Monitoring the Atlantic Puffin *Fratercula arctica*, Common Guillemot *Uria aalge* and Black-legged Kittiwake *Rissa tridactyla* breeding populations on Hornøya, northeast Norway, 1980-2000

Robert T. Barrett

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The breeding populations of Atlantic Puffins *Fratercula arctica*, Common Guillemots *Uria aalge* and Black-legged Kittiwakes *Rissa tridactyla* have been monitored on Hornøya, East Finnmark since 1980 as part of the Norwegian seabird monitoring programme. Whereas numbers of Puffin burrows in plots monitored in 1981-1993 increased at a rate of 2.6% per year, there was no subsequent trend in counts made in a new scheme of circular plots started in 1990. Numbers of Common Guillemots collapsed between 1985-1987 but have since increased in all plots at a rate of 11.6% per year. Kittiwake numbers dropped significantly (1.5% per year) between 1980-1994, but stabilised between 1994-2000. Suggestions are made for improvements to the monitoring scheme to overcome inconsistencies in changes in numbers between plots (e.g. of Kittiwakes), to increase the sensitivity of the counts and for additions to help explain why any changes in the populations occur.

Key words: seabirds, puffin, kittiwake, guillemot, population monitoring

R. T. Barrett, Dept. of Zoology, Tromsø University Museum, NO-9037 Tromsø, Norway. email: robb@imv.uit.no

INTRODUCTION

With 3-4 million pairs breeding along the coast, the numbers of cliff-breeding seabirds in Norway are in the same order of magnitude as in Great Britain and Ireland and on Iceland. In other words, Norway has an international responsibility for a significant part of the Northeast Atlantic population of seabirds. At present, the commonest species are the Atlantic Puffin *Fratercula arctica* (ca. 2 million pairs) and the Black-legged Kittiwake *Rissa tridactyla* (ca. 500 000 pairs). Other species include the Common Guillemot *Uria aalge* and Razorbill *Alca torda* (both ca. 30 000 pairs), the Black Guillemot *Cepphus grylle* (possibly up to 40 000 pairs) and Brünnich's Guillemots (1-2000 pairs) (Gjershaug et al. 1994). Other cliff-breeding species include the European Shag *Phalacrocorax aristotelis* (ca. 15 000 pairs), the Great Cormorant *P. carbo* (ca. 25 000 pairs) and the Northern Gannet *Morus bassanus* (ca. 3000 pairs) (Gjershaug et al. 1994, pers. obs.).

The first systematic counts of colonial seabirds along the Norwegian coast in the 1960s and early 1970s by Brun (1979 and references therein) revealed large changes in numbers of several species. The most dramatic was the steady decline of the Common Guillemot on Hjelmsøya, West Finnmark from an estimated 110 000 pairs in 1965 to 70 000 pairs in 1975. This plus documentation of large declines in the European Shag and Great Cormorant populations in North Norway (Rikardsen & Strann 1983) and reports of repeated breeding failures among the Common Guillemots and the huge populations of Atlantic Puffins on Røst (Tschanz & Barth 1978, Lid 1981) in the 1970s led to the initiation of a Norwegian national seabird monitoring programme in 1979. The aims of the programme were *"to gather data and material to use as a basis for the estimation of population sizes, detection of population changes and the effects of negative factors thereon, plus suggest action which would result in a reasonable management of seabirds as a national and international resource"* (Røv et al. 1984). It was organised by the then Norwegian Directorate for Wildlife and Freshwater Fish (now the Norwegian Directorate for Nature Management) and is described in detail and assessed in Røv et al. (1984) and Anker-Nilssen et al. (1996). The present programme is coordinated by the Norwegian Institute for Nature Research (Lorentsen 2000).

Being top predators, seabirds are sensitive to changes in the marine environment and studies of various population and ecological parameters may provide information on the status of lower trophic levels. For example, several studies have shown that some species are sensitive to changes in availability of preferred fish prey species and that changes in numbers or breeding parameters may directly reflect natural or man-induced increases or decreases in prey availability (Furness 1996). Being the most conspicuous and accessible component of the marine ecosystem, seabirds may thus provide good indices of the state of the local marine system. Furthermore, regular surveillance studies of seabirds are generally more economical than measurements of the prey stocks themselves (Croxall et al. 1988 and references therein).

As pointed out by Furness & Camphuysen (1997) *"Because seabirds are conspicuous animals they are a suitable choice to play a role as sentinel organisms; unexpected changes in their numbers, health or breeding success provide an alarm that may indicate an unknown pollution or food supply problem. [...] The detailed knowledge of general seabird ecology and of numbers and productivity of many populations also makes them particularly appropriate as a choice of biomonitor or bioindicator. [...] A small part of the gap in our knowledge of marine ecosystems under stress from exploitation or pollution can be filled by studies of seabirds, which as top predators may provide a means of monitoring changes at lower trophic levels of the marine food chain."*

This paper presents the results of the first twenty years of the monitoring scheme on Hornøya (72° 22'N, 31° 10'E), one of the original sites chosen as being representative of the Norwegian colonies on the southern coast of Barents Sea (Røv et al. 1984). Other monitoring sites in the western Barents Sea are on Bjørnøya and Spitsbergen.

