SEAPOP Short Report 1-2017

Key-site monitoring in Norway 2016, including Svalbard and Jan Mayen

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Although there were signs of improvement from the previous year, 2016 was not a very successful breeding season for Norwegian seabirds. Again, there were large differences across species and key-sites (Table 1, Figure 1), but in contrast to many of the preceding years the coastal near-shore feeding seabirds scored no better on breeding success than the pelagic species (χ^2=2.396, df=2, p=0.302, Table 1a). Similarly, there was no difference between coastal and pelagic species as to how many populations had increased, remained stable or decreased since 2015 (χ^2=0.092, df=2, p=0.955, Table 1b) or since 2006 (χ^2=0.064, df=2, p=0.969, Table 1c). The rates of population change over the last ten years are disturbingly negative for a large number of populations, although on average still worse for pelagic (-5.1% p.a., *n*=33) than coastal (-3.5% p.a., *n*=33) species (Table 1c, disregarding populations of marginal size). Such rates will reduce a population by 50% in only 13 or 19 years, respectively.

Breeding success

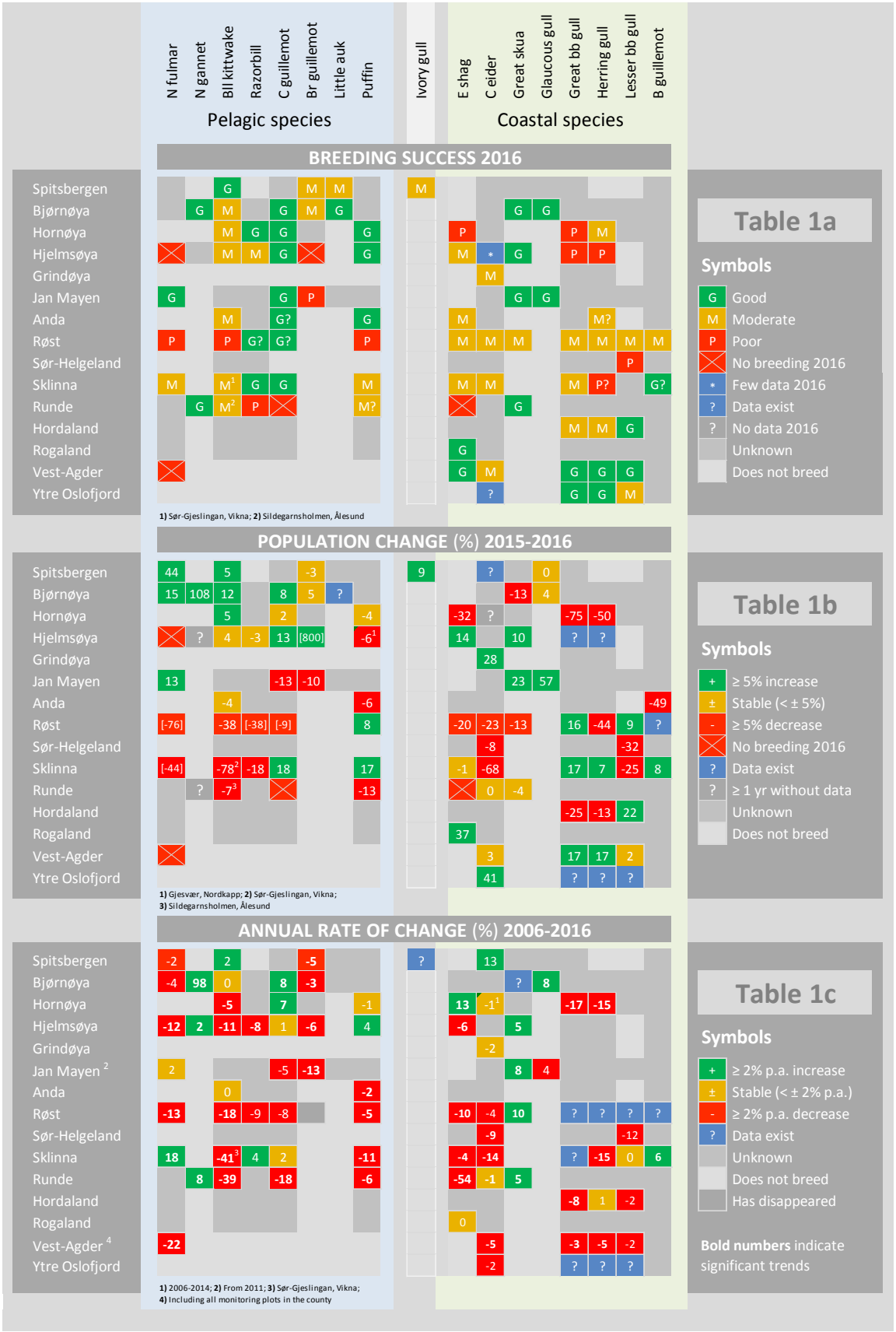
All in all, the 2016 breeding season was not optimal for Norwegian seabirds, although more populations had a good season compared to 2015 (40% contra 29%) and slightly fewer had a poor season (19% contra 27%). In the north of the country, there was a clear improvement for most of the pelagic species, despite kittiwakes and puffins having yet another near failure at Røst. Although only 6% of the puffin chicks survived at Røst, it was the first time for ten years that any at all fledged. In the arctic regions, the situation was relatively good, with the exception of Brünnich's guillemots on Jan Mayen where more than two of three pairs failed.

