

## Key-site monitoring in Røst in 2009

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All existing long-term data series on seabird population trends, survival rates, reproductive performance and diets in the Røst archipelago were updated in 2009 following well-established, standardised procedures (Table 1) but, as in the two preceding years, some sample sizes were limited by poor breeding conditions for many species.

**Table 1** Key population parameters (SE, n) of seabirds in Røst in 2009. Population change is the numeric change in size of the breeding population registered between 2008 and 2009 on the basis of plot counts (p) or total censuses (t). The main kittiwake colony is on Vedøy (ca. 8,900 pairs in 2009), whereas that in the Kårøy area is a relatively small (615 pairs) population nesting on buildings. For each species, the listed survival estimate was derived from the basic CJS model(s) that fitted the data set best (i.e. that/those with  $\Delta QAIc < 2$  when adjusting for median c-hat).

Species	Population change	Annual adult survival		Reproductive performance	
		Period (yrs)	Estimate %	Sampling unit	Estimate
Fulmar	+ 4.7% <sup>p</sup>				
Cormorant	- 37.4% <sup>t</sup>			Clutch size <sup>1,2</sup>	2.00 (0.15, 72)
				Large chicks/nest <sup>2</sup>	0.47 (72)
Shag	- 20.0% <sup>p</sup>	2007-08 (1)	74.0% (4.1, 385) <sup>3</sup>	Clutch size <sup>4,5</sup>	2.08 (0.03, 474)
				Clutch size <sup>2,5</sup>	1.90 (0.04, 541)
Eider	- 27.1% <sup>p6</sup>			Clutch size	3.87 (0.25, 30)
Great skua	+ 75.0% <sup>t7</sup>			Breeding success	0.20 (0.20, 5) <sup>3</sup>
Common gull				Clutch size <sup>4</sup>	2.23 (0.17, 13)
Herring gull				Clutch size <sup>4</sup>	1.92 (0.17, 26)
Great black-b. gull				Clutch size <sup>4</sup>	2.37 (0.08, 78)
Kittiwake					
Vedøy	- 3.5% <sup>p8</sup>			Large chicks/nest <sup>8</sup>	0.00 (n=333)
Kårøy	- 2.8% <sup>t</sup>	2008-09 (1)	82.4% (4.9, 210) <sup>3</sup>	Clutch size/pair <sup>9</sup>	1.46 (0.08, 81)
				Large chicks/pair	0.44 (0.06, 81)
				Large chicks/nest <sup>10</sup>	0.32 (n=615)
Arctic tern				Clutch size	1.42 (0.05, 113)
				Breeding success	<sup>3</sup> 0.03 (0.02, 79)
Common guillemot	- 9.3% <sup>p</sup>	2005-06 (1)	>86.5% (13.5, 69) <sup>3</sup>	No data	
Razorbill	+ 4.4% <sup>p</sup>				
Puffin	- 5.5% <sup>p</sup>	2007-08 (1)	80.4% (6.3, 452)	Hatching success	0.46 (n=67)
				Breeding success	0.00 (n=74) <sup>11</sup>
Black guillemot	+ 2.2% <sup>p12</sup>	1997-09 (12)	86.4% (2.0, 92)	Clutch size	1.82 (0.07, 33)
				Large chicks/clutch	1.25 (0.17, 16) <sup>3</sup>

**1)** Minimum estimate on 19 June, when some clutches possibly were still incomplete while 21 (29%) had small chicks; **2)** Including empty nests; **3)** See text for details of estimation; **4)** Excluding empty nests; **5)** On 1 July; estimated by linear regression of mean values for eight different counts between 1 and 27 July; **6)** Change since 2005 north of Åfjorden (not counted 2006-08); **7)** From four to seven breeding pairs; **8)** Based on total counts in study plots; **9)** On 17 June, on main buildings only (field VIII); **10)** Based on total counts; **11)** Fledging success 0.00 (n=31); **12)** Maximum number of individuals on a resting site close to the colony, as monitored by time-lapse photography.