Among the many seabird species breeding in Norway, three main target species were initially selected as being representative of different trophic levels and feeding strategies; the Atlantic Puffin, the Common Guillemot and the Black-legged Kittiwake. They represent shallow-diving icthyophores, deep-diving icthyophores and surface-feeding icthyophores/planktophores respectively.

METHODS

Description of Hornøya

Hornøya lies ca. 2 km. east of Vardø in East Finnmark. It is ca. 1 km long (N-S) and 750 m wide (W-E) and rises to 68 m. The rocks are sandstone and shale that dip south-eastwards at an angle of 25°. The strata outcrop along the west side of the island forming a large cliff and in several places on the east of the island forming minor cliffs. On the cliffs are excellent ledges on which the cliff-breeding species breed. The Atlantic Puffins occupy grass-covered terraces in and above the cliffs. There is a lighthouse at the north end of the island which was used as a base for fieldwork.

Atlantic Puffin

Annual counts were made of apparently occupied burrows in three large plots (Plots 1 and 2 ca. 60x40 m, Plot 3 ca. 100x50 m) and along two 3-m wide transects in 1981. Two of the plots (Plots 1 and 3) were at each end of the puffin colony which extended along the top of the birdcliff while the third (Plot 2) was a wide (ca. 20 m) transect across the middle of the colony (Figure 1). The two transects ran down the cliff near the north end of the colony. In 1982, a fourth plot (Plot 4) along the top of an isolated kittiwake cliff (ca. 70 m long) was added to the scheme. The two transects and all the plots were all 'open-ended' to allow for any expansion of the colony into unoccupied areas. Counts of all apparently occupied burrows were made once a year during the incubation period until 1993, after which only Plot 4 was counted. The counts of these four plots proved labour-intensive and there were fears that burrows were being missed due to their size.

To overcome this and to standardise the size of the plots, a new scheme was initiated in 1990 in which all the previous plots (except Plot 4) were replaced by fifty 20 m^2 circular plots. These were centred on numbered wooden stakes driven into the ground and spread across the whole colony. Parallel counts using both schemes were made in 1990-1993. Five stakes were lost by 1998, leaving 45 plots (plus the original Plot 4) still being counted in 2000.

The number of burrows in the initial monitoring plots (520 in 1981) was ca. 10% of the total number of burrows on the island estimated in 1980 (ca. 5000, Barrett 1983). The number in the circular plots plus Plot 4 (ca. 400) was ca. 8% of the total.

Common Guillemot

Monitoring counts were made using internationally standardised methods (Evans 1980, Walsh et al. 1995). Sixteen breeding ledges were originally chosen in 1980 in three main areas on the colony; Vestrestauran, Fuglefjell and Avløysningen (Figure 2). Vestrestauran was a single plot (ca. 40x15 m) containing 300-350 birds that could be easily counted from a ledge ca. 40 m from and ca. 10 m above the plot. Fuglefjell consisted of 10 ledges (numbered 1-10) totalling 350-400 birds on the north part of the main bird cliff. One ledge (no. 9) was counted from the top of the cliff. The remaining nine were counted from below from a site ca. 30 m from the base of the cliff. Five plots were counted on Avløysningen, four from a site ca. 50 m from and level with them while the fifth was counted from above but at a distance of ca. 300 m.

Due to the steep upward angle of view and wide ledges, some birds on Fuglefjell ledges 3-6 were often hidden behind their neighbours and thus sometimes overlooked. An attempt to overcome this was started in 1982 by a second series of counts of the same shelves from a site ca. 60 m from the base of the cliff. The movement away from the cliff gave a shallower angle of view. Three plots were counted, Fuglefjell A (covering Fuglefjell 9 plus some new ledges), Fuglefjell B (covering Fuglfjell 2 and 3) and Fuglefjell C (covering Fuglefjell 4-8 plus two new ledges). In 1989 additional plots were added to the scheme. Two, Alkeberg North and Alkeberg South were wide shelves at the south end of the birdcliff and were counted from above. They were originally rejected as counting plots in 1980 due to the large numbers of birds on them, but after a large decline in 1985-1987 direct counts were considered feasible. However, as numbers have since increased rapidly, they again proved impossible to count directly, and they are now counted from mosaics of 2-5 colour photographs. Fuglefjell D was a plot counted from the top of the cliff and covered Fuglefjell 2-6. In 1991, counts of Fuglefjell E (covering the original ledges Fuglefjell 1 & 9) were also started from the top of the cliff.

Counts of individual birds were made between 0800 and 1200 hrs (Norw. summer time = GMT + 2 h) during the incubation period when both diurnal and seasonal variations in numbers of individuals are at a minimum (Barrett 2001). At least two counts were made of each plot and if the second count deviated by >5% from the first, repeat counts were made until the difference was <5% (see Evans 1980). Each season, counts were repeated on 5-10 not necessarily consecutive days and restricted to days when the weather permitted accurate and consistent counting (i.e. not in thick fog, heavy rain or snow and/or wind Beaufort force 5 or more).

