SEAPOP Short Report 1-2014

Key-site monitoring in Norway 2013, including Svalbard and Jan Mayen

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Despite a few positive signs, the 2013 breeding season was dismal for many Norwegian seabirds. A long-term decline in several pelagic species continued into 2013, and breeding success was poor on many of the key-sites on the mainland. This was especially true in the colonies in the Barents Sea and the northerly part of the Norwegian Sea. Breeding success was also poor in the southwest and south of Norway, especially among the large gulls. Svalbard is no longer an exception, and several of the arctic species are declining. For some species, however, the breeding season was better in 2013 than in earlier years, and more chicks reached fledging than has been normal.

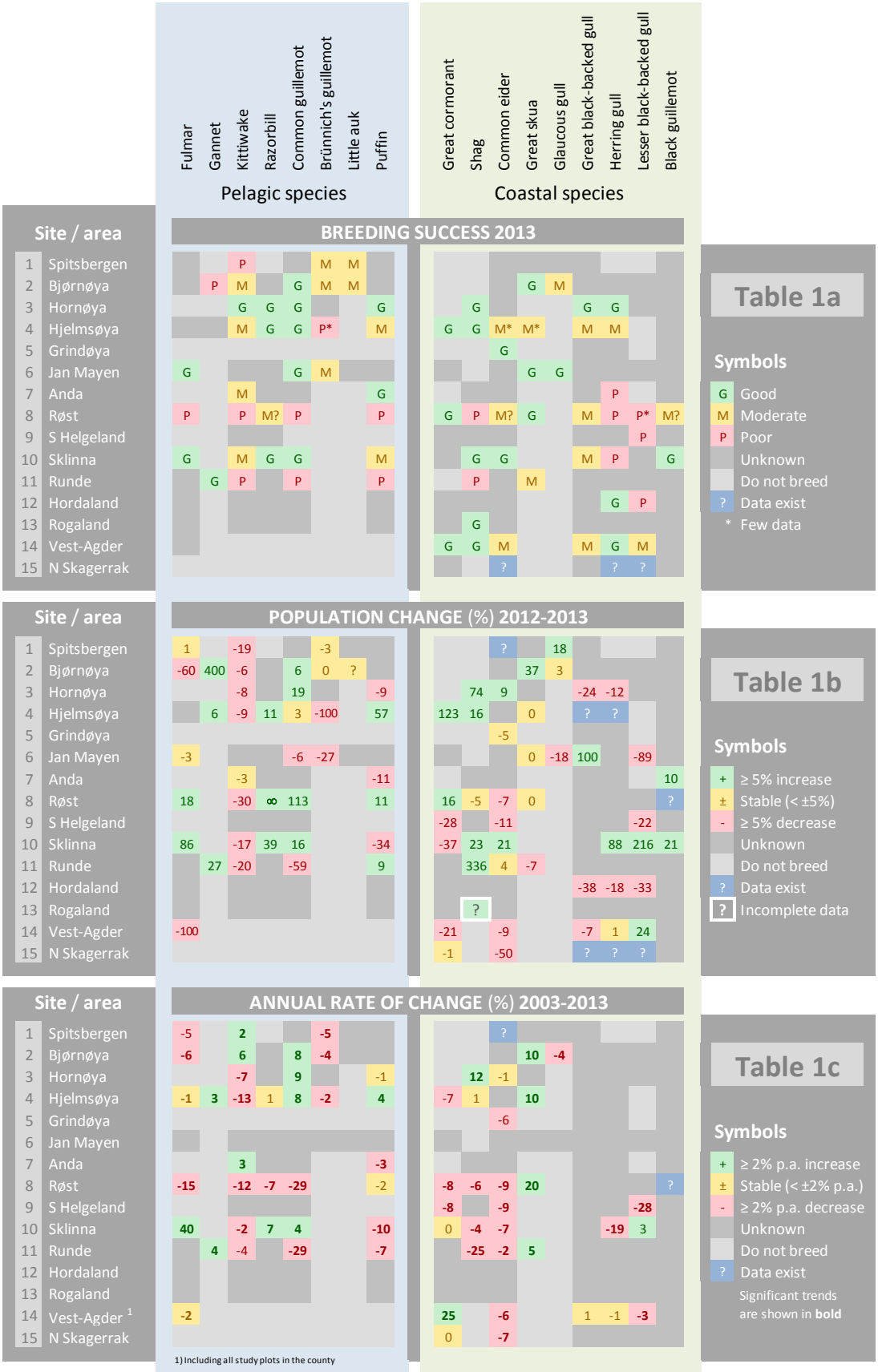
Population changes

While the **common guillemot** *Uria aalge* populations at Røst and Runde continued their decline (at Runde by 59%), those in the three northernmost key-sites (Hjelmsøya, Hornøya and Bjørnøya) plus that at Sklinna continued their increase at rates of 3-19% p.a. since 2012 (Table 1). More birds were seen on the breeding ledges at Røst than in 2012, but the numbers varied greatly from day to day, and did not represent a true population increase. These increases in the north did not, however, outweigh the overall decline in numbers on the mainland where, e.g. Røst and Runde have lost 97% of their populations over the last decade. On Svalbard, the **Brünnich's guillemot** *U. lomvia* population is declining at a rate of 4-5% p.a., although there was a sign of stagnation in this decline on Bjørnøya from 2012-2013. At Jan Mayen numbers attempting to breed dropped by 27% compared to 2012, while at Hjelmsøya only a few birds were seen on the shelves and no chicks were produced. Numbers of **northern gannets** *Morus bassanus* on Bjørnøya, where they first bred in 2011, reached at least 10 pairs in 2013. This positive trend was mirrored in the colonies at Gjesvær and Runde, where numbers have increased by 3-4% p.a. over the last decade. **Great skuas** *Stercorarius skua* are still increasing, although in 2013 this was only on Bjørnøya, while numbers on Runde dropped. On Jan Mayen there was no change since 2012. There was an increase in numbers of **razorbills** *Alca torda* since 2012 in the three colonies where they are monitored (Hjelmsøya, Røst, Sklinna), but only at Sklinna has there been an increase over the last decade (7% p.a.). At Røst the trend is correspondingly negative, while at Hjelmsøya it is more-or-less stable.