**Figure 1**

*Pictures of birds carrying prey in a visible manner makes it possible to identify their food choice, and in some cases colour rings and even metal ring numbers can be read easily. The common guillemot to the left (coded CA) was ringed as an adult in the same colony in 2005 and here returns with a young saithe for its young, whereas that to the right (ring number X95 104) was ringed as a chick in Shetland in 1999. (© H. Eggen)*

Using SLR cameras with high quality telephoto lenses and track focus, we have had great success in increasing food choice sample sizes many-fold for common guillemot, razorbill and puffin. More than 90% of the food loads we examined for these species in 2009 were identified from digital pictures taken of flying birds when they arrived at the colony to feed their young. This method also helped us read many more colour rings of common guillemots than otherwise possible due to their concealed breeding habitat on Herynken, and we were even able to read the full ring numbers of two birds ringed in Britain, one of which as a chick in Shetland 10 years earlier (Figure 1).

For the puffin, other aspects of their breeding performance (not listed in the table) were also monitored in the traditional way. As usual, the fieldwork was divided into two periods: 4.5-14.5 and 11.6-14.8. The main tasks during the first period were the standardised monitoring of puffin breeding numbers (cf. Anker-Nilssen & Røstad 1993) and body condition just prior to egg-laying, and the setting up of the automatic time-lapse camera to register attendance patterns of puffins every hour throughout the rest of the season.

### **A timely change**

In 2009, we also packed all the scientific gear and other movables at the field station into waterproof compartments, as the final preparations for a complete renovation of the housing facilities on Herynken. Before our next field-trip to the island four weeks later, the old cabin was dismantled and a new station building specially designed for the purpose was erected at exactly the same site (Figure 2). Soon we will, for the first time, be able to work, wash, eat, sleep and store equipment in separate rooms! Admittedly, this event aroused a complex variety of emotions among those of us who have spent hundreds and hundreds of days at Herynken over the last four decades. Year after year we have had the privilege to enjoy and develop the unique atmosphere and traditions of the old station, that was established by our predecessors and deceased friends: Svein Myrberget, who started it all in 1964, and Gunnar Lid, who continued Svein's puffin studies throughout the 1970s. However, this was not always easy. We have spent increasingly more energy to fight the inevitably lost battle against

the extreme forces of decay at this exposed outpost. Nevertheless, we have no long-lasting regrets when looking back or ahead. On the contrary, the new station does not only inherit strong traditions. Having developed the building plans over more than a decade, the result is a thought-through symbiosis of modern techniques and local experiences that provides some of the essential qualities needed to make a long story much, much longer.



**Figure 2**

*The ravages of time had its ways with the old field station at Hernyken. In 2009 it was demolished (left) to give room for the new building (right) put up at exactly the same site. Parts of the old cabin served as workmen's huts during the construction period. (© A. Wilhelmsen and T. Anker-Nilssen)*

### **Few species showing signs of recovery**

Arctic terns bred for the first time in three years and the small population of great skuas increased from three to seven breeding pairs, but numbers of most other species dropped from 2008 to 2009 (Table 1). Among the fish-eating seabirds, the breeding populations of the near-shore cormorant and shag dropped by more than a third and a fifth, respectively, the offshore puffin and common guillemot dropped by 5-9%, while the somewhat more coastal razorbill seemingly increased by 4%. For razorbills and common guillemots it must, however, be kept in mind that these numbers only apply to counts of the few birds still trying to breed on the exposed vertical cliffs at Vedøy, where they are now being so harassed by white-tailed eagles that they are unable to breed successfully. On Hernyken and several other islands in the Røst archipelago, where their conspecifics breed in shelter under large rocks and boulders, our less systematic counts of birds at sea and other observations clearly indicate both species are producing more chicks and have increased significantly in numbers over the last two decades. It is thus likely that the overall population of these species in Røst have been at least stable since the turn of the century.