In 1981, a mean of 990 individuals were counted on all monitoring plots. This was equivalent to 13-16% of the total number of birds counted once each year in 1981-1983 (Table 1).

Black-legged Kittiwake

Six plots which were considered to be representative of the Black-legged Kittiwakes breeding habitat were mapped and photographed and their limits drawn on enlargements of the photographs. Four were on the main cliff (Plots 2-5, 20-40

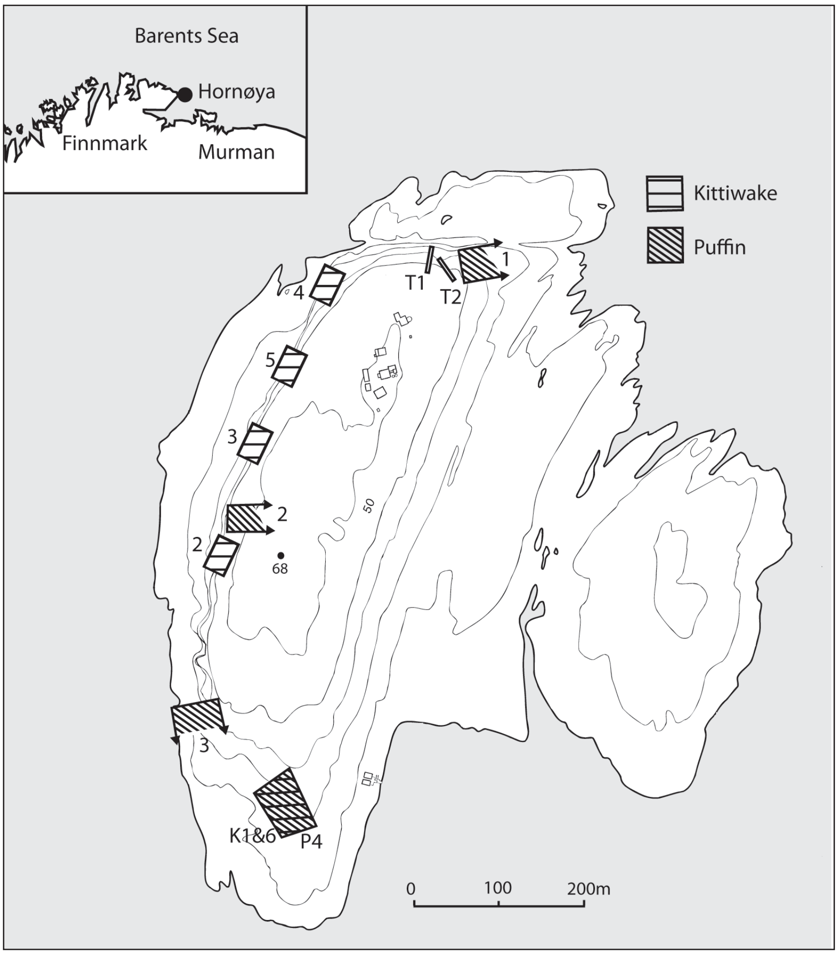

Figure 1
Map of Hornøya showing approximate positions of Atlantic Puffin and Black-legged Kittiwake monitoring sites. (T1 and T2 are Puffin transects).