Among the pelagic species, the dramatic decline in **black-legged kittiwake** *Rissa tridactyla* numbers continued into 2013. This applied to almost all the colonies monitored, including those on Bjørnøya and Spitsbergen where numbers declined slightly 2012-2013, but where populations in the longer term (last decade) have been either increasing or stable. Only on Anda was there little change since 2012. Although the trend over the last decade is not equally dramatic for all the colonies, the situation overall is serious. The biggest fall was at Røst (Vedøy) where numbers dropped by 30% since 2012, and by 87% since 1979.

Table 1

Schematic summary of breeding success (1a) and change in breeding numbers (1b) for focal seabird species at the regular SEAPOP monitoring sites in 2013, and their mean population trend over the last ten years (1c).



For **Atlantic puffins** *Fratercula arctica*, the 2013 season was varied, with an increase in numbers at Hjelmsøya, Røst and Runde since 2012. Breeding failures and lack of recruitment into the Røst population over several years suggest, however, that the apparent increase at Røst was due more to a higher proportion of adults attempting to breed in 2013 than a real increase in numbers of breeding birds. At Hornøya, Anda and Sklinna, numbers of puffins dropped by 9-34%. Although the **northern fulmar** *Fulmarus glacialis* population varies greatly from year to year, there has been a negative trend over the last decade apart from on Sklinna where fulmars started to breed for the first time in 2007. The overall decline varies from site to site, but is, on the average between 2-15% p.a. At Jan Mayen, the number of nests recorded in 2013 was nearly the same as that found in 2012, but monitoring is still in a too early phase to know if there is any trend.

As the common guillemot population has increased on Hornøya, it has encroached onto turf-covered ledges, where heavy rainfall showers make living conditions extremely unpleasant. Here a chick seeks protection under the wing of its parent while a neighbour shakes its head in dismay. (© R. Barrett)

Among the coastal species, counts in 2013 revealed a mixed picture. Furthest north, several species increased. Numbers of **glaucous gulls** *Larus hyperboreus* increased on Spitsbergen since 2012, while those on Bjørnøya remained stable. The Bjørnøya population has, however, declined by 70% since monitoring started in 1986. Also on Jan Mayen there was a large decline (18%) between 2012 and 2013. Although numbers of **great cormorants** *Phalacrocorax carbo* and **shags** *P. aristotelis* increased since 2012 at several sites in the north, including Hornøya and Hjelmsøya, and shags more than tripled on Runde, the long-term trends are negative at most of the key-sites, especially along the Norwegian Sea coast. The only exception is shags at Hornøya (where numbers in the monitoring plots have nearly tripled since 2005!) and cormorants in Vest-Agder that are both increasing. Most populations of **great black-backed**, **herring** and **lesser black-backed gull** *Larus marinus, L. argentatus* and *L. fuscus* populations declined since 2012, especially at Hornøya and in Hordaland (12-38%). One exception was Sklinna where the two latter species increased by 216% (!) and 88% respectively, and another in Vest-Agder where lesser black-backed gulls increased by 24%. The short term declines from 2012-2013 fit in with long-term declines in numbers of the large gulls at most of the monitoring

sites. Population changes of **common eider** *Somateria mollissima* since 2012 varied among sites, with increases in Varanger, Sklinna and Runde and decreases at the remaining sites (5-50%). The overall tendency is however negative with declines of 1-9% p.a.

Breeding success

Among the pelagic species, the **kittiwake** had a bad year with few chicks fledging, except at Hornøya and Hjelmsøya where the breeding success was 0.9 and 1.1 chicks/nest respectively (Table 1). This was, however, only the third good season on Hornøya over the last 10 seasons, and the long-term trend is negative (see below). On the other key-sites, kittiwake breeding success in 2013 was moderate to bad. This was true also for Spitsbergen where kittiwakes have normally fared better than on the mainland but in 2013 they failed completely in the Isfjord key-site. **Common guillemots** had a good year on Bjørnøya, Jan Mayen and in Finnmark, while production failed on Røst (for the fifth time since 2006) and Runde. **Puffins** too did well on the northernmost colonies, but chick production was nevertheless lower than in previous years at Hornøya. At Røst 2013 was yet another year of total breeding failure and at Runde, puffin breeding success was poor.

While Røst and Runde are characterised by declining populations and breeding failures among several pelagic and coastal species, Sklinna shows opposite tendencies with good or moderate production among most species, including the puffin. **Puffins** and **kittiwakes** at Sklinna and Anda have access to alternative food sources either on the shelf break or in the fjords, and hence did much better than those at Røst where neither species have fledged chicks since 2006. The **herring gull** and **lesser black-backed gull** had a poor breeding season in most of the Norwegian Sea localities, but better further south. For several of the large gulls, the situation is serious after many years of breeding failures and population declines. The **glaucous gull** had a moderate breeding success on Spitsbergen and Bjørnøya, and was relatively successful on Jan Mayen.