For the coastal species, the situation was more variable although only great skuas were successful in the north of the mainland. Even for shags on Hornøya that normally produce many chicks, 2016 was a poor year. Along the Norwegian Sea coast, most of the species had a moderate breeding season, while conditions in the North Sea were seemingly better with both shags/cormorants and gulls performing moderately at most localities. Also along the south coast, gulls and eiders did well. At both Bjørnøya and Jan Mayen, great skuas and glaucous gulls had a successful season.

In the longer term, a few populations stand out. Kittiwakes have had a very low breeding success over many years with the exception of Bjørnøya that has not yet had a failure since the start of SEAPOP 12 years ago. The key-sites on Spitsbergen have had, however, more good breeding seasons than any of the other colonies, and one more than on Bjørnøya, Hornøya or Anda. Hjelmsøya has had only one successful year, and Røst and Runde none. If we count poor seasons for kittiwakes, Røst and Runde have had ten in a row, and Hjelmsøya nine. The little colony on Sklinna disappeared in 2010. Colonies on or near buildings seem to succeed better that on the neighbouring seabird cliffs as seen both in Ålesund (vs Runde) and in the harbour at Røst (vs Vedøy). On Runde, the kittiwake colony has all but vanished, and at Vedøy only 1500 pairs remain (equivalent to 6% of the

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 2016, and their mean population trend over the last ten years (1c).