Next year's results are needed to determine to what extent the large decreases for both shag and cormorant were mainly due to deferred breeding or actual reductions in adult survival rates. The former is a typical response of these species when local food supply or other conditions for breeding are poor, and the low clutch sizes of both species in 2009 suggest this is the most likely explanation. Additional support for this assumption comes from our monitoring of black guillemots, which also feed on near-shore (albeit smaller) fish. Despite numbers of birds attending the near-by resting site remained relatively stable, there was a marked decrease in the number of occupied nests in the

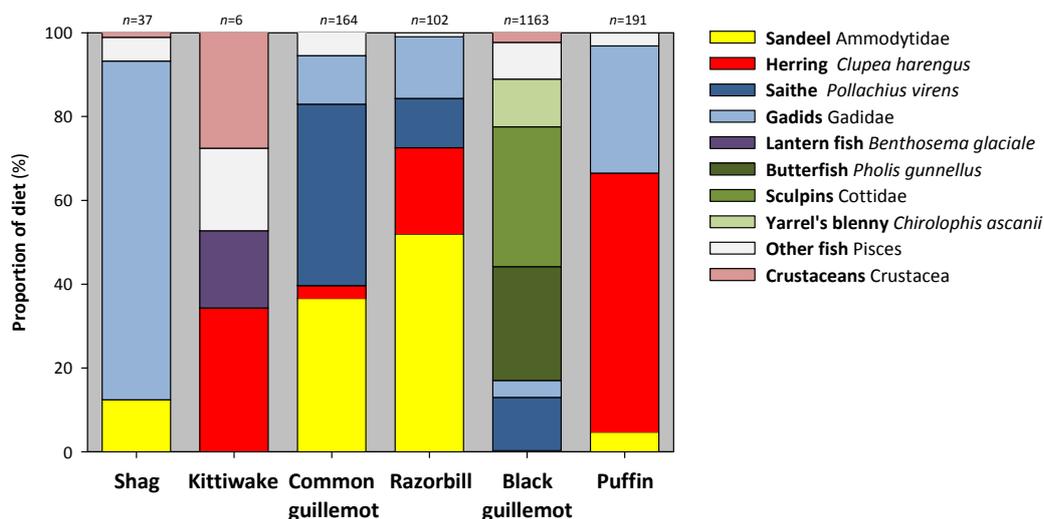
colony between 2008 and 2009. For the eider, however, the 27% reduction in numbers since 2005 is more worrying, and indicates the population has almost halved since 1988.

The offshore surface-feeders fulmar and kittiwake did not change radically in numbers since 2008, but the continued drop for kittiwakes in the main colony on Vedøy was close to the mean rate of population decrease recorded over the last decade ( $-5.5\%$  p.a.). The population has dropped 65% from 25,000 to less than 9,000 pairs in 30 years, and fulmars are still below 20% of their breeding numbers in the late 1990s.

The total population of puffins in Røst in 2009 was estimated at 401,900 pairs or, more precisely, apparently occupied burrows (AOBs), which is only 5% higher than the all-time low in 2002 and 72% lower than the 1.44 million AOBs when monitoring was initiated in 1979. Røst used to be the largest puffin colony in the world, a title which is now held by the Westman Islands in SW Iceland (ca 1.1 million AOBs, E. Snær Hansen pers. comm.).

### Most species had poor success

For the third time on record and the third year in a row, a total breeding failure was again documented for the kittiwakes in the main colony at Vedøy (Table 1). Even the steadily increasing population that breeds out of reach of white-tailed eagles on buildings at Kårøy experienced their poorest seasons in these three years. Poor food conditions were again the main reason for the failure. This also made food sampling very difficult, but the six regurgitations that were obtained indicated the diet was again varied and included (by mass) 28% crustaceans (those identified were krill), 18% glacier lanternfish (36-72 mm,  $n=3$ ), 4% lumpsucker (ca 40 mm,  $n=1$ ) and 7% first-year herring, as well as pieces of large herring (27%, most likely long-line bait) and 15% fish liver (Figure 3).