The highlight of the 2011 season was confirmation of breeding attempts of **northern gannets** on Bjørnøya, and in 2013 the first chicks were seen there on Alkeholmen. Although only a few fledged, it can now be confirmed that gannets have established themselves as a breeding population in Svalbard. The **great skua**, another southern species, has also spread and increased over the last decades, and had a good breeding season on Bjørnøya, Jan Mayen and Røst, and moderate on Hjelmsøya and Runde. In contrast to the expanding populations from the south, breeding success of the northern species **Brünnich's guillemot** and **little auk** was not optimal. Their breeding success was moderate on Spitsbergen and Bjørnøya, and while 0.36 Brünnich's guillemot chicks/nest were produced on Jan Mayen, none were produced on Hjelmsøya. Although not quantified in detail, breeding success on Hornøya was considered good.

Among several of the coastal species, the overall production of chicks was relatively good, with some exceptions. **Great cormorants** fared well in all colonies from Finnmark to Vest-Agder, as did the **shag** with the exception of Røst and Runde where few chicks survived. The breeding success of **common eiders** and **black guillemots** varied from moderate to good in the different key-sites.

Part of the seabird colony on Hornøya showing many kittiwake nests that have been abandoned over the years (© R. Barrett)

A case study: Why is the Norwegian kittiwake population declining?

The Norwegian kittiwake population has decreased alarmingly over the last 30 years, a decrease that has accelerated since the turn of the century (Figure 1). For example, since 2003, numbers of apparently occupied nests in monitoring plots on SEAPOP key-sites Runde, Sklinna, Vedøy (Røst), Hjelmsøya and Hornøya decreased by 2-13% per annum. As a result, the Norwegian kittiwake population is now classified as *endangered* in the Norwegian Red List, and there is urgent need to explore mitigating managerial processes to reverse this situation. Before these can be implemented it is, however, necessary to study and understand the environmental and biological processes behind this decline. Such studies are an integral part of SEAPOP.

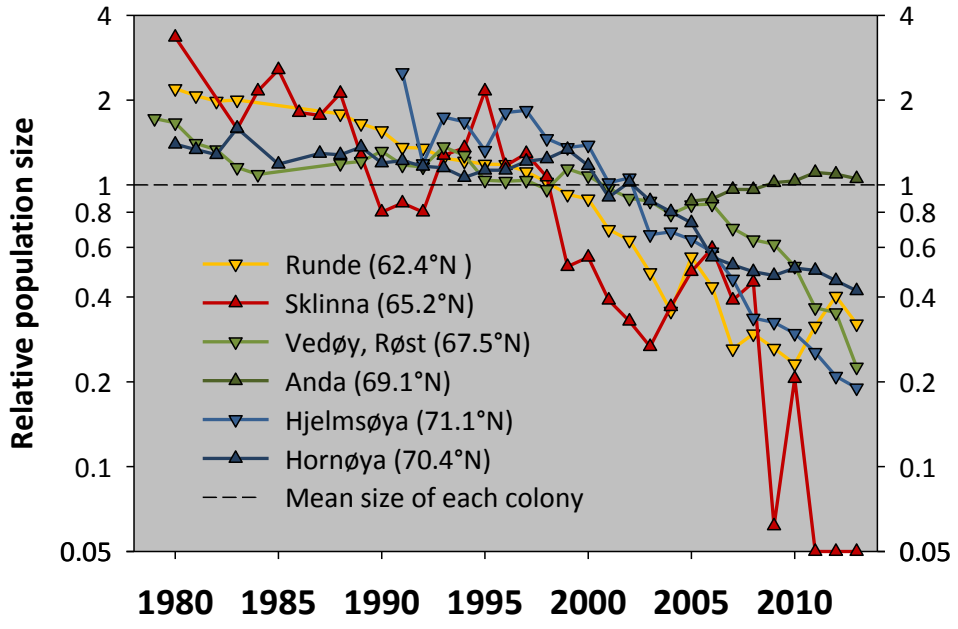


Figure 1
Relative changes in numbers of kittiwakes breeding at five SEAPOP key-sites, 1980-2013.

The status of any population is a product of the interplay between three major demographic parameters – reproductive success, immigration/emigration and adult survival rates. The movements of kittiwakes into or out of a colony are extremely difficult to monitor, but are also considered the least sensitive of the three parameters. As such, SEAPOP has put much effort into documenting the remaining two, breeding success and the annual survival, among several key species at as many key-sites as possible. The results of such long-term documentation give important clues as to why breeding populations are changing.

Breeding success

Breeding success reflects partly the environmental conditions faced by adult birds at the various colonies during the breeding season. Every year, counts of the numbers of chicks produced per nest used have therefore been made in several key-sites, some dating back many years before SEAPOP started. On Vedøy (Røst) and Hornøya there has been, despite much variation from year to year, a general decline in the breeding success of kittiwakes over the last 30 years (Figure 2). Although a much shorter data series, there is also a suggestion of a decline over the last six years on Anda, and kittiwakes on Hjelmsøya have had very poor seasons in eight of the last 10 seasons.