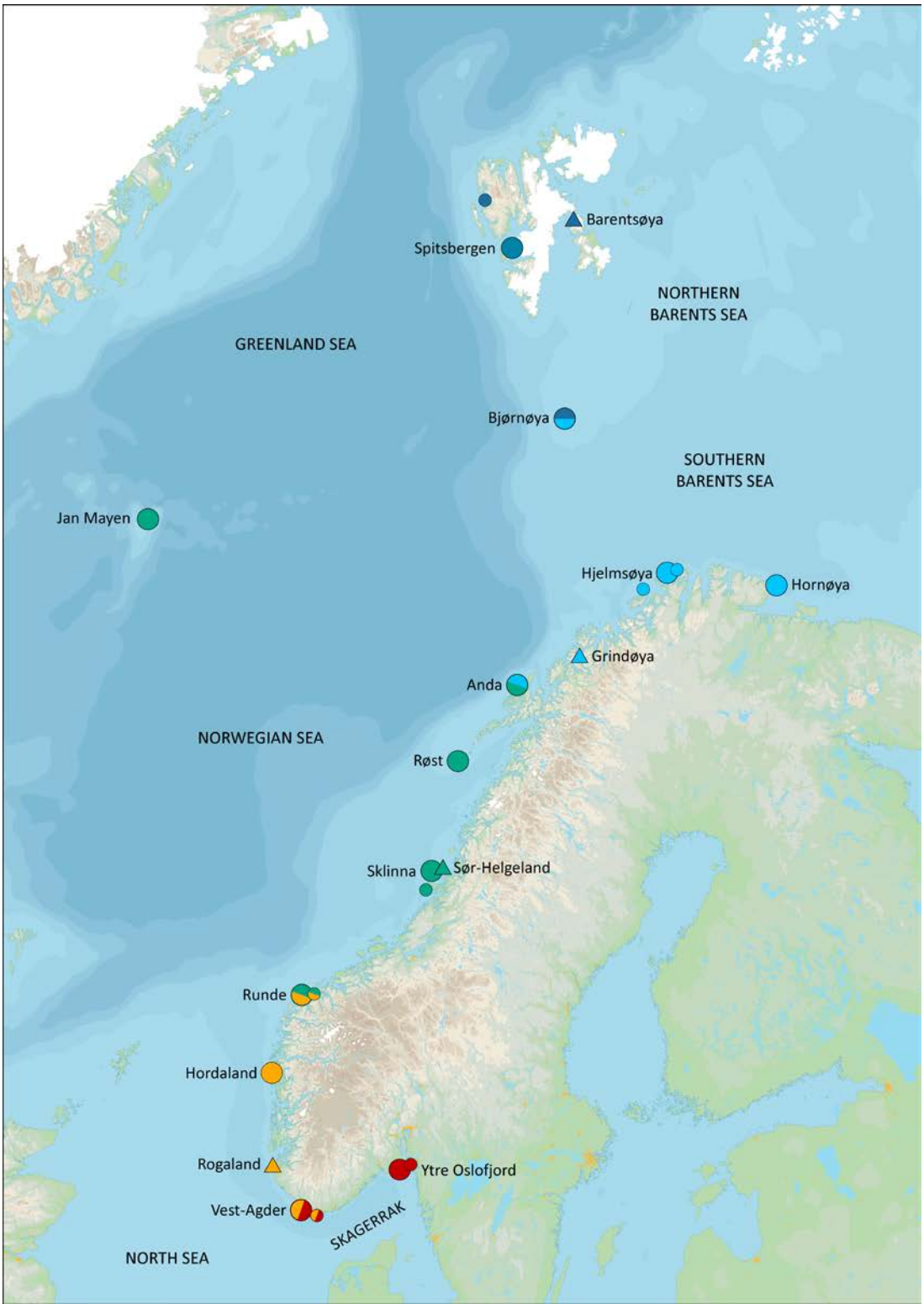


Figure 1

SEAPOP key-sites, as of 2016. Symbol colours indicate which seas they represent: the northern (dark blue) and southern (pale blue) Barents Sea, the Norwegian Sea (green), the North Sea (orange) and the Skagerrak (red). Split colours indicate sites associated with two seas. Large circles indicate the main localities, with some work carried out on nearby sub-localities (small circles). Triangles indicate single-species key-sites for ivory gull (Barentsøya), common eider (Grindøya), lesser black-backed gull (Sør-Helgeland) and shag (Rogaland).

1979 population). At Røst, colonies on buildings now comprise nearly one third of the population and play an important role in the fate of kittiwakes in the municipality.

In the negative sense, the puffin population at Røst is outstanding. Since SEAPOP started, there has only been one year with good chick production (in 2006) and breeding has been successful in only 17 seasons since monitoring started in 1964. The other 34 have been either complete or near failures. On Hornøya, where monitoring started in 1980, puffins were successful for the first 30 years but after four poor years since 2010, Anda now heads the list as the most productive colony within the SEAPOP period. At Runde, Sklinna and Hjelmsøya, production has been much more variable, with 3-4 poor seasons at all sites.

For most of the key species monitored in SEAPOP, the numbers of chicks produced is the most important proxy of recruitment. The survival of immature birds can, however, vary greatly but is, unfortunately, much more difficult to measure. Nor do changes in breeding populations reflect only own recruitment and adult mortality but also how many skip breeding or move to or from other colonies. Furthermore, age at first breeding can vary greatly. SEAPOP will now use new statistical models to address to what extent breeding success and/or adult survival determine changes in Norwegian populations, and which environmental factors are important drivers of these vital traits.

Population changes

Compared to 2015, there were more positive changes in the north than in the south for several of the pelagic species, but some sadly continued their long-term decline. Over a 10-year perspective (2006-2016), declines characterise most of the Norwegian populations. From being primarily a problem along the Norwegian Sea coastline on the mainland, this trend has now spread north to Svalbard and south to southern Norway. The situation is worst for kittiwakes that, despite a small increase in the colonies on Svalbard and stability on Hornøya and Hjelmsøya, continued their decline in the other key-sites. The situation is similar for other pelagic species such as the razorbill, puffin, Brünnich's guillemot and common guillemot, although the latter continued its increase on Hornøya and Bjørnøya and was stable on Hjelmsøya and Sklinna.

