 1,000	0	0	1,300	<0.1
Lesser Black-backed Gull[4]	C Su	0	*c.* 1,000	8,000	40,000	49,000	1.7
Herring Gull	C Su	100,000	100,000	13,000	20,000	233,000	8.0
Great Black-backed Gull	C Su	15,000	30,000	6,000	2,500	53,000	1.8
Black-legged Kittiwake	P Su	250,000	80,000	6,000	0	336,000	11.6
Common Tern	C Su	1,000	< 3,000	4,000	3,000	11,000	0.4
Arctic Tern	C Su	10,000	20,000	5,000	< 100	35,000	1.2
Common Guillemot	P Di	< 10,000	< 5,000	150	0	15,000	0.5
Brünnich's Guillemot	P Di	< 1,500	< 10	0	0	1,500	0.1
Razorbill	P Di	< 15,000	< 10,000	300	0	25,300	0.9
Black Guillemot	C Di	20,000	15,000	350	30	35,000	1.2
Atlantic Puffin	P Di	900,000	800,000	14,000	0	1,700,000	59.0
Total		1,385,670	1,283,330	133,305	101,450	2.9 mill.	

[1] *Phalacrocorax carbo carbo*, [2] *P. c. sinensis*, [3] *L. fuscus fuscus*, [4] *L. f. intermedius*

results from the model with the lowest AIC (Akaike's Information Criterion) value were selected. In order to treat all colonies equally, the TRIM indices for the best colony-specific models in the first run were scaled equally by setting the start year count at 100 before calculating the regional data series. Note that in a few colonies, both individuals and nests were counted with different results, for instance for common guillemot at Hjelmsøya where individuals (large decrease) and eggs (increase) are monitored on different plots (Lorentsen 2005). In such cases all count data were entered simultaneously into TRIM, in order to achieve a unified index for each colony.

Statistics for all trends were calculated by Monte-Carlo simulations. Using this method, the linear regression slope was estimated for the ln-transformed data set and compared with the corresponding slopes for 10,000 different randomised sequences of the same data values. The P value for a positive or negative trend was then computed as the fraction of the generated slopes that were greater or less than the real slope, respectively. Results of Monte Carlo simulations when n (here the number of census years) is small should be treated with great caution. When $n = 3$, only six permutations are possible and the lowest P value obtainable is 0.166 (1/6), while these numbers rise to 24 permutations and $P = 0.042$ when $n = 4$. Significance levels were chosen according to the recommendation by Anker-Nilssen *et al.* (1996) with $P < 0.1$, $P < 0.05$ and $P < 0.01$ indicating low, medium and high significance, respectively. The r^2 statistics were obtained by linear regression on ln-transformed data from TRIM, including the imputed values for missing years. Although fitting linear trends may mask short-term changes in numbers and no checks were made for density-dependent variation in trends between colonies (because most of the colonies of each species monitored were far apart and of similar magnitudes of size), we believe that the results offer an accurate representation of the status of each species.

RESULTS

Numbers and distribution An estimated 2.9 million pairs of seabirds breed along the coast of Norway with Atlantic puffins (1.7 million pairs) comprising nearly 60% of the total number (Table 1). Only four other species exceed 100,000 pairs: the Black-legged Kittiwake (336,000 pairs, *c.* 12% of total), Herring Gull *Larus argentatus* (233,000 pairs, 8%), Common Eider (190,000 pairs, 6%) and Common Gull *Larus canus* (135,000 pairs, 5%).

The distribution of breeding sites along the Norwegian coast is very uneven with >90% of the cliff-nesting species breeding north of the Arctic Circle, and >90% of all Norwegian seabirds breeding north of 62° N, i.e. along the coasts of the Norwegian and Barents Seas (Table 1). Furthermore, the

Barents Sea and Norwegian Sea seabird communities are dominated by pelagic-feeding species comprised mainly of diving (mostly Atlantic Puffins) and surface-feeding birds (mostly Black-legged Kittiwakes), whereas coastal species dominate the smaller communities in the south (Table 2). The proportions of coastal species within each region increase southwards, especially those of surface feeders (gulls and terns), which comprise only 10% of the Barents Sea seabird community but 84% of the Skagerrak community (Table 2). Coastal benthic feeders (represented by Common Eiders only) are also relatively important among the North Sea (30%) and Skagerrak (15%) seabird complements, although their absolute numbers are highest in the Norwegian Sea. Pelagic species are all but absent in Skagerrak except for *c.* 20 pairs of Northern Fulmar that breed near the border with the North Sea.

Table 2. The proportions (%) of seabirds breeding within each of the four marine ecoregions of the Norwegian coast according to feeding characteristics (area and behaviour).

Tabel 2. Het aandeel (%) broedende zeevogels in de vier mariene ecoregio's in Noorwegen verdeeld naar foerageerkarakteristieken (gebied en gedrag).

Feeding characteristic	Barents Sea	Norwegian Sea	North Sea	Skagerrak
Pelagic surface-feeding (P Su)	18	7	6	<1
Pelagic plunge diving (P Pd)	<1	<1	0	0
Pelagic diving (P Di)	67	64	11	0
Coastal surface-feeding (C Su)	10	18	50	84
Coastal diving (C Di)	3	4	4	<1
Coastal benthic-feeding (CBe)	2	8	30	15
Total	100	100	100	100

Population trends and species accounts Where available, summaries of monitoring effort and overall population trends from the start of the monitoring to 1995 and from 1996 to 2005 are presented for each ecoregion in Tables 3-6. Further details are given in the following species accounts.

SPECIES ACCOUNTS

Northern Fulmar Northern Fulmars first nested in Norway on Runde in the early 1900s, and the population has since spread to sites in Rogaland, Lofoten, Vesterålen and NW Finnmark. More than 95% of the Norwegian population breeds, however, along the Norwegian Sea and North Sea coasts, with

Table 3. Tabel 3.