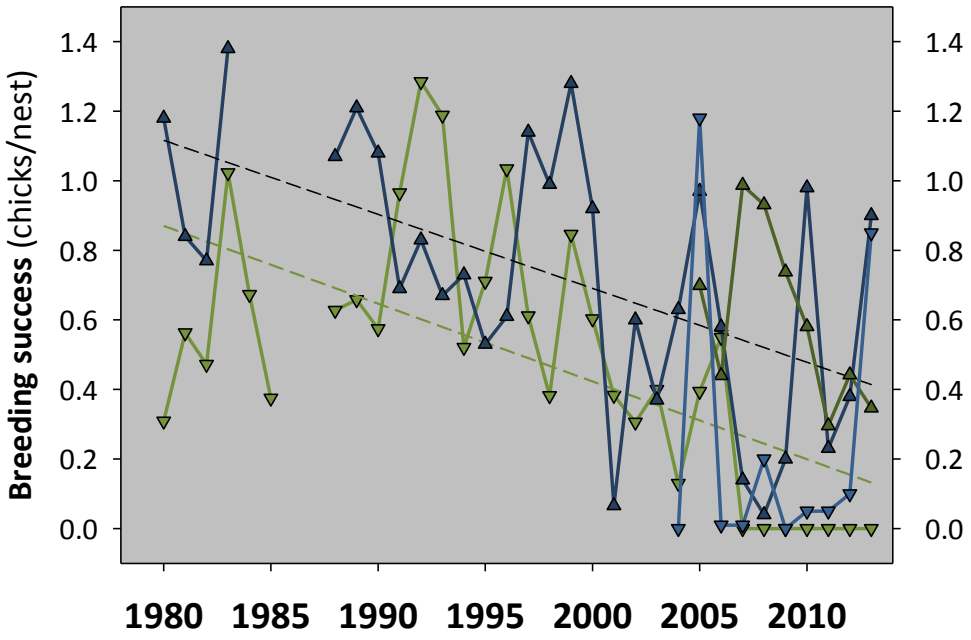


Figure 2
Variations and overall decline in breeding success (number of large chicks/nest) of kittiwakes at four SEAPOP key-sites, 1980-2013.

On Hornøya, breeding success has, since 2000, dropped to approximately half the level it was during the preceding 20 years including 3-4 seasons with near total breeding failure. Such a decrease has undoubtedly had a knock-on effect on the recruitment of first-time breeders into the population 3-4 years later and thus contributed to the decline in numbers of breeding birds. On Røst this is even more apparent with total breeding failures among the kittiwakes breeding on Vedøy every year since 2007 that has and will result in a complete lack of local recruitment into the population.

Adult survival

Similarly, annual counts of colour-ringed breeding adults that return to the colonies at four SEAPOP key-sites are used as measures of adult survival rates and reflect partly the environmental conditions in the ocean areas used by the birds outside the breeding season. These again vary greatly from year to year (Fig. aa) but recent analyses, again of Hornøya data, have shown that since 2000, although the population decline can be partly explained by years of low adult survival rate, most of it is a result of poor breeding success and hence low recruitment rates (Reiertsen 2013).

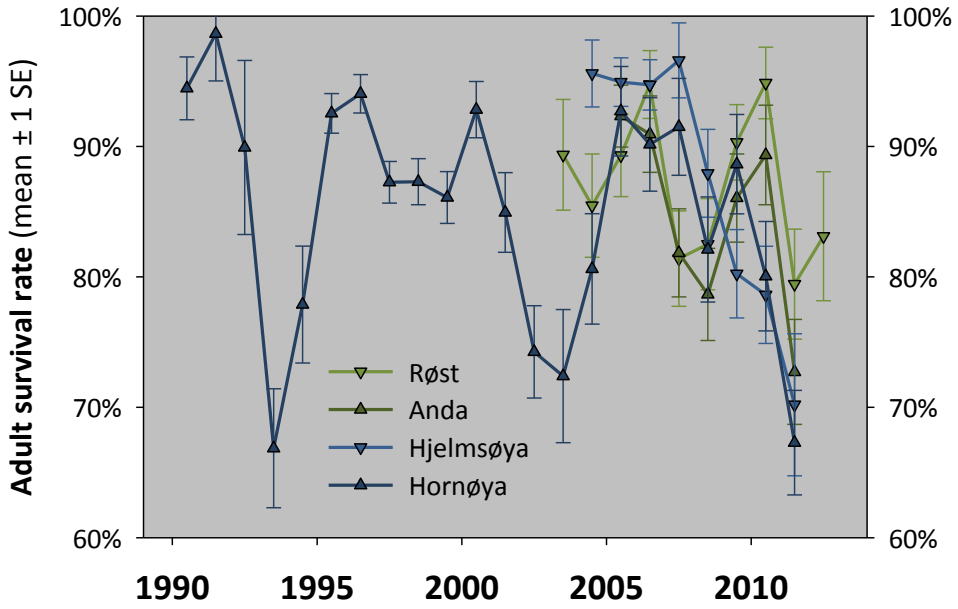


Figure 3
Variations in survival rates (% surviving from one year to the next) of adult kittiwakes breeding at four SEAPOP key-sites, 1990-2013.

These results suggest that the environmental conditions around the colonies are very important to address when discussing possible mitigating measures to reverse the present decline in the kittiwake population. It is, however, interesting to also note that there seems to be a co-variation in the annual changes in adult survival rates between the four colonies, i.e. there are near parallel variations from year to year between the four colonies. This may be a reflection of changes in the environmental conditions in the wintering area in the NW Atlantic that logger studies have shown is shared by birds from all the colonies studied. Such changes have already been shown to influence survival rates of birds from Hornøya (Reiertsen et al. *in press*) and might contribute to the general decline of the species in the North Atlantic. A detailed analysis of the interplay between breeding success and adult survival rates of kittiwakes and its effect on the current population decline is presently being addressed through demographic modelling and sensitivity analyses in a collaborative SEAPOP study.

Reference

Reiertsen, T.K. 2013. Seabirds, climate and prey. A population study of two seabird species. PhD thesis, Univ. Tromsø.