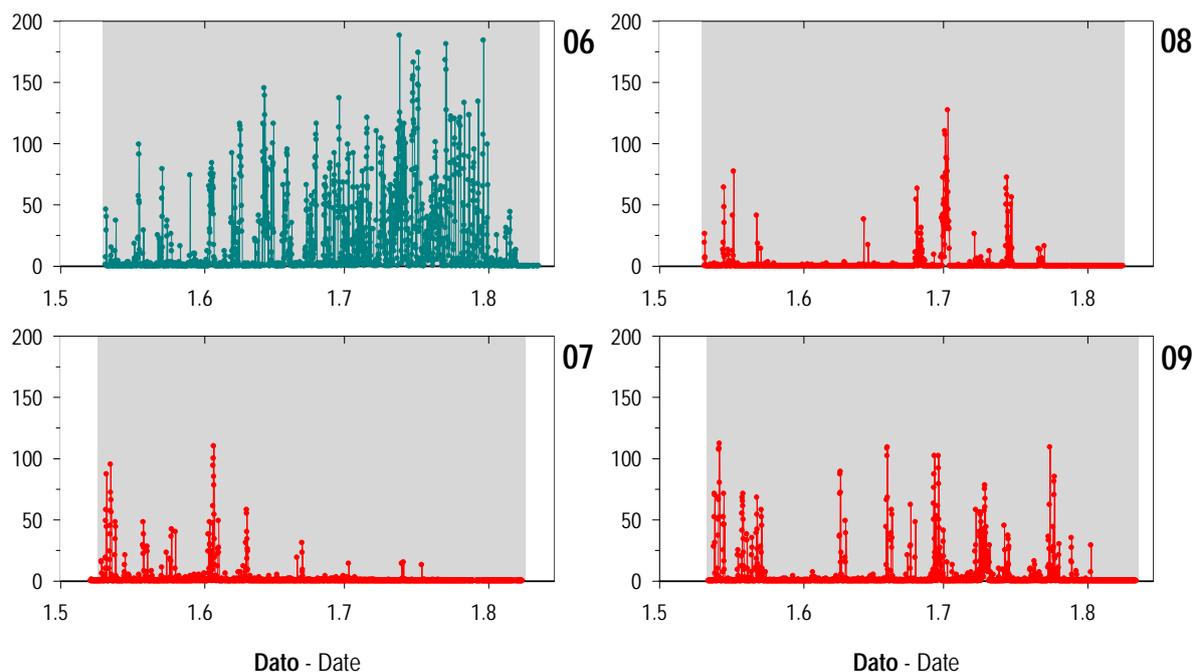


**Figure 3**

Diet composition of five different seabird species in Røst in 2009. Numbers of food loads examined are indicated above each bar. Data for shag (pellets from adults only) and kittiwake (regurgitations from 5 adults and 1 chick) are presented by mass, whereas data for the auks are based on observations of food loads intended for chicks and presented by frequency of occurrence.

The mean hatching date of kittiwakes on the buildings at Kårøy was 23 June ( $SE=1.6$ ,  $n=33$ ), which is 10 days later than in 2008 and 3 days later than in 2007. None produced two fledglings, and neither clutch size nor breeding success differed much from those in the two previous years.

The reproduction of common guillemots and razorbills is not monitored, but once again qualitative observations strongly indicated a total breeding failure for those nesting on open ledges. However, and in strong contrast to the situation in the two preceding years, many of those breeding in shelter under boulders most likely had a good breeding season and many were observed feeding their chicks throughout most of July. As usual, saithe was the most frequent prey (43%) of common guillemots. As in 2009, greater sandeel *Hyperoplus lanceolatus* was also an important component and comprised 75% of the sandeel carried by common guillemots and 30% of the sandeel carried by razorbills. Even two puffins were observed bringing this prey. The most common puffin food, however, was transparent herring larvae, which comprised 84 of 191 loads (44%) and indicated very poor conditions for both herring and puffins in 2010. Only 10% (19) of the puffin loads consisted of larger herring, whereas this proportion was 20% (20 loads) for razorbills, which once again carried a much higher proportion of lesser sandeels than any of the other seabird species monitored.