Species	Monitored colonies	Monitoring period	Max years counted	Annual change (%) up to 1995	r^2	*P*- trend up to 1995	Annual change (%) 1996-2005	r^2	*P*- annual change
Northern Fulmar	1	1993-05	11				-2.5	0.13	n.s.
Northern Gannet	3	1961-05	23	16.8	0.92	< 0.01	12.8	0.98	< 0.01
Great Cormorant (*carbo*)	38	1983-05	21	4.2	0.42	< 0.1	6.6	0.86	< 0.01
European Shag	16*	1981-05	19	0.8	0.03	n.s.	9.9	0.85	< 0.05
Common Eider	BS/GS	2000-05	6				8	0.34	n.s.
Great Skua	1	1997-05	9				6.4	0.4	n.s.
Black-legged Kittiwake	49*	1980-05	24	-2.2	0.83	< 0.01	-6.4	0.94	< 0.01
Arctic Tern**	6-19	1989-05	17	-9.3	0.41	n.s.	-0.4	0.01	n.s.
Common Guillemot	2	1980-05	24	-14.8	0.7	< 0.05	10.3	0.99	< 0.01
Brünnich's Guillemot	2	1984-05	22	-14.3	0.35	< 0.1	-25.9	0.85	< 0.01
Razorbill	1	1996-05	8				-2.9	0.25	n.s
Atlantic Puffin	2	1980-05	23	2.4	0.88	< 0.01	1.9	0.48	< 0.05

* Including 12 shag and 47 kittiwake colonies in Sør-Varanger counted 10 times since 1966 (Barrett 2003), ** K.-B. Strann *pers. obs.*

Table 4. Tabel 4.

Species	Monitored colonies	Monitoring period	Max years counted	Annual change (%) up to 1995	r^2	*P*- trend up to 1995	Annual change (%) 1996-2005	r^2	*P*- annual change
Northern Fulmar	1	1997-05	9				-14.7	0.73	< 0.05
Northern Gannet	3	1946-05	30	9.8	0.84	< 0.01	-0.5	0.03	n.s.
Great Cormorant (*carbo*)	Many, AS	1974-05	23	2.4	0.68	< 0.01	-0.9	0.04	n.s.
European Shag	3	1975-05	22	1.6	0.32	< 0.1	9.9	0.68	< 0.01
Common Eider	GS+AS	1962-05	43	0.4	0.37	< 0.01	-0.5	0.03	n.s.
Great Skua	9	1998-05	5				10	0.88	< 0.05
Common Gull	24*	1989-05	10	17.4	0.45	< 0.1	14.2	0.52	n.s.
Lesser Black-backed Gull**	24*	1980-05	17	-5.4	0.81	< 0.01	-3.2	0.77	< 0.05
Herring Gull	21*	1989-05	10	-0.8	0	n.s.	15.7	0.77	< 0.05
Great Black-backed Gull	25*	1989-05	10	8.7	0.41	n.s.	0.8	0.27	n.s.
Black-legged Kittiwake	3	1979-05	24	-3.3	0.79	< 0.01	-7.8	0.9	< 0.01
Terns***	Many	2000-05	6				12.7	0.33	n.s.
Common Guillemot	2	1980-05	22	-5.7	0.73	< 0.01	-19.7	0.66	< 0.05
Razorbill	1	1997-05	7				-8.4	0.5	< 0.1
Atlantic Puffin	3	1979-05	27	-1.9	0.42	< 0.05	-2.1	0.74	< 0.05

* All relatively small colonies located in one restricted area (Sør-Helgeland)

**About half-and-half *Larus fuscus fuscus* and *L. f. intermedius*, but only colonies of *L. f. fuscus* monitored

***Common and Arctic tern

Opposite page: Table 3. Status of Norwegian seabirds breeding on the coast of the Barents Sea for which monitoring data exist. Population trends for the period from when the monitoring began and up to 1995 and for the last 10 years (1996-2005) are indicated. Boat surveys (BS) and ground level surveys (GS) cover relatively large areas.

Tegenoverliggende pagina: tabel 3. Status van Noorse zeevogels als broedvogel op de kust van de Barentszee. Populatie trends zijn aangegeven voor de periode vanaf het begin van de monitoring tot 1995, en voor de laatste 10 jaar (1996-2005). Scheepstellingen (BS) en inventarisaties vanaf land (GS) beslaan relatief grote oppervlakten.

Opposite page: Table 4. Status of Norwegian seabirds breeding on the coast of the Norwegian Sea and for which monitoring data exist. Population trends for the period from when the monitoring began and up to 1995 and for the last 10 years (1996-2005) are indicated. Aerial surveys (AS) and ground level surveys (GS) cover relatively large areas.

Tegenoverliggende pagina: tabel 4. Status van Noorse zeevogels als broedvogel op de kust van de Noorse Zee. Populatie trends zijn aangegeven voor de periode vanaf het begin van de monitoring tot 1995, en voor de laatste 10 jaar (1996-2005). Scheepstellingen (BS) en inventarisaties vanaf land (GS) beslaan relatief grote oppervlakten.

concentrations in Møre and Romsdal and Rogaland. The total population was estimated to be 1100 pairs in the early 1970s, 1850 pairs in 1982 and *c.* 7,000 pairs in the early 1990s (Brun 1979; Barrett & Vader 1984; Gjershaug *et al.* 1994). The present population is *c.* 9000 pairs, and Runde is still the largest colony (*c.* 5000 pairs, A.O. Folkestad *pers. comm.*). While there has been a steep decline in the one colony monitored on the Norwegian Sea coast (Røst; Table 4) and a recent decline at Runde and other small colonies nearby (A.O. Folkestad *pers. comm.*), there has been an expansion of the population further south resulting in large local increases in the small colonies at the south end of its range (mean 39% *p.a.*; Table 6). Why so few (<1000 pairs) Northern Fulmars breed in North Norway, where most of Norway's cliff-nesting seabirds breed, is perplexing, especially considering that well over 100,000 pairs breed on Svalbard (Anker-Nilssen *et al.* 2000).

Northern Gannet The Northern Gannet is also a relatively recent addition to the Norwegian seabird community. Since the establishment of the first Norwegian colony at Runde in 1947, numbers nesting in Norway have increased to *c.* 4100 pairs in 2005 with the establishment of colonies at 10 different sites in North Norway (Barrett & Folkestad 1996; RTB unpublished). However, due to a large turnover of colonies in the north in recent years, Norway has never hosted more than six extant gannetries at any given time.

Table 5. Tabel 5.

Species	Monitored colonies	Monitoring period	Max years counted	Annual change (%) up to 1995	r^2	*P*-trend up to 1995	Annual change (%) 1996-2005	r^2	*P*-annual change
Northern Fulmar	3-8	1973-98	23	20	0.9	< 0.01		0.41	
European Shag	18	1978-05	18	15.8	0.89	< 0.01	10.3	0.7	< 0.05
Common Eider	BS	2000-05	6				0.01	0	n.s.
Herring Gull	30	1978-05	7	-0.4	0.03	n.s.	-12.2	0.56	< 0.05
Terns*	22	1978-05	8	-9.3	0.96	< 0.01	-18.3	0.77	< 0.01

* Common and Arctic tern

Table 6. Tabel 6.