Reiertsen, T.K., Erikstad, K.E., Anker-Nilssen, T., Barrett, R.T., Boulinier, T., Frederiksen, M., González-Solís, J., Gremillet, D., Johns, D., Moe, B., Ponchon, A., Skern-Mauritzen, M., Sandvik, H. & Yoccoz, N.G. *in press*. Prey density in non-breeding areas affects adult survival of Black-legged Kittiwakes Rissa tridactyla. *Marine Ecology Progress Series.*

APPENDIX – Key parameters from all key-sites in 2013

Key to Tables A1-A13

Key population parameters (SE, n) of seabirds breeding on the key-sites indicated above each table. The start year of most data series are listed in Table 3.1.1 of Anker-Nilssen et al. (2008). Population change (expressed as percentage) is the numeric change in size of the breeding population registered between 2012 and 2013 on the basis of plot counts (p) or total censuses (t). In all cases the listed survival estimate was derived from the basic CJS model(s) that fitted the data set best (i.e. the one with the lowest AICc or QAICc value). If the analysis indicated survival varied between years the given estimate applies for the last estimable time step only (yrs=1), whereas it applies for the whole monitoring period indicated (yrs>1) if the analysis indicated a constant survival.

Ref.: Anker-Nilssen, T. (ed.), Barrett, R.T., Bustnes, J.O., Christensen-Dalsgaard, S., Erikstad, K.E., Fauchald, P., Lorentsen, S.-H., Steen, H., Strøm, H., Systad, G.H. & Tveraa, T. (2008) SEAPOP studies in the Barents and Norwegian Seas in 2007. **NINA Report 363**, 92 pp.

Table A1 *Key population parameters (SE, n) of seabirds on* ***Spitsbergen*** *in 2013.*

Species	*Colony*	Population change%	Annual adult survival		Reproductive performance	
			Period (yrs)	Estimate%	Sampling unit	Estimate%
Fulmar	*Nøisdalen*	+ 1 [p]	*No data*		*No data*	
Glaucous gull	*Kongsfjorden*	*No data*	2011-12 (1)	89.8 (10.8, 58)	Hatching success	59.0 (*n*=29)
Kittiwake	*Ossian Sars*	− 13 [p]	*No data*		*No data*	
	Grumantbyen	*No data*	2008-13 (5)	86.9 (2.1, 160)	Chicks >15d/nest [1]	0.0 (*n*=18)
	Fuglehuken	− 21 [p]	*No data*		*No data*	
Brünnich's guillemot	*Ossian Sars*	− 22 [p]	2007-13 (6)	84.5 (2.0, 175)	Chicks >15d/egg	52.8 (*n*=53)
	Diabasodden	+ 2 [t]	2005-13 (8)	91.2 (1.2, 416)	Chicks >15d/egg	44.9 (*n*=118)
	Fuglehuken	+ 1 [p]	*No data*		*No data*	
Little auk	*Bjørndalen*	*No data*	2011-12 (1)	88.9 (3.1, 495)	Chicks >15d/egg	50.0 (*n*=25)
	Feiringfjellet	*No data*	2011-12 (1)	78.2 (4.1, 670)	*No data*	

1) *Nests with at least 1 chick surviving to 15 days of age.*

Table A2 *Key population parameters (SE, n) of seabirds on* ***Bjørnøya*** *in 2013.*

Species	Population change%	Annual adult survival		Reproductive performance	
		Period (yrs)	Estimate%	Sampling unit	Estimate
Fulmar	− 60 [p]				
Gannet	+ 400 [p 1]				
Great skua	+ 37 [p]	2005-2013 (8)	94.8 (0.9, 198)	Large chicks/nest	1.12 (0.11, 41)
Glaucous gull	+ 3 [p]	2009-2013 (4)	*No estimate*	Large chicks/nest	0.89 (0.03, 62)
Kittiwake	− 6 [p]	2004-2013 (9)	88.0 (0.8 ,334)	Large chicks/nest	0.70 (0.02, 389)
Common guillemot	+ 6 [p]	*Results not yet available*		Fledging success [2]	0.71 (0.04, 115)
Brünnich's guillemot	0 [p]	2011-2012 (1)	84.6 (7.1, 340)	Fledging success [2]	0.58 (0.07, 48)
Little auk	[3]	2011-2012 (1)	87.8 (1.7, 732)	Fledging success	0.78 (0.05, 50)

1) *Twenty-one individuals recorded, ten nests built;* ***2)*** *Measured at the age of 20 days;* ***3)*** *Pilot project data under analysis.*

Table A3 *Key population parameters (SE, n) of seabirds in* ***Hornøya*** *in 2013.*

Species	**Population change**	**Annual adult survival** Period (yrs)	Estimate%	**Reproductive performance** Sampling unit	Estimate
Shag	+ 74 [p]	2004-2013 (9)	85.2 (2.1, 233)		
Herring gull	− 12 [p]	2006-2013 (7)	81.0 (3.7, 100)	Clutch size	2.83 (0.08, 31)
				Fledging success [1]	0.44 (0.16, 25)
Great black-backed gull	− 24 [p]	2001-2013 (12)	82.0 (1.9, 208)	Clutch size	2.40 (0.12, 30)
				Fledging success [1]	0.85 (0.23, 20)
Kittiwake	− 8 [p]	2011-2012 (1)	67.3 (4.0, 1296)	Clutch size	2.08 (0.05, 63)
				Large chicks/nest	1.10 (0.03, 616)
Common guillemot	+ 19 [p]	1988-2013 (25)	96.2 (0.4, 233)	Fledging success [1]	0.68 (0.09, 31)
Razorbill	no data	1995-2013 (18)	91.6 (0.8, 270)	Fledging success [1]	0.59 (0.07, 51)
Puffin	− 9 [p]	2011-2012 (1)	95.9 (3.0, 770)	Fledging success [1]	0.65 (0.08, 40)