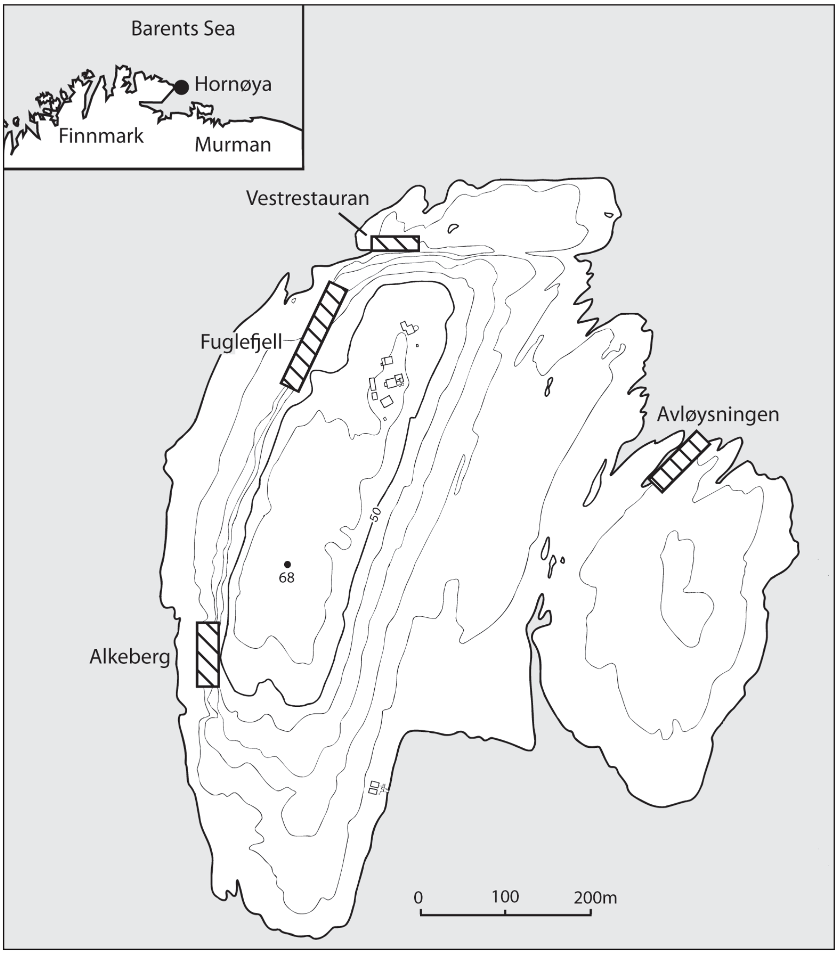

Figure 2
Map of Hornøya showing approximate positions of Common Guillemot monitoring plots.

Table 1. Approximate numbers of individual Common Guillemots on Hornøya estimated from single counts of all individuals during the incubation period.

Year	Approx. number
1981	6000+
1982	ca. 7200
1983	7500
1987	1600
1989	1900
1992	ca. 2600
1996	ca. 4000

m long and covering the height of the main cliff (ca. 25 m)) while two (Plots 1 and 6) were isolated groups on a 5-10 m high and ca. 70 m long cliff near the south end of the island (Figure 1). Counts were of apparently occupied nests (AON), ie. a substantial structure capable of holding eggs (Wanless & Kinnear 1988). They were made either directly (Plots 1, 2 and 6) or from enlargements of monochrome or, since 1996, colour photographs (Plots 3-5) once in the second half of the incubation period (when adult diurnal and seasonal attendance patterns are most stable (Barrett 2001) on a day with fine, calm weather.

A total of 1712 AONs were counted in the six plots in 1982. This was equivalent to 8% of the 21000 ± 1000 AONs counted on the whole colony in 1983 (Furness & Barrett 1985).

Frequency of counts and choice of plots

Counts for all species were made every year between 1980 and 2000 except 1984 and 1986. Mean annual rates of population change were calculated using regressions of lognormal transformed counts against year.

For all three species, monitoring plots were chosen on a logistics (ease of access, safety of the counter, degree of visibility, spatial spread through the colony and topography of the colony) rather than a random basis. Puffin and Kittiwake plots were spread throughout the colony and their form or position was chosen to allow for any expansion of the breeding range. For example

Kittiwake Plots 1 and 6 are small 'satellite' colonies where one might expect the first decrease or increase of the population to occur. Similarly some of the circular puffin plots are just outside the present breeding range but in areas where any expansion would be expected.

RESULTS

Atlantic Puffins

Whereas there was a 2.6% per year increase in numbers of burrows in the initial monitoring plots and transects in 1981-1993 ($y=-45{,}9+0.026x$, $r^2=0.77$, $p<0.01$ where y=log of number of burrows, x=year), there was no trend in the sums of the numbers of burrows in the 45 circular plots plus Plot 4 in 1990-2000 (Figure 3).

All correlations between counts within the four initial plots and the two transects were positive, with 10 of the 15 possible combinations being significant (Table 2). There was no correlation between the total numbers of burrows in the initial plots and those in the circular plots in the four years both sets were counted (1990-1993).

Common Guillemot

Changes in total numbers of individual Common Guillemots in the three main monitoring areas (Fuglefjell 1-10, Avløysningen 1-5 and Vestrestauran) were all very consistent (correlation coefficients $r^2>0.96$, $p=<0.001$ for all three combinations), with a large decrease between 1985 and 1987 (Figure 4).

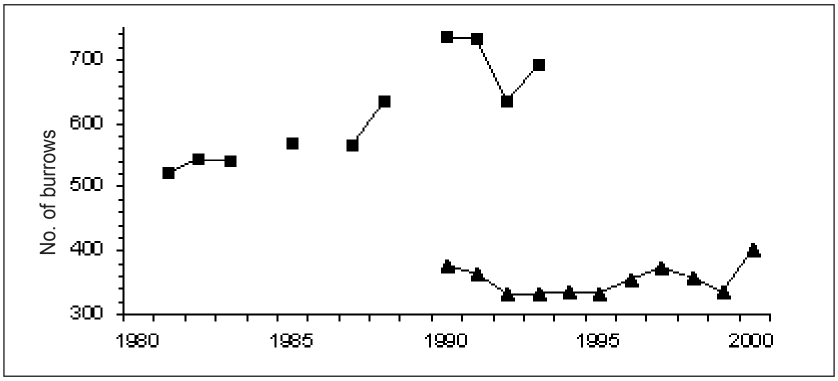

Figure 3
Numbers of apparently occupied Atlantic Puffin burrows counted in six monitoring plots (1981-1993, solid circles) and 45 20 m^2 circular plots (1990-2000, solid triangles) on Hornøya, North Norway.