Species	Monitored colonies	Monitoring period	Max years counted	Annual change (%) up to 1995	r^2	*P*-trend up to 1995	Annual change (%) 1996-2005	r^2	*P*-annual change
Northern Fulmar	1	1995-05	11				38.7	0.74	< 0.05
Great Cormorant	8	1997-05	9				53.2	0.73	< 0.01
Common Eider	AS	1988-05	18	7.9	0.56	< 0.1	1	0.06	n.s.
Common Gull	26+ +M	1974-05	32	-6.1	0.66	< 0.01	-9.4	0.64	< 0.05
Lesser black-backed Gull*	24+	1974-05	32	9.8	0.69	< 0.01	-4.1	0.85	< 0.01
Herring Gull	26+	1974-05	32	7	0.8	< 0.01	-3.3	0.63	< 0.05
Great Black-backed Gull	28+ +M	1974-05	32	5.3	0.68	< 0.01	0.1	0	n.s.
Common Tern	24 +M	1974-05	32	-3.1	0.51	< 0.01	-12.5	0.7	<0.1

* *Larus fuscus intermedius*

Opposite page: Table 5. Status of Norwegian seabirds breeding on the coast of the North Sea and for which monitoring data exist. Population trends for the period from when the monitoring began and up to 1995 and for the last 10 years (1996-2005) are indicated. BS = boat surveys (covering large areas).

Tegenoverliggende pagina: tabel 5. Status van Noorse zeevogels als broedvogel op de kust van de Noordszee. Populatie trends zijn aangegeven voor de periode vanaf het begin van de monitoring tot 1995, en voor de laatste 10 jaar (1996-2005). Scheepstellingen (BS) beslaan relatief grote oppervlakten.

Opposite page: Table 6. Status of Norwegian seabirds breeding on the Skagerrak coast for which monitoring data exist. Population trends for the period from when the monitoring began and up to 1995 and for the last 10 years (1996-2005) are indicated. AS = aerial surveys (covering the whole coastline). M = many colonies surveyed within a defined coastal section.

Tegenoverliggende pagina: tabel 6. Status van Noorse zeevogels als broedvogel op de kust van het Skagerrak. Populatie trends zijn aangegeven voor de periode vanaf het begin van de monitoring tot 1995, en voor de laatste 10 jaar (1996-2005). AS = vliegtuigtellingen (gehele kustlijn). M = in een bepaalde kustsectie zijn vele kolonies geïnventariseerd.

While numbers have continued to increase at Runde (*c.* 2% *p.a.* since 1996, Lorentsen 2005), there have been contrasting population trends in colonies further north resulting in a stabilization of the population along the Norwegian Sea coast (Table 4). Two of the largest colonies in the Lofoten/Vesterålen region (Hovsflesa and Skarvklakken), for example, declined after the early 1990s and were abandoned in 2001 and 2003 respectively (RTB unpublished data). At the same time, two new colonies were established in neighbouring Great Cormorant colonies, partly as the result of movements of birds from Hovsflesa and Skarvklakken (Våge & Stenersen 2003). The abandonment of Hovsflesa and Skarvklakken has been attributed to increasing numbers of immature White-tailed Eagles *Haliaeetus albicilla* that have long been observed threatening and preying on both adult and young gannets (Barrett & Folkestad 1996; Våge & Stenersen 2003; RTB unpublished).

In the Barents Sea, numbers of Northern Gannets continued to increase (13% *p.a.*, Table 3) at least until 2005, partly due to the establishment of a new colony off the coast of Troms in 2001.

Great Cormorant Approximately 30,000 pairs of the nominate subspecies *P. c. carbo* breed in Norway, all north of 62° N and mostly along the Norwegian Sea coast (Table 1). This is a little more than 50% of the world population of *P. c. carbo* (57-58,000 pairs; Mitchell *et al.* 2004, Table 7) such that Norway is the most important area for this subspecies.

The Great Cormorant was described as being "quite rare" in Norway in the 1950s and 1960s (Gjershaug *et al.* 1994), but subsequent population

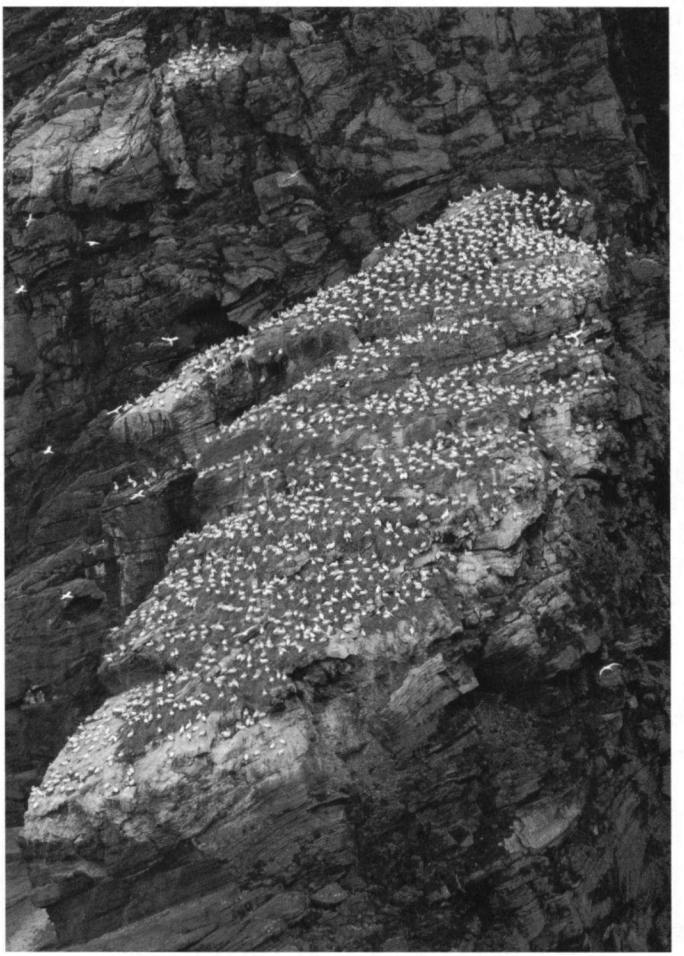
estimates indicate a rapid increase in numbers. Barrett & Vader (1984) listed the Great Cormorant as a "declining species", but this was based on limited, local data from Troms. Røv & Strann (1987) published an estimate of 21,000 pairs based on counts made between 1982-1986, and drew attention to rapid increases in mid-Norway. Ten years later, Røv (1997) again reported an estimate of 21,400 pairs in 1995, followed by an estimated 26,650 pairs in 2003 (Røv *et al.* 2003). Since then, the Norwegian Sea population has remained stable (Table 4) while the Barents Sea population has continued to increase at an annual rate of 7% (Table 3).