That being said, the 2016 season did have some bright spots. The gannet population continued to increase with a doubling (from 25 to >50 pairs) on Bjørnøya since 2015, and increases of 2 and 8% p.a. on Gjesværstappan (E of Hjelmsøya) and Runde respectively. Furthermore, numbers of fulmars had a sudden surge on Svalbard, Bjørnøya and Jan Mayen with increases of 44, 15 and 13% respectively since 2015. The colonies on the mainland, however, fared badly. No active fulmar nests were found on Bondøya (SW of Hjelmsøya) and in Vest-Agder, and the small colonies monitored at Røst and Sklinna declined by 76 and 44% respectively. Great skua numbers increase over the long term on all the key-sites where it breeds, despite declines in a couple in 2016. The 2016 season was exceptional on Bjørnøya with eggs being laid very late in the season and 13% fewer pairs breeding than in 2015.

For coastal species, 2016 was not a good year, with the negative trends continuing for most of the species. Great cormorants increased at Røst and in Vest-Agder, but declined in the other colonies. Shags had a good season on Lille Kamøy (SW of Hjelmsøya) and in Rogaland, in sharp contrast to

Runde where, yet again, no nests were found in the monitoring plots. Eiders fared better with increases in both the north and south of the country. Those data must however be treated with extra care because the counts are of males in the breeding areas and therefore subjected to bias from inter-annual variation in the onset of breeding. Over the last 10 years, eiders have declined at all key-sites except those on Spitsbergen. The largest declines are in the Norwegian Sea region. Numbers of black guillemots declined sharply on Anda (49% since 2015), but increased on Sklinna.

Population trends for the large gulls varied. There were no changes in numbers of glaucous gulls on Bjørnøya and Spitsbergen since 2015, while numbers increased on Jan Mayen. Great black-backed gulls declined a lot, especially on Hornøya (by 75%!) and in Hordaland (25%). At the other sites, numbers increased on average 17% since 2015. The pattern for herring gulls was similar with declines on Hornøya and in Hordaland, but also at Røst (by 44%). There were also large variations for the lesser black-backed gull, with large declines in Sør-Helgeland (32%) and Sklinna (25%) and increases at the other sites. Common for all the large gulls is, nevertheless, a negative trend over the last 10 years in most of the key-sites.

Kittiwakes resting at Hornøya in front of the Vardø radar station. There are no signs of recovery for the now severely impoverished population of kittiwakes on the Norwegian mainland coast, although some colonies, especially those on buildings, are producing relatively well. © Tycho Anker-Nilssen

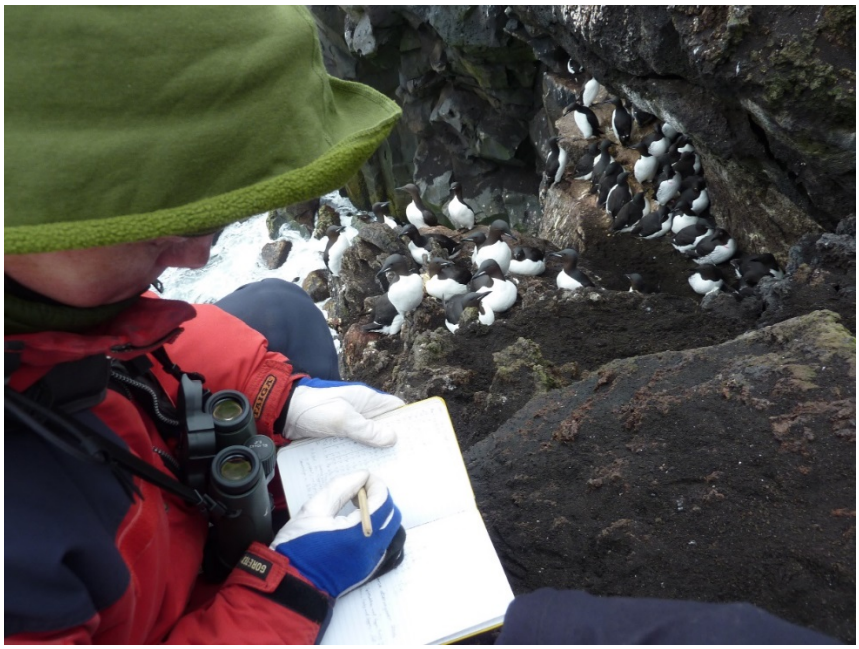
Adult survival

Changes in adult survival rates is an important parameter to monitor as it is a significant driver of population dynamics. It often reflects the condition of the population outside the breeding season and the environmental conditions under which they spend the winter. This dark and cold time of the year can be challenging for many seabirds. Production in the sea is low and short days limit foraging time. To monitor adult survival rates, representative numbers of breeding adults are marked with individually coded colour rings and return rates to the colony are noted in successive years. These rates are treated statistically to estimate the survival rate of individuals from one season to the next. One limitation of the method, however, is that we cannot estimate accurate survival rates for the last winter such that, here, we present rates from 2014 to 2015. Estimates for all earlier years are updated annually and reported on the SEAPOP Maps and data web portal.