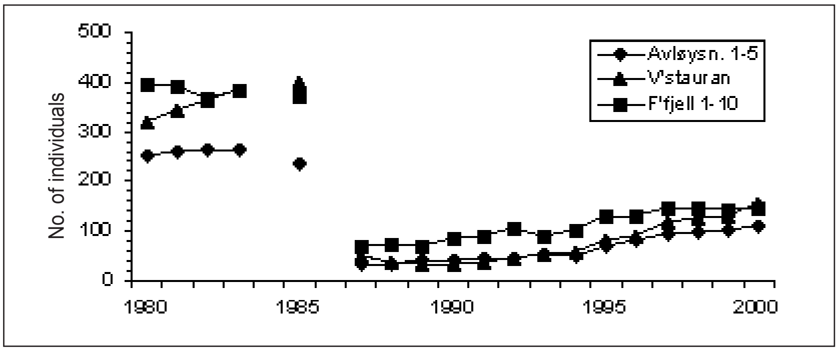

Figure 4
Numbers of individual Common Guillemots counted in three monitoring areas on Hornøya, North Norway, 1980-2000.

Table 2. Coefficients of correlations between four plots and two transects in annual counts of Atlantic Puffins made during the incubation period in 1981-1993 on Hornøya. * indicates p=0.01-0.05, ** p=0.001-0.01, *** p=0.000. (N = 10 years)

	Plot 2	Plot 3	Plot 4	Transect 1	Transect 2	Sum transects
Plot 1	0.09	0.78**	0.62*	0.25	0.28	
Plot 2		0.10	0.05	0.44**	0.29	
Plot 3			0.87***	0.46*	0.41*	
Plot 4				0.63*	0.51*	
Transect 1					0.64**	
Sum plots						0.65**

The subsequent increases (1987-2000) in numbers were all significant (r^2 of lognormal transformed counts=0.86-0.95, $p<0.001$) at rates of 6.6% yr^{-1} (Fuglefjell 1-10), 9.7% yr^{-1} (Avløysningen 1-5) and 11.7% yr^{-1} (Vestrestauran).

The counts of the plots on Fuglefjell A-D were all highly correlated with the counts of their equivalent ledges among Fuglefjell 1-9 (see methods) ($r^2>0.6$, $p<0.001$), as were the counts of all birds on Avløysningen in relation to those on the plots Avløysning 1-5 ($r^2=1.0$, $p=0.000$).

Similarly, counts on Alkeberg N, Alkeberg S, Vestrestauran, Avløysningen (total) and Fuglefjell D+E were all highly consistent after 1987 ($r^2>0.85$, $p<0.001$ in all cases). Since 1989 numbers on all these plots have increased at rates varying between 7.7 and 15.4% yr^{-1} (Table 3, Figure 5). The overall rate of increase of the summed plots was 11.6% yr^{-1}.

Table 3. Annual rates of increase in numbers of individual Common Guillemots in five monitoring areas on Hornøya in 1989-2000 based on lognormal transformed counts (see Figure 4). p=0.000 in all cases.

Plot	% rate of increase/yr	r^2
Vestrestauran	15.3	0.98
Avløysningen	11.2	0.94
Fuglefjell D+E	7.7	0.86
Alkeberg N	15.4	0.93
Alkeberg S	10.6	0.98
Total	11.6	0.97

Black-legged Kittiwake

An inspection of the graph of the totals of the six monitoring plots in Figure 6 suggests that numbers dropped between 1980-1994 followed by a recovery after 1994. A regression of the numbers between 1980 and 1994 showed that the decrease was significant ($y=37.6-0.015x$, $r^2=0.51$, $p<0.01$ where y = log of number of birds, x = year), i.e. the numbers dropped at a rate of 1.5 % per year. The apparent recovery in 1994-2000 was not quite significant ($y=-4.5+0.026x$, $r^2=0.56$, $p=0.053$).

There were, however, inconsistent changes in numbers of nests counted in the individual plots (Table 4). While the correlations between Plots 2, 4 and 5 and between Plots 1 and 2 and Plots 1 and 4 were positive and significant, changes in Plot 3 did not correlate with any of the other plots. Furthermore, numbers on Plot 6 tended to decrease as those on Plots 2, 4 and 5 increased

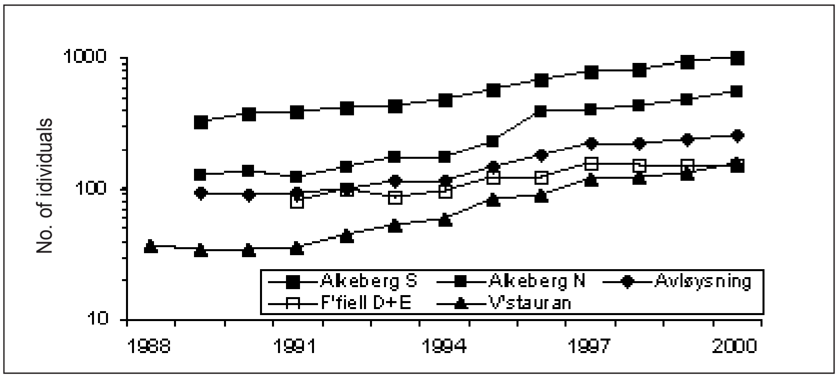

Figure 5
Numbers of individual Common Guillemots counted in five monitoring areas on Hornøya, North Norway, 1988-2000. Note logarithmic scale of y-axis. Rates of increase are given in Table 3.