The continental subspecies *P. c. sinensis* established a colony in Rogaland in 1996 and another in Østfold, east Skagerrak in 1997. The population in Østfold has since increased rapidly to *c.* 870 pairs in 2005 (though peaking at 990 pairs in 2004), distributed in seven colonies, and the same subspecies has also colonised Aust-Agder and Vest-Agder with some 200 pairs (Lorentsen 2005; C. Steel *pers. comm.*).

European Shag As for *P. c. carbo*, Norway is an important area for the European Shag with a population total of 24,000 pairs or *c.* 30% of the NE Atlantic population (*c.* 75,000 pairs; Table 7, Mitchell *et al.* 2004). The European Shag has a more southerly distribution than the Great Cormorant with 5,000 pairs breeding along the North Sea coast where no nominate Great Cormorants breed (Table 1).

Again, in common with the Great Cormorant (and again contrary to Barrett & Vader's (1984) pessimistic view), numbers of European Shags breeding in Norway have increased since the late 1970s, from estimates of *c.* 15,000 pairs in 1980-1984 (Røv *et al.* 1984) to the present 24,000 pairs.

While overall numbers increased by 10% *p.a.* between 1996 and 2005 in colonies monitored in the Barents, Norwegian and North Seas (Tables 3-5), there have been large inter-colony differences in population changes. For example, within the Norwegian Sea region, the population at Runde declined by *c.* 75% from *c.* 5000 pairs in 1975 to <1000 pairs in 2004 (Lorentsen 2005), but has since showed tendencies towards a recovery. At Sklinna, by contrast, numbers have increased by 8.3% *p.a.* between 1984 and 1995, and by 11.3% *p.a.* since 1996. The latter was partly due to the building of a new breakwater in 1999, but the trend was paralleled by a 14% *p.a.* increase at Ellefsnyken, Røst despite two or three seasons of presumed deferred breeding in the mid 1990s, when numbers declined from >450 breeding pairs in 1993 to 69 in 1995 and returning to *c.* 440 in 1996 (Lorentsen 2005; Anker-Nilssen & Aarvak 2006). Sklinna has now replaced Runde as one of Europe's largest colonies, with 2500 pairs in 2005.



The world's northernmost Northern Gannet Morus bassanus *colony at Storstappen, Gjesvær, Norway. The colony was established in 1987 and numbered 1250 pairs in 2005.* De meest noordelijk gelegen kolonie van Jan-van-gent ter wereld, in Storstappen, Gjesvær, Noorwegen. De kolonie is in 1987 gesticht en telde in 2005 1250 paar. *Rob Barrett, Tromsø University Museum.*

*Table 7. Importance of seabird populations in Norway as a proportion (%) of the relevant biogeographic areas to which they belong. Those areas marked * contain the world population, and those marked ** nearly the whole world population. Data for the biogeographic areas are from the species-specific tables of international importance in Mitchell* et al. *(2004), having corrected for the revised estimates for Norway. Data for Common Eider and Brünnich's Guillemot are from Anker-Nilssen* et al. *(2000).*

*Tabel 7. Belang van zeevogelpopulaties in Noorwegen, uitgedrukt als het aandeel (%) van de biogeografische regio's waartoe deze behoren. * deze regio's herbergen dewereldpopulatie; ** deze regio's herbergen vrijwel de gehele wereldpopulatie. Data voor de biogeografische regio's zijn afkomstig van de soortspecifieke tabellen 'of international importance' in Mitchell* et al. *(2004), gecorrigeerd voor de aangepaste schattingen voor Noorwegen. Data voor Eider en Dikbekzeekoet zijn afkomstig van Anker-Nilssen* et al. *(2000).*

	Norway	Biogeographic population		
	Pairs	%	Area	Pairs
Northern Fulmar	9,000	< 1	N. Atlantic	2.7-4.1 mill.
Northern Gannet	4,500	1	N. Atlantic*	400,000
Great Cormorant[1]	30,000	53-54	N. Atlantic*	57-58,000
Great Cormorant[2]	800	< 1	W. Palearctic	200-230,000
European Shag	24,000	31-32	N.E. Atlantic	75-77,000
Common Eider	190,000	10-13	Europe	1.5-2.0 mill.
Great Skua	155	< 1	N. Atlantic*	16,000
Common Gull	135,000	23-31	Europe**	430-590,000
Lesser Black-backed Gull[3]	1,300	8-9	Europe*	14-17,000
Lesser Black-backed Gull[4]	49,000	37-49	Europe*	100-131,000
Herring Gull	233,000	27-28	Europe	840-860,000
Great Black-backed Gull	53,500	46-49	Europe**	110-120,000
Black-legged Kittiwake	336,000	13-15	N. Atlantic	2.3-2.6 mill.
Common Tern	11,000	3-5	Europe	220-330,000
Arctic Tern	35,000	2-7	Europe+N. Atlantic	0.5-1.8 mill.
Common Guillemot	15,000	< 1	N. Atlantic	2.8-2.9 mill.
Brünnich's Guillemot	1,500	< 1	N. Atlantic	4.9-7.5 mill.
Razorbill	25,000	5	N. Atlantic*	530,000
Black Guillemot	35,000	9-13	N. Atlantic**	275-405,000
Atlantic Puffin	1,700,000	26-31	N. Atlantic*	5.5-6.6 mill.
Total	2.9 mill.	13-17		17-22 mill.

[1] *P.c. carbo,* [2] *P.c. sinensis,* [3] *L.f. fuscus,* [4] *L.f. intermedius*

In the Barents Sea region, there have also been considerable fluctuations in all colonies monitored, and the 10% *p.a.* increase since 1996 (Table 3) reflects primarily the rapid recovery of the population in one large colony (Lille

Kamøya), which collapsed between 1990 and 1994 (from 400 to four nests in the monitoring plots). In Sør-Varanger, eastern Finnmark, where 12 colonies have been recorded, there have also been large fluctuations but an overall decline from 110 pairs in 1975 to 15-20 pairs in 2002 (Barrett 2003).

Common Eider Common Eiders nest along the whole coast of Norway and the total population is roughly estimated to be 190,000 pairs. The only previous population estimate of 70,000-100,000 pairs was made in the early 1980s (Gjershaug *et al.* 1994), but it is difficult to determine if the present figure is due to a real population increase or simply better coverage of the population.