**Figure 2**

*Colony attendance of puffins in a study plot on Hernyken in 2009 (lower, left) compared to the corresponding results for the three preceding years. The data are counts of birds on digital pictures taken every hour by an automatic time-lapse camera.*

### The progress of the puffin season

The automatic time-lapse monitoring documented that the adult puffins visited the colony more often than in the two preceding years, but indicated also that very few birds spent time in the colony during the peak of the incubation period between 22 May and 18 June (Figure 2). As in 2008, this was

paralleled by relatively few of the study nests containing an egg, and although almost half of the eggs were hatched, none of the pairs in our study burrows managed to raise a chick. The mean date of hatching was 20 June ( $SE=0.70$ ,  $n=28$ ), the last chick died on 8 July ( $n=30$ ) and the mean age of chicks at death was only 7.4 days ( $SE=0.94$ ,  $n=28$ ). No fledglings were observed in the colony or the surrounding sea areas. Nevertheless, a few puffins were observed carrying fish back to the colony throughout July and early August. This probably indicated that food conditions improved towards the end of the season, although the traffic was too low to make it worthwhile sampling food loads using the traditional mist nets. Instead, digital photographs of the birds in flight when they arrived at the colony (Figure 1), enabled us to identify the composition of the chick diet throughout the season from 24 June to 6 August. Most food loads contained first-year herring (61.8%) and/or gadoids (30.4%), and only 10 loads (5.2%) had sandeels. Among the 128 loads with herring, 23 loads (18.0%) contained herring that had undergone metamorphosis and 110 loads (85.9%) contained transparent herring larvae (i.e. 5 loads had a mixture of the two size groups). The most abundant gadoid prey, haddock, was present in at least 38 loads (19.9%).

It is safe to conclude that at the population level 2009 was the 14<sup>th</sup> total breeding failure for puffins in Røst since 1964, and this does not take into account the additional five seasons when only a very small proportion ( $\leq 10\%$ ) of the chicks fledged (Anker-Nilssen & Aarvak 2006).

Fortunately for the monitoring of survival rates, many adults visited the colony on a several occasions in late June and first half of July (Figure 2). The mean number of birds sitting in the photo plot between early May and early August (4.19,  $SE=0.30$ ,  $n=2136$ ) was more than twice those in the two preceding years (2007: 1.65,  $SE=0.18$ ,  $n=2178$ ; 2008: 1.75,  $SE=0.20$ ,  $n=2153$ ), and although it was only a quarter of that in the record year of 2006 (17.78,  $SE=0.68$ ,  $n=2115$ ) it was similar to that in 2004 (3.70,  $SE=0.16$ ,  $n=2157$ ) when fledging success was estimated at 88% (Anker-Nilssen & Aarvak 2006).

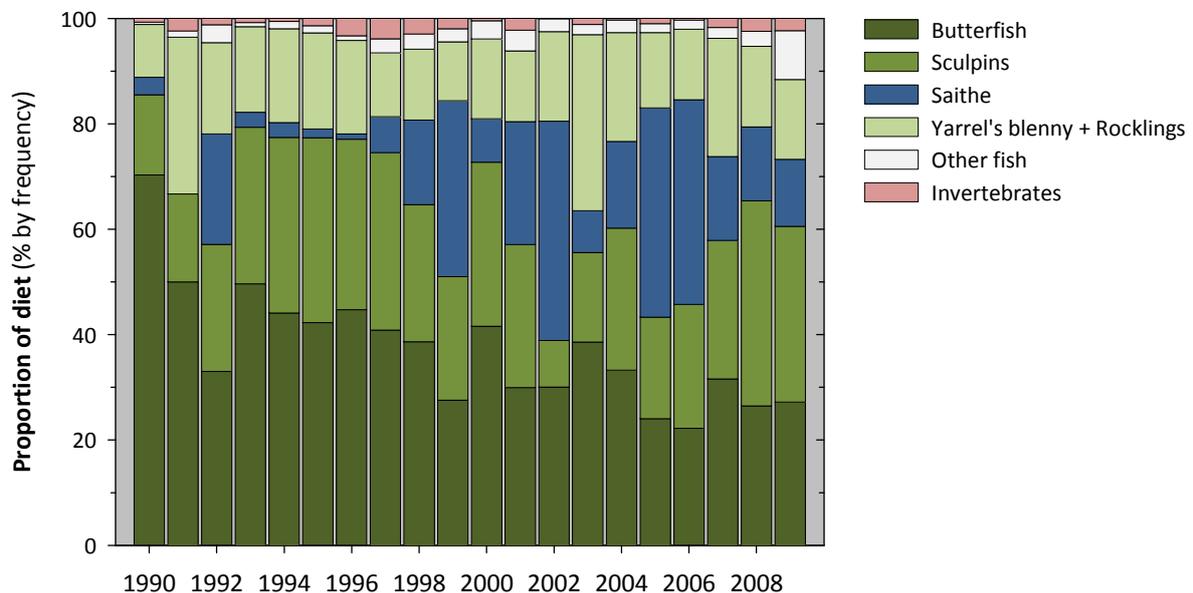
The puffin is the only species that is monitored in early May. Because 2002 and 2004 are the two most recent successful breeding seasons, some five- and seven-year-old birds were expected to settle as first-time breeders. The 5.5% decrease in burrow occupancy since 2007 thus indicates either that 1) the immature survival of these year classes was lower than one could have hoped for, 2) adult survival rates have decreased, or 3) many birds (experienced breeders and/or potential recruits) deferred breeding, e.g. because of poor food conditions in the pre-breeding season. These factors work in concert, and cannot be quantified independently without further monitoring. However, the mean body mass of 17 adults captured in the colony on 13-14 May (452.1 g,  $SE=7.33$ ) was the third lowest on record and 4.7% lower than the average level for the pre-laying period (first half of May) in 16 earlier years (474.6 g,  $SE=4.65$ , range 439.2-521.7). This supports the hypothesis that the proportion of non-breeders was higher than usual, as was also indicated by the low proportion of study borrows containing an egg.