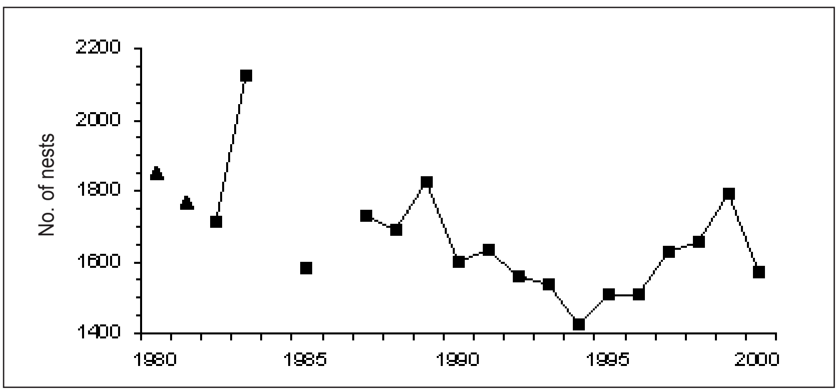

Figure 6
Total numbers of apparently occupied Black-legged Kittiwake nests counted in six monitoring plots on Hornøya, North Norway in 1982-2000. (Data points for 1980 and 1981 are extrapolated from Plots 1-4)

Table 4. Coefficients of correlations between six plots in annual counts of Black-legged Kittiwakes made during the incubation period in 1980-2000 on Hornøya. * indicates p<0.05, ** p=0.001-0.01, *** p=0.000. (Nos. of years are given in brackets)

	Plot 2 (19)	Plot 3 (19)	Plot 4 (19)	Plot 5 (17)	Plot 6 (17)
Plot 1	0.27*	0.03	0.35**	0.12	0.06
Plot 2		0.19	0.67***	0.75***	-0.32*
Plot 3			0.15	0.05	0.04
Plot 4				0.76***	-0.43**
Plot 5					-0.66***

DISCUSSION

Methods

Although the monitoring counts on Hornøya revealed some unambiguous trends, several weaknesses in the methods used were apparent and need to be addressed before further counts are made.

For example, whereas a slow increase in numbers of Atlantic Puffins was revealed in 1981-1993 using the initial monitoring scheme covering large plots and transects, the circular plot monitoring showed no continuation of the trend in 1990-2000. This may be coincidental, i.e. the population did actually level out when the new scheme was introduced, or it may be a result of the change of methodology (Mudge 1988). While both schemes were run in parallel over a four-year period (1990-1993), the lack of consistent trends in the numbers of burrows counted suggest the latter. This is corroborated by Anker-Nilssen & Røstad (1993) who set out a monitoring scheme on Hernyken, Røst in 1983 using evenly-spaced circular plots which were more representative than previously used quadratic plots and transects. They found, for example, that the density of burrows in the initial plots was 1.0 m^{-2} whereas that of the whole colony was only 0.6 m^{-2}. A return to counts on Hornøya using both schemes over a longer period may show whether there has been any change in bias in the selection of plots. This, however, counteracts the initial purpose of the new, circular plot scheme which was to reduce the labour intensity and possible inaccuracy of the original scheme.

Such problems did not arise in the monitoring of Common Guillemots during which there were very consistent trends in counts made in the different plots and areas. This is despite the initial counts of the ten plots on Fuglefjell being made from close to the base of the cliff from where many birds at the back of the breeding ledges were either invisible or difficult to see. Although these initial plots were thus seemingly representative, they should now be replaced by the more recently initiated counts of many of the same ledges made from a new position at the top of the cliff where all but a handful of birds can be clearly seen. The few birds not seen are hidden by a small overhang, and are estimated to constitute ca. 5% of the numbers on the shelf in question (Fuglefjell D, pers. obs.). This is small compared to the numbers of birds missed when counting from below. For example, the movement of the counting point away from the base of the cliff increased the numbers of birds visible on Fuglefjell 4-8 (which is equivalent to Fuglefjell C) by ca. 50%. The number of birds visible on Fuglefjell B and C was further increased by ca. 25% when viewed from the top of the cliff (Fuglefjell D). A continuation of counts from below the cliff may result in birds establishing new nest sites at the back of the ledge being missed. The new position at the top of the cliff was not used originally due to our then unfamiliarity with the topography of the colony.