1) *Medium-sized chicks/egg laid.*

Table A4 *Key population parameters (SE, n) of seabirds on* ***Hjelmsøya*** *in 2013.*

Species	**Population change%**	**Annual adult survival** Period (yrs)	Estimate%	**Reproductive performance** Sampling unit	Estimate
Great cormorant	+ 123 [p]				
Shag	+ 16 [p]			Clutch size [1]	2.27 (0.08, 196)
				Large chicks/nest [2]	2.66 (0.04, 167)
Great skua	0 [t]			Clutch size	2.00 (0.00, 7)
				Large chicks/nest	1.00 (0.00, 4)
Arctic skua	+ 40 [t]			Clutch size	2.00 (0.XX, 2)
Common gull	+ 66 [t]			Clutch size	2.91 (0.09, 11)
Herring gull	X [t 3]			Clutch size	1.33 (0.12, 52)
				Breeding success [4]	0.42 (*n*=31)
Great black-backed gull	X [t 3]			Clutch size	1.77 (0.20, 22)
				Breeding success [4]	0.42 (*n*=31)
Kittiwake	− 9 [p]	2011-2012 (1)	70.2 (5.4, 284)	Clutch size	1.89 (0.06, 57)
				Large chicks/nest	0.85 (0.08, 86)
Common guillemot					
Open ledges (inds.)	+24 [p]			Breeding success [5]	0.0
Crevices (eggs)	+ 3 [p]	2004-2013 (9)	93.3 (2.6, 196)	Breeding success [6]	0.43 (*n*=28)
Brünnich's guillemot	− 100 [p]			Breeding success [5]	0.0
Razorbill	+ 11 [p]			Breeding success [6]	0.50 (*n*=12)
Puffin	+ 57 [p]	2007-2013 (6)	83.8 (3.6, 107)	Fledging success [6]	0.71 (*n*=17)
				Breeding success [7]	0.16 (*n*=78)

1) *Including empty nests;* ***2)*** *Excluding empty nests;* ***3)*** *Results not yet available;* ***4)*** *Combined estimate for herring gull and great black-backed gull (chicks not identified to spp);* ***5)*** *No eggs produced, or eggs depredated immediately;* ***6)*** *Chicks alive on 10 August per egg hatched before 10 July;* ***7)*** *Medium-sized chicks/egg laid.*

Table A5 *Key population parameters (SE, n) of seabirds on* ***Jan Mayen*** *in 2013.*

Species	**Population change%**	**Annual adult survival**		**Reproductive performance**	
		Period (yrs)	Estimate%	Sampling unit	Estimate
Fulmar	− 3 [p]			Chicks/nest [1]	0.69 (0.05, *n*=102)
Common guillemot	− 6 [p]	2011-12 (1)	80.2 (9.6, 30)	Breeding success [2]	0.67 (0.11, *n*=18)
Brünnich's guillemot	− 27 [p]	2011-12 (1)	97.4 (2.4, 108)	Breeding success [2]	0.36 (0.05, *n*=102)
Great skua	0 [p]			Large chicks/nest	1.38 (0.16, *n*=26)
Glaucous gull	− 18 [p]			Large chicks/nest	1.00 (0.23, *n*=28)
Great black-backed gull	+ 100 [p]			Large chicks/nest	0.50 (0.25, *n*=4)
Lesser black-backed gull	− 89 [p]			Large chicks/nest	0.00 (*n*=1)

1) *Recorded early in the chick-rearing period when most chicks were still small or medium sized;* ***2)*** *Number of chicks ≥15 days of age divided by number of breeding pairs (n).*

Table A6 *Key population parameters (SE, n) of common eider on* ***Grindøya*** *in 2013.*

Species	**Population change%**	**Annual adult survival**		**Reproductive performance**	
		Period (yrs)	Estimate%	Sampling unit	Estimate
Common eider	− 22 [t]	2011-12 (1)	87.3 (15.5, 1365)	Clutch size	4.92 (0.24, 37)

Table A7 *Key population parameters (SE, n) of seabirds at* ***Anda*** *in 2013.*

Species	**Population change%**	**Annual adult survival**		**Reproductive performance**	
		Period (yrs)	Estimate%	Sampling unit	Estimate
Kittiwake	− 3 [p]	2011-12 (1)	72.7 (4.0, 344)	Clutch size [1]	1.66 (0.07, 50)
				Large chicks/nest	0.34 (*n*=906)
Puffin	− 11 [p]	2005-13 (8)	88.9 (1.2, 373)	Hatching success	0.76 (*n*=58)
				Large chicks/nest [2]	0.62 (*n*=60)
Black guillemot	+ 10 [t]				

1) *At first inspection on 18 June;* ***2)*** *Number of chicks ≥ 20 days divided by number of nests*

Table A8 *Key population parameters (SE, n) of seabirds in* ***Røst*** *in 2013.*