Surveys within the four ecoregions suggest that numbers have been more or less stable along the coast of the North and Norwegian Seas and possibly increasing along the Skagerrak and Barents Sea coasts. Common Eider data are, however, very sparse and numbers fluctuate greatly within given areas and colonies. In several smaller areas between Central Norway and the Lofoten area, local populations have declined severely since the early 1980's. This trend is observed both for breeding and wintering populations (Lorentsen & Nygård 2001; Lorentsen 2005). Common eiders were heavily hunted during the Second World War, and subsequent protective legislation and establishment of protected areas have enabled the population to recover. Interpretation of monitoring results is further complicated by recent declines in egg and down harvesting practices, changing levels of pollution within some monitoring areas, and the spread of feral American Mink *Mustela vison* to island colonies.

Great Skua The first mainland-breeding Great Skua nest was recorded in the Barents Sea region (at Loppa) in 1975 (Vader 1980) and the next breeding site was established at Runde in 1980 (Folkestad *et al.* 1980). The population has since spread to several sites near Runde, to Røst, Hjelmsøya, and Sværholt (Gjershaug *et al.* 1994), and was estimated to be *c.* 115 pairs in 2005. Most breed in at least eight sites along the northwestern coast of South Norway.

In common with the Northern Fulmar, it is interesting that few Great Skuas nest in North Norway (20-30 pairs) considering the large numbers breeding in the Northern Isles of Scotland, and the 500-1000 pairs breeding on Svalbard (Mitchell *et al.* 2004; H. Strøm *pers. comm.*).

Common Gull The Common Gull breeds over most of the country, often far inland (Lorentsen 1994) but only the coastal population is considered here. This is estimated to be approximately 135,000 breeding pairs, or about 25-30% of the European population (Table 7).

More than half of the Norwegian coastal population breeds within the Norwegian Sea ecoregion. Here the population, which is monitored only in a

small area on the coast of Helgeland, Nordland, increased rapidly up to the mid-1990s, since when it has remained stable. Along the Skagerrak coast, however, the population has declined considerably since monitoring started in 1974, and in 2005 was only about 15% of its initial size. Numbers at the sites monitored along the Skagerrak coast have decreased by 9% *p.a.* since 1996, possibly due to movements to inland and urban areas (Lorentsen 1994).

Lesser Black-backed Gull Two subspecies of the Lesser Black-backed Gull breed in Norway. The nominate *fuscus* subspecies breeds in the north of the country, mainly along the Norwegian Sea coast (*c.* 1000 pairs), and *intermedius* breeds further south and in much larger numbers (*c.* 50,000 pairs) with 80% breeding in Skagerrak (Table 1).

Total numbers of *L. f. intermedius* in Norway have increased greatly since the 1960s when the population was estimated to be 5800 pairs (Barth 1968; Thingstad 1994). Monitoring has shown that despite large annual variations, this increase has continued at least in the Skagerrak at a rate of 1-5% *p.a.* since 1974. There seems, however, to have been a reversal of this trend in recent years with numbers falling again at a rate of 4% *p.a.* (Table 6). No monitoring data for *L. f. intermedius* exist for the North Sea and Norwegian Sea coastlines.

While there has been an overall increase in *L. f. intermedius*, the numbers of *L. f. fuscus*, have declined sharply over the last 40-50 years. Although no complete census was ever made, the population of this subspecies in the 1960s was probably at least 3000-4000 pairs (Haftorn 1971) but has since declined to *c.* 1300 pairs in 2005. In the colonies monitored in Nord-Trøndelag and Sør-Helgeland, the heart of their distribution, declines of 5-10% *p.a.* have been recorded since 1980 and up to the mid-1990s. Between 1996 and 2005, an increase in numbers has for the first time been recorded in Helgeland, which is considered to be the core area for this subspecies along the Norwegian coast. The situation for the subspecies is considered to be critical, and there is great need for expanding the monitoring of this subspecies into the northern part of its range and to include demographic parameters that might explain the status of the species.

Herring Gull Nearly a quarter of a million pairs of Herring Gulls are thought to breed in Norway more or less evenly distributed along the whole coastline (Table 1). This is similar to Brun's (1979) estimate of 260,000 pairs, but higher than Gjershaug *et al.*'s (1994) figure of 150,000-200,000 pairs. An estimate of 260,000 pairs constitutes the largest national population in western Europe; only Russia hosts larger numbers with *c.* 800,000 pairs (Mitchell *et al.* 2004).

Despite this large population, few Herring Gull colonies are monitored regularly, and little can be said about overall population trends. The few colonies that are monitored (in Skagerrak and on the Norwegian Sea coast) have increased in size over the last 16-30 years. They constitute, however, a very small part of the total population, and an expansion of the monitoring programme to increase the coverage should be considered.

Great Black-backed Gull In common with the Herring Gull, the Great Black-backed Gull breeds along the whole Norwegian coastline and the total population is estimated to be around 50,000-55,000 pairs (Table 1). This is slightly higher than Brun's (1979) and Gjershaug *et al.*'s (1994) figure of 40,000 pairs, and constitutes *c.* 50% of the European population and *c.* 30% of the world's population (170,000-180,000 pairs; Table 7, Mitchell *et al.* 2004). Current monitoring is limited to a few sites only, but it seems that numbers in the Norwegian Sea have been relatively stable since 1989, whereas Skagerrak numbers increased by 5% *p.a.* from the mid-1970s to the mid-1990s, and have since remained stable (Tables 4 and 6).

Black-legged Kittiwake The total Black-legged Kittiwake population in Norway is *c.* 336,000 pairs (13-15% of the North Atlantic population of 2.3-2.6 million pairs; Table 7, Mitchell *et al.* 2004), with almost all breeding along the coasts of the Norwegian and Barents Seas, and none in the Skagerrak. The largest colony is at Syltefjord, where the population was estimated to be 140,000 pairs in 1989 (Stougie *et al.* 1989). Unfortunately, very few colonies have been censused in more recent years.

Numbers of Black-legged Kittiwakes increased in North Norway at a rate of *c.* 1% *p.a.* in the 1960s and 1970s, and this increase continued into the early 1980s, at least in eastern Finnmark where the increase was as high as 4-8% *p.a.* in 1970-1983 (Brun 1979; Krasnov & Barrett 1995; Barrett 1985). There is also evidence of population increase in Troms and Vesterålen during the same time period (Bleiksøya 2000 pairs 1974, 5800 pairs in 1993, RTB unpubl. data). Since 1980, when the total Norwegian population was estimated to be about 500,000 pairs (Barrett & Vader 1984), numbers in all monitored colonies in Norway have declined significantly at rates varying between 1-5% *p.a.* Furthermore, there is evidence that the rate of decline has accelerated since the mid-1990s, up to 10-15% *p.a.* in some colonies (Barrett 2003; Lorentsen 2005) resulting in average decreases of 6% *p.a.* in the Barents Sea colonies and 8% *p.a.* in the Norwegian Sea colonies (Tables 3 and 4). Numbers of apparently occupied nests in monitoring plots on the key sites Runde, Vedøya (Røst), Hjelmsøya and Hornøya decreased by 75%, 50%, 75% and 50% respectively between the early 1980s and 2005 (Lorentsen 2005).