Among the auks, there were both positive and negative tendencies. The largest negative one was among the puffins whose survival rates declined at Røst, Anda and Hornøya but remained stable at Runde and Hjelmsøya. At Hornøya, this was a continuation of a longer-term negative trend, reaching a hitherto minimum of 61% (contra 63% from 2013-2014). Survival rates of common guillemots at Hornøya, on the other hand, remained constant and high. On Sklinna they dropped a little, but at Jan Mayen and Hjelmsøya they increased very considerably (from 87% the previous winter to 92%, and from 43% to 76% respectively). The estimate for Hjelmsøya is, however, still a source of concern and may reflect predation by mink in the monitoring plot in 2015 and 2016. Some of the birds may, alternatively, have moved to other parts of the colony and thus not seen, but we have no data to assess that. Survival rates of Brünnich's guillemots increased on both Spitsbergen and Jan Mayen, but dropped sharply on Bjørnøya from 96% to only 82%. Little auk survival rates also dropped on Bjørnøya, but increased strongly on Spitsbergen from 59% to 91%. Among the more coastal species, there were small changes for black guillemots at both Sklinna and Røst, while razorbills fared better at Hornøya (from 77% to 94%).

Kittiwakes are, at present, among the species of greatest concern in Norway and here survival rates either increased slightly or remained stable. They were, however, still much lower than normal in several colonies, e.g. 72% at Røst. On Spitsbergen, Hjelmsøya and Sør-Gjeslingan there were increases compared to the year before. Glaucous gulls showed a positive tendency at Bjørnøya and Spitsbergen, but for the other large gulls survival rates were either stable or dropped slightly. There were large drops in survival among the populations of lesser black-backed gulls at Rauna and of herring gulls at Lyngøy.

Survival rates of shags vary greatly between key-sites. At both Sklinna and Hornøya there were large declines to 76% and 64% respectively, while at Røst survival increased to 88% (compared to 83% the year before). Great skuas are monitored only on Bjørnøya where there was no change, whereas survival of eiders, which is only monitored on Grindøya, increased markedly.



Even if common and Brünnich's guillemots breed side-by-side in several colonies, as here on Jan Mayen, their breeding performance, diets and survival rates are usually very different. © Erlend Lorentzen

APPENDIX – Key parameters from all key-sites in 2016

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 2015 and 2016 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 2016.*

Species	***Colony***	**Population change** %	**Annual adult survival** Period (yrs)	Estimate %	**Reproductive performance** Sampling unit	Estimate %
Fulmar	*Nøisdalen*	+ 43 [p]				
Glaucous gull	*Kongsfjorden*	+ 0 [p]	2011-16 (5)	88.7 (3.1, 90)	Hatching success	61.3 (*n*=62)
Kittiwake	*Ossian Sars*	+ 29 [p]				
	Grumantbyen	*No data*	2014-15 (1)	84.1 (5.4, 188)	Chicks >15d/nest [1]	68.7 (*n*=67)
	Fuglehuken	– 2 [p]				
Brünnich's guillemot	*Ossian Sars*	– 17 [p]	2014-15 (1)	86.8 (3.1, 214)	Chicks >15d/egg	73.7 (*n*=38)
	Diabasodden	– 11 [t]	*Not yet available*		Chicks >15d/egg	77.8 (*n*=36)
	Fuglehuken	+ 0 [p]				
Little auk	*Bjørndalen*	*No data*	*Not yet available*		Chicks >15d/egg	70.0 (*n*=20)
	Feiringfjellet	*No data*	2014-15 (1)	90.6 (2.0, 729)		