Species	Population change%	Annual adult survival		Reproductive performance	
		Period (yrs)	Estimate%	Sampling unit	Estimate
Fulmar	+ 64 [p]				
Cormorant	+ 16 [t]			Clutch size [1,2]	3.03 (0.16, 31)
				Large chicks/nest [2]	1.52 (31) [3]
Shag	− 5 [p]	2011-12 (1)	56.8 (7.8, 441)	Clutch size [4,5]	2.55 (0.04, 299)
				Clutch size [2,5]	2.44 (0.05, 336)
				Large chicks/nest [2]	0.54 (0.24, 13) [6]
Common eider	− 7 [p]			Clutch size	3.75 (0.23, 20)
Great skua	0 [t 7]			Breeding success	1.33 (0.33, 3)
Common gull				Clutch size [4]	2.71 (0.11, 24)
				Large chicks/nest [2]	0.20 (0.16,20)
Herring gull				Clutch size [4]	1.85 (0.18, 20)
Great black-backed gull				Clutch size [4]	2.17 (0.13, 30)
				Large chicks/nest [2]	0.53 (0.29, 15)
Kittiwake *Vedøy*	− 36 [p 8]			Large chicks/nest [8]	0.00 (*n*=122)
Gjelfruvær [9]	+ 7 [t 9]			Large chicks/nest	0.00 (*n*=206)
Kårøy area	+ 20 [t 11]	2012-13 (1)	83.1 (4.9, 254)	Clutch size/pair [10]	2.10 (0.05, 31)
				Large chicks/pair [10]	0.58 (0.10, 31)
				Large chicks/nest [11]	0.22 (*n*=702)
Arctic tern				Clutch size [12]	1.59 (0.06, 99)
				Large chicks/nest [13]	0.04 (0.16, 99)
Common guillemot	+ 113 [p]	*No data 2013*		Breeding success	0.00 (0.00)
Razorbill	+ ∞ [p]				
Puffin	+ 11 [p]	2011-12 (1)	87.7 (4.2, 452)	Hatching success	0.00 (0.00, 34)
				Breeding success	0.00 (0.00, 34)
Black guillemot	*No data 2013*	2012-13 (1)	86.7 (2.0, 104) [13]	Clutch size	2.00 (0.11, 14)
				Large chicks/clutch	1.47 (0.15, 15)

1) *Minimum estimate for largest colony on 12 June, when some clutches possibly were still incomplete and only 5 clutches (16%) had chicks;* ***2)*** *Including empty nests;* ***3)*** *Largest colony on 3 July, when all but 2 clutches (94%) had hatched and 47 (72%) of 65 chicks had reached ringing age. Provided all chicks fledged, maximum breeding success would be 2.10 (SE=0.24, n=31);* ***4)*** *Excluding empty nests;* ***5)*** *On 1 July; estimated by linear regression of mean values for counts on 8 different days between 27 June and 25 July;* ***6)*** *Maximum breeding success calculated as in comment 3 above, was 1.15 (SE=0.22, n=13);* ***7)*** *Five breeding pairs annually 2011-2013;* ***8)*** *Based on total counts in study plots;* ***9)*** *Small cliff-breeding colony with 206 pairs in 2013 situated 9 km SW of Vedøy;* ***10)*** *On main ledges in plot VIII only;* ***11)*** *Based on total counts of entire colony on buildings;* ***12)*** *One colony, on Breinykskjeran;* ***13)*** *Maximum breeding success calculated as in comment 3 above, was 0.25 (SE=0.05, n=99);* ***13)*** *Note under-dispersion in the data set (c-hat=0.52).*

Table A9 *Key population parameters (SE, n) of lesser black-backed gull on* ***Sør-Helgeland*** *in 2013.*

Species	Population change%	Annual adult survival		Reproductive performance	
		Period (yrs)	Estimate%	Sampling unit	Estimate
Lesser black-backed gull	− 31 [t]	2005-2013 (8)	91.0 (1.6, 179)	Clutch size	1.4 (0.18, 8)
				Large chicks/nest [1]	0.0 (*n*=18)

1) *Number of chicks ≥ 20 days divided by number of nests*

Table A10 *Key population parameters (SE, n) of seabirds on* ***Sklinna*** *in 2013.*

Species	Population change%	Annual adult survival Period (yrs)	Annual adult survival Estimate%	Reproductive performance Sampling unit	Reproductive performance Estimate
Fulmar	+ 86 [t]				
Great cormorant	− 37 [t]			Clutch size [1]	
Shag	+ 23 [t]	2011-12 (1)	73.6 (6.2, 365)	Clutch size [2]	2.04 (0.04, 474)
				Hatching success/nest	0.57 (*n*=54)
				Clutch size hatching	1.07 (0.15, 54)
				Chicks ≥ 10d/nest	1.65 (*n*=29)
				Chicks ≥ 20d/nest	1.53 (*n*=17)
				Chicks ≥ 30d/nest	2.00 (*n*=5)
Common eider	+ 21 [t 3]			Clutch size	3.48 (0.32, n=25)
Common gull				Clutch size	2.75 (0.25, 4)
Herring gull [4]	+ 88 [p]			Clutch size [5]	1.72 (0.17, 54)
				Clutch size [6]	2.33 (0.12, 40)
Great black-backed gull				Clutch size [7]	1.75 (0.14, 71)
Kittiwake *Sklinna*	0 [t 8]				
Sør-Gjæslingan	− 17 [t 9]	2011-12 (1)	76.8 (4.2, 189)	Large chicks/nest [10]	0.07 (*n*=548)
Common guillemot	+ 16 [t]	2008-13 (5)	89.7 (1.8, 231)		
Razorbill	+ 39 [t]				
Puffin	− 34 [p]	No estimate yet possible [11]		Hatching success/nest	0.55 (*n*=29)
				Chicks ≥ 10d/nest	0.31 (*n*=29)
				Chicks ≥ 20d/nest	0.14 (*n*=29)
Black guillemot	+ 21 [p]	2008-13 (5)	88.7 (3.0, 60) [12]		