Counts from photographs may be as much as 19% lower than field counts (Harris et al. 1983), but on the assumption that this underestimate does not change as numbers of birds changes, photographic counts of Alkeberg N and Alkeberg S should continue. However, a test of this underlying assumption should be carried out as an increase in variability as the density of birds increases might be expected.

Although based on rough counts only, the total population of Common Guillemots seems to have increased at a similar rate (Table 1, 10.3% yr^{-1}, r^2=1.0, p=0.001) to that of the numbers on the monitoring plots (11.6%).

The overall increase in Common Guillemot numbers has, however, involved the spread of birds into previously unoccupied parts of the cliff (pers. obs.). This raises one major problem with the monitoring of numbers within fixed plots which is that the population may increase through either an increase in density within the plots or by an expansion of the habitat. Until the number of nests or birds within a plot reaches the maximum physically possible, annual counts are likely to reflect changes in the population. Once the maximum is reached, however, any further increase in the population will entail an expansion of the habitat outside the plots including, at the extreme, the establishment of new nest sites in other colonies. This problem is partly overcome in the monitoring scheme at Hornøya by the present inclusion of the peripheral 'open-ended' Puffin plot P4 plus a number of circular plots on the edge of or just outside the present habitat plus the 'open-ended' Kittiwake plots K1 and K6. It is, however, especially critical for Common Guillemots which are rapidly increasing in number. As the population increases and densities of birds in the monitoring plots approach those of the pre-collapse (1985) level, new plots will have to be established in areas into which the population eventually expands.

With regards to the significance of numbers of plots and the frequency of the counts chosen, an analysis by Anker-Nilssen et al. (1996) showed that there is little to gain in the sensitivity of the present monitoring scheme from the increase of either on Hornøya.

The reasons for the inconsistencies in the changes in numbers of nests in the Black-legged Kittiwake plots are unknown, and a similar lack of concordance between monitoring plots for Kittiwakes has been found in e.g. Orkney, Shetland and Scotland (Wanless et al. 1982, Heubeck et al.1986, Wanless & Kinnear 1988). With the present evidence that numbers of nests in different parts of a Kittiwake colony or in closely neighbouring colonies may change at different rates and in different directions as a result of e.g. differences in nest-site quality, tick-infestation or local reproductive success (Coulson 1968, Boulinier & Danchin 1996, Danchin et al. 1998), recommendations have been made to use total colony counts rather than extrapolations from selected plots as monitoring units (Heubeck et al. 1986). Annual counts of the whole colony on Hornøya are not, however, considered as a workable option due to the numbers involved (ca. 20 000 nests). On the other hand, total colony counts should be made at say five- or ten-year intervals as controls of the plot counts. Whereas such total counts will be the best measure of long-term changes, annual plot counts will aid interpretations of these trends. This was clearly demonstrated by the lack of counts of Common Guillemots on Hornøya in 1986, the season prior to the one when the huge decline in the population was revealed (see below). Whether the population had declined or started to decline in 1986 is unknown.

Furthermore, the Norwegian monitoring scheme is based on single counts of Kittiwake AONs each season whereas Walsh et al. (1995) recommend several counts during the incubation period and the use of the highest reliable count as the final figure for the year. This allows for seasonal variations in the numbers of occupied nests and increases the sensitivity of the monitoring. Similar recommendations are made by Walsh et al. for counts of Great Cormorants, European Shags and gulls (Laridae), and where practical such repeat counts should be introduced in Norway, at least on a trial basis.

While nest counts are the basis of most Kittiwake monitoring (Walsh et al. 1995), counts of individuals should also be considered as they give a measure of whole populations of breeders and non-breeders (Heubeck et al. 1986, Hatch & Hatch 1988). The use of individuals as a counting unit also avoids the problem of the observer's subjective definition of a nest (e.g. Heubeck & Mellor 1994) and results in smaller inter-observer differences in counts than when nests are used as units (Wanless et al. 1982). In the short term, counts of adults may also be useful indicators of attendance changes which, in turn, may be a result of e.g. fluctuating food availability, predation or human disturbance (Wanless & Harris 1992, Cadiou 1999, Sandvik & Barrett 2001). On Hornøya, repeat counts of Kittiwake AONs and adults could be carried out during the same ca. 10-d period that Common Guillemots are monitored, but should ideally be spread over a greater part of the breeding season.

Trends in numbers 1980-2000

Despite the above-mentioned needs for improvement in the monitoring scheme on Hornøya, the counts made since 1980 documented at least one major incident, namely the huge decline in numbers of Common Guillemots between 1985 and 1987. This decline was registered at several colonies in the southern Barents Sea and was attributed to a large adult mortality in the 1986/87 winter due to a collapse in the capelin *Mallotus villosus* stocks in the mid-1980s (Vader et al. 1990, Krasnov & Barrett 1995, Anker-Nilssen et al. 1997). Similarly the apparent decline in the Black-legged Kittiwake population in 1980-1994 and the initial increase in the Atlantic Puffin population in 1981-1993 on Hornøya in relation to other colonies in the region have been discussed in Krasnov & Barrett (1995). Whether what appears to be a subsequent recovery of the kittiwake population is real will be determined by future counts.