Little is known about the causes of this decline, but Brun (1979), Furness & Barrett (1985) and Krasnov & Barrett (1995) have reported Capelin to be the preferred food of Black-legged Kittiwakes breeding in East Finnmark, and have suggested that large Capelin stock fluctuations (including several collapses) in the Barents Sea (Gjøsæter 1998) may be having negative effects on the population (Barrett 2007). There is also evidence that increasing harassment from White-tailed Eagles in many colonies along the whole coastline has caused repeated local breeding failures and declines in Black-legged Kittiwake numbers (Barrett 2003; Anker-Nilssen & Aarvak 2006; *pers. obs.*). For example, on Bleiksøya, where White-tailed Eagles continually patrol the cliff face causing the Black-legged Kittiwakes to repeatedly fly out in panic, the kittiwake population has declined from 5800 pairs in 1993 to *c.* 600 pairs in 2005 (RTB *pers. obs.*).

Common and Arctic Tern Common and Arctic Terns breed over most of the country, also inland (Gjershaug *et al.* 1994), but only coastal populations are considered here. Both species breed along the whole mainland coast with most Common Terns (total population *c.* 11,000 pairs) in the south and most Arctic Terns (total population *c.* 35,000 pairs) in the north (Table 1). Both figures must be considered as very approximate estimates, but are in the same order of size as those suggested by Gjershaug *et al.* (1994; 10,000-20,000 pairs and 40,000 pairs respectively).

The population status of terns in Norway was recently summarized by Lorentsen (2006). Arctic Terns are monitored in 6-19 colonies within a small area in the Barents Sea where numbers were relatively stable in 1989-2005 (Table 3, K.-B. Strann *pers. comm.*). Along the Norwegian Sea coast, numbers (mostly of Arctic Terns) have been stable since 2000 (Table 4), whereas they have declined considerably in the North Sea (mostly Common Terns) and Skagerrak (Common Terns) at rates of 3-18% *p.a.* (Tables 5 and 6). The severe negative trends for terns in the North Sea and Skagerrak have persisted for the last 25 years and are probably a result of food shortage (Lorentsen 2006).

Common Guillemot The present population of Common Guillemots in mainland Norway is *c.* 15,000 pairs and thus less than 0.5% of the total North Atlantic population (2.8-2.9 million pairs; Mitchell *et al.* 2004). This is a very marked reduction since the first population estimate of 120,000-160,000 pairs, estimated in the 1960s (Brun 1969), and is most likely mainly the result of drowning in fishing gear, hunting and food shortages. West of the North Cape (Barents Sea), the annual drowning of breeding adults during the long-line and drift-net fisheries for Atlantic Salmon *Salmo salar* was probably the most significant single factor causing declines in what were once the largest colonies

in Europe in the 1960s and 1970s (Brun 1979; Strann *et al.* 1991). These fisheries were banned in the early 1980s and 1989 respectively, but birds are still sometimes reported drowned in nets set for cod. Some colonies have declined so much that they may now be on the verge of extinction with seemingly too few pairs remaining for the colonies to be viable. Although drowning in fishing gear is now considered a minor threat to adult birds, numbers along the Norwegian Sea coast (Table 4) and at Hjelmsøya (one of the two colonies monitored in the Barents Sea) continue to fall steeply (98-99% declines at Vedøy in Røst and at Hjelmsøya between the early 1980s and 2005). While the breakdown of the social structure of the colonies (with single or very few birds on individual breeding shelves) is thought to contribute to the further decline, there is now compelling evidence that the present large population of White-tailed Eagles (which has gradually recovered since it was legally protected in 1968) is exacerbating the situation, resulting in some populations (e.g. Røst, Bleiksøya, Hjelmsøya) being forced to breeding under cover, for example in large cracks or stone screes, to avoid predation. Although still poorly covered by existing monitoring, birds breeding in such habitats are much more productive than those on exposed cliff ledges (*pers. obs.*).

While colonies west of the North Cape declined in the 1970s and 1980s, numbers seem to have increased during the same period further east (Vader *et al.* 1990; Krasnov & Barrett 1995). Between 1986 and 1987, however, very large (up to 80-85%) declines were recorded in all colonies in the Barents Sea and northern Norwegian Sea as a result of a collapse in the Capelin stocks. This caused a mass mortality of adult Guillemots during the winter of 1986/87 and a near total breeding failure in 1987 (Vader *et al.* 1987, 1990). Subsequent monitoring on Hornøya has, however, revealed a rapid recovery at 11% *p.a.* (Barrett 2001; Lorentsen 2005), perhaps partly due to both many years of high reproductive success and to immigration of birds from abroad, for example Shetland (RTB pers. obs). The recent increase at Hornøya outweighs the simultaneous decline at the second Barents Sea colony, Hjelmsøya, resulting in a (somewhat misleading) overall 10% *p.a.* increase for the region (Table 3).

The population development of the Common Guillemot in the Norwegian Sea is similar to that in the western Barents Sea (Table 4). Although three colonies (Runde, Sklinna and Vedøy in Røst) are monitored regularly, the results from Sklinna were not used in the present analysis because this is a relatively small and atypical colony that increased from only three pairs in 1983 to *c.* 50 pairs in 1999 and *c.* 400 pairs in 2005. This increase (an average 19% *p.a.* for the whole period 1980-2005, 35% *p.a.* in the period 1996-2005, Lorentsen 2005) is unlikely to have taken place without extensive immigration.

Brünnich's Guillemot Brünnich's Guillemots were first recorded breeding in Norway in 1964 (Brun 1965), but were almost certainly present in colonies before then. Today they breed in small numbers on at least Hjelmsøya, Gjesvær, Syltefjord and Hornøya/Reinøya, and the total population is in the order of 1500 pairs, with few or none south of the Barents Sea area (Table 1). Little is known about population trends, but it seems that after a steep decline in 1986/87 similar to that of Common Guillemots (Vader *et al.* 1990), numbers have further decreased west of the North Cape (on Hjelmsøya, Table 3), but are recovering east of the cape. This is certainly true for Hornøya, where the population doubled to *c.* 600 individuals between 1987 and 1996, since which it seems to have stabilized (RTB unpubl. data).