1) *Not collected in 2013;* ***2)*** *Counted on 7-8 June; 3****)*** *Population counts from Hortavær, Leka municipality;* ***4)*** *Monitoring of adult survival discontinued in 2010;* ***5)*** *Including empty nests, counted on 4 June;* ***6)*** *Not including empty nests, counted on 4 June;* ***7)*** *Counted on 4-6 June;* ***8)*** *No kittiwakes have been breeding on Sklinna since 2010;* ***9)*** *Numbers of breeding birds based on counts of pictures taken in mid-May;* ***10****) Based on nest count on 11 June and chick count on 26 June;* ***11)*** *Colour ringing for monitoring of survival rates was initiated in 2007 but no adults were re-sighted in 2008 and re-sighting rate was very low in 2009-2013 due to poor breeding success and very few birds attending the colony during the incubation period;* ***12)*** *Note under-dispersion in the data set (c-hat=0.50).*

Table A11 *Key population parameters (SE, n) of seabirds on* ***Runde*** *in 2013.*

Species	Population change%	Annual adult survival Period (yrs)	Annual adult survival Estimate%	Reproductive performance Sampling unit	Reproductive performance Estimate
Common eider	+ 4 [t]				
Gannet	+ 27 [t]			Large chick/nest [1]	0.89 (*n*=679)
Shag	− 336 [p]	No estimate yet possible [2]		Clutch size [3]	
Great skua	− 7 [t]			Large chick/nest	0.54 (*n*=71)
Kittiwake *Runde*	− 20			Large chicks/nest	0.00 (*n*=324)
Sildegarnsholmen	+ 17 [t]	No estimate yet possible [4]		Large chicks/nest	0.61 (*n*=640)
Common guillemot	− 59			Breeding success	0.00
Puffin	+ 9 [p]	2007-13 (6)	85.7 (1.5, 247)	Hatching success/nest	0.73 (*n*=45)
				Chicks ≥ 10d/nest	0.53 (*n*=45)
				Chicks ≥ 20d/nest	0.27 (*n*=45)
				Fledged chicks/nest [7]	0.16 (*n*=45)

1) *Large chicks counted in 4 study plots on 1 August.* ***2****) Colour ringing for monitoring of survival rates was initiated in 2008, but sample size is still too low;* ***3)*** *Not assessed due to collapse in breeding attempts during egg-laying;* ***4)*** *Colour ringing for monitoring of survival rates was initiated in 2012;* ***7)*** *Maximum estimate.*

Table A12 *Key population parameters (SE, n) of seabirds on the different localities in* ***Hordaland*** *in 2013.*

Species	**Population change%**	**Annual adult survival** Period (yrs)	Estimate%	**Reproductive performance** Sampling unit	Estimate
Lesser black-backed gull	− 33 [t]	No estimate yet possible [1]		Clutch size [2]	2.41 (0.11, 76)
				Fledged chicks/nest	0.24 (*n*=83)
Herring gull	− 18 [t]	No estimate yet possible [1]		Clutch size [2]	2.19 (0.05, 308)
				Fledged chicks/nest	0.94 (*n*=319)

1) *Colour ringing for monitoring of survival rates was initiated in 2009, but still too few ringed birds have been re-sighted;* ***2) I****ncluding empty nests.*

Table A13 *Key population parameters (SE, n) of seabirds on the different sites in* ***Vest-Agder*** *in 2013.*

Species	**Population change%**	**Annual adult survival** Period (yrs)	Estimate%	**Reproductive performance** Sampling unit	Estimate
Cormorant	− 16	No estimate yet available [1]		Clutch size	2.97 (0.10, 200)
				Large chicks/nest	1.51 (*n*=302)
Common eider	− 14 [2]			Clutch size	3.50 (0.11, 106)
				Small chicks on sea	0.67 (*n*=348)
				Large chicks on sea	0.49 (*n*=348)
Lesser black-backed gull		2001-13 (12)	82.8 (1.8, 421) [3]		
Slettingene	− 14			Clutch size [4]	2.29 (0.11, 85)
				Fledged juv./pair	0.41 (*n*=85)
Storøy	+ 2			Clutch size [4]	1.10 (0.06, 259)
				Fledged juv./pair	0.08 (*n*=264)
Klovholmene	− 24			Clutch size [4]	1.90 (0.11, 134)
				Fledged juv./pair	0.00 (*n*=135)
Rauna	+ 34			Clutch size [4]	2.03 (0.17, 30)
				Fledged juv./pair	0.89 (*n*=2004)
Herring gull		2001-13 (12)	78.3 (3.3, 214) [3]		
Slettingene	+ 48			Clutch size [4]	2.39 (0.10, 61)
				Fledged juv./pair	0.65 (*n*=92)
Storøy	− 3			Clutch size [4]	2.32 (0.11, 78)
				Fledged juv./pair	0.56 (*n*=107)
Klovholmene	− 2			Clutch size [4]	2.71 (0.09, 34)
				Fledged juv./pair	0.38 (*n*=40)
Rauna	− 7			Clutch size [4]	2.00 (0.21, 28)
				Fledged juv./pair	0.73(*n*=211)

1) *Colour-ringing of chicks for later monitoring of survival rates was initiated in 2008;* ***2)*** *based on counts of adult male in Farsund municipality;* ***3)*** *General estimate for birds from several colonies;* ***4)*** *Empty nests included.*

Cover photo:
Brünnich's guillemot on Hornøya (© Espen Lie Dahl)

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