Since the 1985-1987 collapse, a recovery of the Common Guillemot population is now apparent. The overall rate of 11.6% yr^{-1} is towards the maximum rate of that recorded elsewhere (14% yr^{-1} in Britain, 1969-1978 (Harris 1991), 10% yr^{-1} in Britain, 1975-1982, (Rothery et al.1988) and ca. 4% yr^{-1} on Coats Island, Hudson Bay (Gaston et al. 1993)). This rapid recovery has been facilitated by successive years of high annual adult survival (96% in 1989-1997, Erikstad et al. 1998) and high chick growth suggesting optimal breeding conditions (Barrett unpubl.). Furthermore, sightings of two birds ringed as chicks on the Shetlands in 1990 prospecting (and one later breeding, pers. obs.) on Hornøya in the mid-1990s (Nikolaeva et al. 1996) suggest that immigration has also played a role in this increase.

Although the monitoring of seabirds on Hornøya has shown clear long- and short-term changes in numbers, the underlying causes of them are not fully documented. While some parameters such as chick growth, food choice, and breeding success have been studied on Hornøya since 1980 and adult survival since 1990 (Barrett & Golovkin 2000 and refs. therein), other demographic parameters which help explain population changes such as age-specific survival rates, the proportion of mature birds that breed each year, the age of first breeding, and immigration and emigration rates should also be addressed (ICES 2001). In this context, Hornøya would play a key role as a reference site for other colonies in the southern Barents Sea (Anker-Nilssen et al. 2000).

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SAMMENDRAG

Overvåking av lunde *Fratercula arctica*, lomvi *Uria aalge* og krykkje *Rissa tridactyla* på Hornøya 1980-2000

Hekkebestandene av lunde *Fratercula arctica*, lomvi *Uria aalge* og krykkje *Rissa tridactyla* på Hornøya, Øst Finnmark er blitt overvåket siden 1980 som en del av et nasjonal overvåkningsprosjekt for sjøfugl. Bestandene blir overvåket ved å telle henholdsvis reirhuler (lunde), individer (lomvi) eller reir (krykkje) i avgrensede områder. Disse områdene anses som representative for hele kolonien. I 1981-1993 økte antall okkuperte lundehuler med 2,6 % per år i prøvefeltene, men ingen endring i bestanden ble dokumentert i 1990-2000 da nye prøvefelt ble brukt. Etter at lomvibestanden på Hornøya brøt sammen i 1987, har antall fugler i de forskjellige prøvefeltene økt med 11,6% per år. Antall krykkjereir synes å ha minket med 1,5% hvert år mellom 1980 og 1994, men var stabilt fra 1995-2000. Det ble imidlertid avdekket flere problemer med metodikken som bør forbedres for å minske uoverensstemmelser mellom tellinger i de ulike prøvefeltene (særlig hos krykkje) og for å øke følsomheten av tellingene. Prøvefeltene for krykkje bør telles flere ganger hvert år (for eksempel fem), og ikke bare én gang som nå. For lunde bør konsekvensen av å bytte til nye prøvefelter i 1990 kontrolleres ved å bruke også de gamle prøvefeltene en periode. Tilleggsundersøkelser (av for eksempel hekkesuksess, næringsvalg og voksen overlevelse) foreslåes for bedre å kunne forklare evt. endringer i bestandene.

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Attention Moosers!

We are pleased to invite you to participate at the 5th International Moose Symposium to be held in Hafjell, Norway from 4 - 9 August 2002. As with the four previous international moose symposia, the conference aims to facilitate exchange of knowledge and ideas between moose scientists and managers involved in research on and management of moose around the world. Under the implementation of the Convention on Biological Diversity, a special emaphasis has been placed upon an integrated ecosystem approach. Some of the "Malawi principles" state that management objectives are a matter of societal choice, and that management should be decentralised to the lowest appropriate level. A key feature of the ecosystem approach includes conservation of ecosystem structure and functioning on a long- term basis, and the ecosystem approach should seek the appropriate balance between conservation and use of biodiversity. The 5th International Moose Symposium will cover a broad spectre of topics, but the conference organisers would like to particularly focus on the role of moose in the ecosystem, and how the Malawi principles can be adopted in moose management. Accordingly, the theme of the conference is 'Moose in a modern integrated ecosystem management'. Papers addressing these questions are especially welcome. The 5th International Moose Symposium replaces the annual North American Moose Conference and Workshop for 2002.

For those of you interested in obtaining more information regarding this event, please consult our website: http://www.ninaniku.no/moosesymposium

On behalf of the organizing committee,

Scott Brainerd
Viltkonsulent (Dr. Scient.)/Wildlife Biologist (Ph.D.)
Norges Jeger- og Fiskerforbund/Norwegian Assoc. of Hunters & Anglers
Box 94
N-1378 Nesbru
NORWAY

Tel.: (+47) 66 79 22 16
Fax: (+47) 66 90 15 87
Mobil: (+47) 41 91 51 75
e-mail: scott.brainerd@njff.no