Razorbill Most of the Razorbills breed in the large seabird colonies in the Norwegian and Barents Sea regions and the total population is roughly estimated to be 25,000 pairs. Although this is only 5% of the world's population, Norway hosts an important proportion of the subspecies *A. t. torda*, with *c.* 30% of the 80,000 pairs in NW Europe (Mitchell *et al.* 2004). The Norwegian population estimate is, however, of doubtful accuracy, and present population trends are not well-known (Tables 3 and 4). There was, however, an increase on Hornøya between 1967 (65 pairs) and 1980 (*c.* 200 pairs), and this seems to have continued (Barrett & Vader 1984; RTB *pers. obs.*)

Black Guillemot An estimated 35,000 pairs of Black Guillemot breed along the whole coast of Norway, all but a few hundred of them breeding in the Norwegian and Barents Sea regions. Although there has been no recent monitoring of population trends, large local declines were reported in southwestern Norway in the 1970s and 1980s, and in North Norway (by >50%) since 1930, all probably due to the spread of feral American Mink (Barrett & Vader 1984; Gjershaug *et al.* 1994).

Atlantic Puffin Approximately 1.7 million pairs of Atlantic Puffin breed in Norway today (Anker-Nilssen 1991, updated for more recent trends), representing 25-30% of the world population (5.5-6.6 million pairs, Mitchell *et al.* 2004). Only a very small fraction (comprising 14,000 pairs) breeds on the North Sea coast and none in the Skagerrak. A number of estimates of the total breeding population of Atlantic Puffins in Norway have been made over the years, including figures of 1.25 million pairs in the mid-1970s and *c.* 2 million pairs in the early 1990s (Brun 1979; Anker-Nilssen 1991; Gjershaug *et al.* 1994). Since these two estimates, based on both direct and indirect counts (Brun 1979), much effort was directed towards conducting detailed, accurate counts of apparently occupied burrows in most of the large colonies, with large

discrepancies being revealed. For example, at Gjesværstappan, a census conducted in 1991 resulted in an estimate of more than 400,000 pairs (TAN unpubl. data), whereas Brun's (1979) estimate in 1973 was only 18,000 pairs. In Vesterålen, counts made of four colonies (Fuglenyken, Måsnyken, Frugga and Bleiksøya) in 1988-1990 were all two to four times higher than estimates made 15-20 years earlier (RTB unpubl. data). Similarly, the population estimate at Røst increased from Brun's (1979) 700,000 pairs in 1964 to almost 1.5 million pairs in 1979 (Anker-Nilssen & Røstad 1993; Anker-Nilssen & Øyan 1995). Such differences are not considered to be a result of population increases but rather increases in survey effort.

Since 1980, the Norwegian Sea population of Atlantic Puffins has declined greatly (Table 4). This is largely because the Røst population, which, although still probably the largest seabird colony in mainland Europe, declined by 70% to an estimated 433,000 pairs in 2005 (Anker-Nilssen & Aarvak 2006). The decline has primarily been caused by repeated breeding failures, but also perhaps by reduced adult survival caused by the collapse in the spring-spawning herring stock in the late 1960s (e.g. Anker-Nilssen 1992; Anker-Nilssen *et al.* 2003; Durant *et al.* 2003; Anker-Nilssen & Aarvak 2006). Whereas numbers have decreased at Røst, the colony at Runde (*c.* 100,000 pairs), which is much less dependent on herring and more on sandeels and gadoids as prey (Barrett *et al.* 1987), increased by nearly 50% between 1980 and 1995, after which it decreased again by 1.6% *p.a.* over the next decade (Lorentsen 2005).

The Barents Sea colonies, where Atlantic Puffins have access to other prey such as Capelin and sandeels, have either been stable (at Gjesvær since 1997) or are increasing slightly (at Hornøya since 1980; Table 3). There are, however, indications that puffins in eastern Finnmark, where numbers have increased since the 1960s (Barrett & Vader 1984; Barrett 2001; Table 3), have recently suffered from a gradual deterioration in food conditions (Barrett 2002). If this continues, one might expect a reversal in the present positive population trend.

DISCUSSION

Internationally important populations In this review, about 2.9 million pairs of seabirds are estimated to breed along the coast of mainland Norway. Of these, 1.4 million (48%) and 1.3 million pairs (42%) breed within the Barents Sea and Norwegian Sea ecoregions respectively, confirming Anker-Nilssen *et al*'s (2000) earlier estimate of 2.7 million pairs. Norway, therefore, has a considerable responsibility for a large part of the world's seabird community (Table 7). More than 10% of the total biogeographic population of all the present species breed on the Norwegian mainland, and seven of the 20

populations considered in this review are very important in that they constitute (sometimes well) over 20% of the world, Atlantic or European populations (Table 7). The population of Great Cormorant (subsp. *carbo*) is the only one that exceeds 50% of the world population, whereas those of European Shag, Common Gull, Lesser Black-backed Gull (subsp. *intermedius*), Herring Gull, Great Black-backed Gull and Atlantic Puffin all comprise between 25 and 50% of their respective biogeographic populations and should thus be considered species of extra international responsibility (>25% of biogeographic population, DN 1999). Several other populations, including the Lesser Black-backed Gull (subsp. *fuscus*), Common Guillemot, and Black-legged Kittiwake, would probably also have met this criterion only a few decades ago, had they not declined so severely in recent years.

In recognition of this, Norwegian authorities have established many nature reserves and sites of special protection, encompassing of the largest colonies of cliff-nesting seabirds and islet colonies of Great Cormorants and Northern Gannets. Harvesting of eggs and down (from Common Eider and *Larus* spp.), and hunting (of Great Cormorant, European Shag, Common Eider, Great Black-backed, Herring and Common Gulls) are still permitted, but under strict restrictions that are subjected to regular revision (see www.lovdata.no/for/sf/md/td-20020211-0149-0.html#1 for the current regulations). There is, however, a need for improved population surveillance of Norwegian seabirds. Whereas most of the internationally important populations are included in the present monitoring project, almost nothing is known about the population trends of the Great Black-backed and Herring Gulls. Further priority should thus be accorded to monitoring these species, and to expanding the monitoring of the Lesser Black-backed Gull *intermedius* and Common Gull to include populations from the North Sea (both species) and Barents Sea (Common Gull) coasts.