### **Continued problems also for inshore-feeding species**

The breeding success of black guillemots was relatively low ( $1.25\pm 0.17$  large chicks/nest, Table 1), but higher than in 2008 ( $0.75\pm 0.11$ ,  $n=16$ ). The improved breeding success could be expected to have a 'negative' effect on the number of birds resting on a small islet close to the colony, which has been monitored by an automatic time-lapse camera since 2006 (Anker-Nilssen 2007). Indeed, the evening

peaks in numbers of resting adults in the late incubation and early chick rearing periods, as well as the later increase in numbers towards the end of the chick period, were generally lower in 2009 than in the preceding year and similar to those in 2006-2007. Nevertheless, the maximum number of black guillemots on the time-lapse pictures peaked at 93 birds (at 00:23 on 29 July), which is two more than the previous record set in 2008.

As in most other years, the black guillemot chicks were fed mainly sculpins (33.4%) and butterfish (27.2%), but for the third time (all since 2006) sculpins were the most abundant dietary item (Figure 3). While saithe (12.7%) and Yarrel's blenny (11.3%) were less numerous than in the preceding five and nine years, respectively, the diet in 2009 contained a record high proportion of dragonets *Callionymus* spp. (5.2%). Sculpins were back at levels similar to those in the mid 1990s, while butterfish was again scarcer than in the 1990s. These changes may indicate a significant shift in food availability for black guillemots and other inshore-feeding seabirds.



**Figure 3**

*The inter-annual variation in diet composition of black guillemot chicks at Hernyken, Røst in the 20-year period 1990-2009 (cf. Table 2 for scientific names). Before 1997, Yarrel's blenny was not distinguished from rockling spp., but blennies probably make up the bulk of this group as rocklings have later only constituted on average 2.3% of the diet. Most invertebrates were hermit crab.*

The clutch size of shags on Ellefsnyken on 1 July ( $2.08 \pm 0.03$ ,  $n=474$ ) was similar to that in 2008 ( $2.06 \pm 0.03$ ,  $n=566$ ), and indicated yet again a poor availability of 1-year-old saithe or alternative prey early in the season. However, the mean brood size did not decrease much during July (estimated at 1.86 on 31 July), which indicates chick survival and overall breeding success was probably slightly higher than in 2007-08. This corroborates the general impression of improved food conditions for several species in July. The unusual flock-feeding behaviour of shags described in the report for 2008 (Anker-Nilssen 2009) continued in 2009. Sandeel otoliths in the shag pellets were on average smaller and indicated a mean fish length of 138.6 mm ( $SE=3.6$ ,  $n=150$ ), but consisted of two distinct size

groups with mean lengths of about 110 mm (range 26-150 mm,  $n=99$ , probably lesser sandeel *Ammodytes marinus*) and 193 mm (range 150-288 mm, probably greater sandeel *Hyperoplus lanceolatus*).

From record high population and clutch sizes in 2008, the substantial drop in breeding numbers of cormorant was accompanied by its lowest clutch size since the monitoring started in 2002 (Table 1, previous range of annual means 2.14-2.78). In the largest colony, in which the drop in nest numbers (from 86 to 46) was largest, 32 nests contained egg(s)/small chick(s) on 19 June, but mean clutch size was only 2.19 (1.52 when including the 14 empty nests) and three weeks later (on 11 July) all nests were empty and no adults were present in the colony. The problem was less apparent in the other colony where clutch size on the same two occasions dropped from 2.85 to 1.85 and 34 large chicks were ringed (one of which drowned in a herring net six months later). Again, many food pellets were collected but have not yet been analysed. These observations strongly indicate that the problem in the main colony was not food related. Although it is impossible to exclude a human impact, it is much more likely that this was a direct effect of predation of chicks by white-tailed eagles.

The clutch size of eiders ( $3.87 \pm 0.25$ ,  $n=30$ , Table 1) was also lower than in 2008 and closer to the overall mean (range of annual means 2.93-4.24). No other quantitative information on breeding performance is collected for this species in Røst. For common and herring gulls, clutch sizes tended to be lower than in the preceding year, and again very few pairs succeeded in raising any young. The clutch size of great black-backed gulls was not very different from those in the two preceding years, but on 21 June only nine of 23 nests in a great black-backed gull colony at Skomvær contained eggs or chicks. Although their mean clutch size was then 2.78 ( $SE=0.15$ ), only 0.55 live chicks remained per pair ( $SE=0.18$ ,  $n=9$ ) on 9 July. This indicated reproduction was even lower than that registered in the same colony on the same date in 2008 (0.87,  $SE=0.22$ ,  $n=15$ ).

## Survival of adults

The estimates of adult survival for the four species monitored for 5-18 years were updated with data from 2009. With no covariates included in the analyses, survival varied significantly between years for the kittiwake and puffin only, with an estimated survival rate of 82.4% and 80.4%, respectively, in the last estimable year (2008-09 for kittiwakes, which had a constant recapture rate; 2007-08 for puffins, where recapture rate also varied between years). For puffins this is the poorest survival on record for this population. With an accompanying 10.2% decrease in borrow occupancy it is too early to exclude substantial recruitment of birds fledged in 2004 and 2006. Survival was at its maximum in the first four years of the study (1990-94; 94.3-97.1% p.a.) but has since varied between 80.4% and 94.4% with a mean of 87.7% p.a. ( $n=14$  years).

Using the same data sets for Røst and three colonies in the UK as Harris et al. (2005), Grosbois et al. (2009) showed that 67% of the inter-annual variance in adult survival of puffins is accounted for by a global spatial scale component, indicating there is substantial synchrony among colonies. The local sea surface temperature (SST) at each colony accounted for 40% of the global scale component, but also for an equally large fraction of the local scale component. SST thus acted at the same time to synchronize and desynchronize survival rates, but the analysis also suggested some other unknown environmental factor(s) acted as synchronizing agents.

For shags, the monitoring revealed a marked drop in survival, from an average of 85.2% (range 81.2-87.8) in the first five years (2002-07) to only 74.0% between 2007 and 2008, indicating a 76% higher mortality rate than normal. There is less variation in recapture rate (range 73.1-79.4%), with the estimate for 2008 (74.9%) not deviating notably from the overall mean (76.6%). Thus, increased non-breeding does not likely explain much of the estimated drop in survival, but further monitoring will demonstrate to what extent this is the case.

For black guillemot, the addition of an extra year of data decreased the overall survival estimate from 88.0% to 86.4%, but there is still no evident variation in survival between years. The best model indicated that recapture rate varied between years, thus the estimate applies for the whole period 1997-2009.

### *Personal acknowledgments*

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**Cover photo:**

Adult razorbill preening (© T. Anker-Nilssen)

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