Population trends The Northern Fulmar, Northern Gannet, Great Skua and *sinensis* subspecies of the Great Cormorant all established populations in Norway during the 1900s (1920, 1946, 1975, and 1996 respectively), and numbers were still increasing at the end of the century throughout much of their ranges. There are, however, indications that the increase in Northern Gannet numbers has reached a plateau, with very variable trends in the northern parts of the Norwegian Sea. Other populations with overall positive trends are the nominate subspecies *carbo* of the Great Cormorant, the European Shag and the *intermedius* subspecies of the Lesser Black-backed Gull. With the exception of the European Shag, which has declined recently in Britain and Ireland (Mitchell *et al.* 2004), these are all taxa that occur in large and increasing numbers and whose breeding range in western Europe is expanding. In several instances, this

is a result of a general recovery after heavy persecution in the late 1800s and early 1900s through increased protection and increased access to non-natural food sources (e.g. garbage, offal and fish discards).

Although the Atlantic Puffin population has declined significantly in the centre of its distribution, it has increased at the southern and northern limits of its range in Norway. The increase in the south mirrors the 13% increase documented in Scotland and the near doubling of the English population between the late 1980s and 2000 (Mitchell *et al.* 2004). Whether the large differences between Brun's (1979) population estimates in the late 1960s and the more recent counts are due to real population increases or a simple refinement in counting methods (probably the latter) is unknown, but as the Herring stock collapsed more than a decade prior to the onset of the present monitoring schemes, a very large increase in puffin numbers seems unlikely, at least in colonies on the Norwegian Sea coast (Anker-Nilssen 1992). There are now indications that the recovery of the Norwegian spring-spawning herring stock (Fig. 2) has improved the feeding conditions and breeding success of Atlantic Puffins at Røst to an extent that might allow a slow recovery of this important population (Anker-Nilssen & Aarvak 2006).

The recent decline in the Black-legged Kittiwake population after a long period of steady population increase throughout its range is unexpected, and what may be an acceleration in this decline rate is disquieting. While deteriorating feeding conditions through a decrease in the availability of Capelin and Herring is a possible cause for the declines on Hornøya (Barents Sea) and on Røst (Norwegian Sea) respectively (Anker-Nilssen *et al.* 1997, Barrett 2007), little is known about possible causes elsewhere in Norway. Disturbance by White-tailed Eagles may have been a contributing factor over large areas of North-Norway in the last few decades (e.g. Anker-Nilssen & Aarvak 2006; *pers. obs.*), but the fact that numbers have decreased outside the range of eagles (e.g. in Britain and Ireland where numbers have declined by 23%, including a 69% decline in Shetland, in the same time period) suggests that other causes may be important. The decline in Britain has been attributed to changes in oceanographic conditions resulting in changes in the distribution and stocks of key prey fish species, and decreases in breeding success, body condition and survival of adult birds (Frederiksen *et al.* 2004).

Of considerable concern is the overall >95% decline in the Common Guillemot population in North Norway since the 1960s and the possible future extinction of what were important Common Guillemot colonies in the European context. There are signs of a recovery of the species east of the North Cape, but to the west some shelf-nesting colonies are close to extinction. This decline, originally a result of direct and indirect human pressure (fisheries), but recently a breakdown of social structure exacerbated by harassment from White-tailed

eagles is in sharp contrast with the recent large, overall increase in numbers of Common Guillemots in Britain, a major breeding region with >30% of the North Atlantic population (Mitchell *et al.* 2004) where none of these negative factors has been a significant problem.

Similarly, the critical situation for the northern subspecies of the Lesser Black-backed Gull *L. f. fuscus* requires immediate investigation. Not only are numbers dropping in Norway, but the subspecies is now absent from the Kola Peninsula and has declined at a rate of 8% p.a. between 1986-2002 in Finland where the present population is around 5000-10,000 pairs (Hario *et al.* 1998; Anker-Nilssen *et al.* 2000). Only in a few colonies in Onezhski Bay in the southern White Sea has there been some respite with an increase at least until the early 1990s when the population was estimated to be c. 1600 pairs (Anker-Nilssen *et al.* 2000). The cause(s) of the decline are unknown but may be related to food shortages during the breeding season or, as proposed for the Finnish population, high chick mortality caused by elevated levels of DDE picked up in the wintering areas in East Africa (Strann & Vader 1992; Anker-Nilssen *et al.* 2000; Bakken *et al.* 2003; Hario *et al.* 2004).

There is also a general concern about deteriorating conditions for seabirds in the North Sea where breeding failures among a number of species have been recorded recently, the possible population effects of which have not yet been discerned. This may be exacerbated beyond national scales in the light of the far-reaching and, as yet, largely unknown physical and biological consequences of climate change at different marine trophic levels, including the biological and distributional responses of important seabird prey such as sandeels, Herring and Capelin (Arnott & Ruxton 2002; Rose 2005a,b). How and through which mechanisms climate change, the resulting (and other) changes in the fishing industry (with its direct and indirect effects on fish stocks), and other anthropogenic activities will affect Norwegian seabird populations cannot readily be predicted (e.g. Durant *et al.* 2004).

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Registry and the National Seabird Monitoring Programme. Without them, a description of the status of the Norwegian seabird populations would be complete guesswork. This review was financed by the Norwegian Institute for Nature Research and Tromsø University Museum.

STATUS VAN BROEDENDE ZEEVOGELS OP HET VASTELAND VAN NOORWEGEN

Langs de kust van het vasteland van Noorwegen broedt ongeveer 2,9 miljoen paar verdeeld over 18 soorten zeevogels. Hiervan broedt 1,4 miljoen paar langs de Barentszee en 1,3 miljoen paar langs de Noorse Zee. De algemeenste soorten zijn Papegaaiduiker *Fratercula arctica* (1,7 miljoen paar), Drieteenmeeuw *Rissa tridactyla* (336.000 paar) en Zilvermeeuw *Larus argentatus* (233.000 paar). Noorwegen heeft een grote verantwoordelijkheid voor een groot deel van 's werelds zeevogels, aangezien meer dan 10% van de totale biogeografische populatie van de aanwezige soorten op het Noorse vasteland broedt en zeven van de twintig populaties bedragen (soms zelfs aanzienlijk) meer dan 25% van de wereld-, Atlantische of Europese populatie. Sommige soorten nemen in aantal toe. Papegaaiduiker, Drieteenmeeuw, Zeekoet *Uria aalge* en de noordelijke (onder)soort van de Kleine Mantelmeeuw *Larus (fuscus) fuscus* nemen alle in rap tempo af. Gevreesd wordt dat lokale zeekoetpopulaties ten westen van de Noordkaap in de nabije toekomst zullen uitsterven.

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