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 2016.*

Species	**Population change** %	**Annual adult survival** Period (yrs)	Estimate %	**Reproductive performance** Sampling unit	Estimate
Fulmar	+ 15 [p]			*No data*	
Gannet	+ 108 [p 1]			Large chicks/nets	0.63 (0.12, 44)
Great skua	– 13 [p]	2005-2016 (11)	94.2 (0.8, 216)	Large chicks/nest	0.93 (0.22, 43)
Glaucous gull	+ 4 [p]	2009-2016 (7)	76.6 (2.4, 163)	Large chicks/nest	1.19 (0.09, 26)
Kittiwake	+ 12 [p]	2004-2016 (12)	88.1 (0.8, 361)	Large chicks/nest	0.49 (0.02, 747)
Common guillemot	+ 8 [p]	*Results not yet available*		Fledging success [2]	0.69 (0.05, 137)
Brünnich's guillemot	+ 5 [p]	2014-2015 (1)	81.6 (7.9, 347)	Fledging success [2]	0.58 (0.07, 60)
Little auk	[p 3]	2014-2015 (1)	70.8 (2.4, 903)	Fledging success	0.90 (0.05, 50)

1) *A minimum of 53 nests recorded.* ***2)*** *Measured at the age of 20 days.* ***3)*** *Pilot project data under analysis.*

Table A3 *Key population parameters (SE, n) of seabirds on* ***Hornøya*** *in 2016.*

Species	**Population change** %	**Annual adult survival** Period (yrs)	Estimate %	**Reproductive performance** Sampling unit	Estimate
Shag	− 32 [p]	2014-2015 (1)	64.0 (5.6, 273)	*No data*	
Herring gull	− 50 [p]	2006-2016 (10)	84.0 (2.3, 116)	Clutch size	2.63 (0.09,30)
				Breeding success [1]	0.70 (0.18,30)
Great black-backed gull	− 75 [p]	2001-2016 (15)	82.0 (1.4, 219)	Clutch size	2.65 (0.09,31)
				Breeding success [1]	1.06 (0.19, 31)
Kittiwake	+ 5 [p]	2014-2015 (1)	66.0 (5.2, 1390)	Clutch size	1.80 (0.17,15)
				Large chicks/nest [1]	0.47 (0.24, 15)
Common guillemot	+ 2 [p]	1988-2016 (28)	96.5 (0.4, 243)	Breeding success [1]	0.82 (0.06, 39)
Razorbill	*No data*	1995-2016 (21)	93.9 (0.7, 308)	Breeding success [1]	0.59 (0.09, 29)
Puffin	− 4 [p]	2014-2015 (1)	61.3 (4.9, 858)	Breeding success [1]	0.58 (0.09, 33)

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

Table A4 *Key population parameters (SE, n) of seabirds on* ***Hjelmsøya*** *in 2016.*

Species	**Population change** %	**Annual adult survival** Period (yrs)	Estimate %	**Reproductive performance** Sampling unit	Estimate
Great cormorant	− 19 [t]			*No data*	
Shag *Lille Kamøy*	+ 14 [p]			Clutch size [1]	2.21 (0.10, 75)
				Clutch size [2]	2.42 (0.09, 65)
Gannet *Gjesværstappan*	*No data*				
Common eider	[t 3]				
Great skua	+ 10 [t]			Clutch size	1.91 (0.08, 11)
				Large chicks/nest	1.78 (0.14, 9)
Arctic skua	+ 118 [t]				
Common gull	− 2 [t]			Clutch size [1]	2.61 (0.11, 34)
Herring gull	[p 3]	*No data*		Clutch size [1]	1.64 (0.12, 28)
				Large chicks/nest [1]	0.00 (0.00, 28)
Great black-backed gull	[p 3]	*No data*		Clutch size [1]	1.69 (0.22, 16)
				Large chicks/nest [1]	0.25 (0.11, 16)
Kittiwake	+ 4 [p]	2014-2015 (1)	81.4 (3.8, 393)	Clutch size [1]	1.15 (0.07, 143)
				Clutch size [2]	1.67 (0.05, 95)
Common guillemot				Large chicks/nest	0.20 (0.04, 136)
Open ledges (inds.)	− 1 [P]	*No data*		Breeding success	0.00 [4]
Crevices not predated (eggs)	+ 13 [p]	2014-2015 (1)	76.0 (8.4, 259) [6]	Breeding success [5]	0.67 (0.14, 12)
Crevices predated (eggs)				Breeding success [5]	0.00 (0.00, 18)
Brünnich's guillemot	+ 800 [P 7]	*No data*		Breeding success	0.00 [4]
Razorbill					
Open ledges (inds.)	− 78 [P]	*Too small sample*		*No data*	
Crevices not predated (eggs)	− 3 [P]			Breeding success [5]	0.60 (0.00, 5)
Crevices predated (eggs)				Breeding success [5]	0.00 (0.00, 8)
Puffin *Gjesværstappan*	− 6 [P 8]				
Hjelmsøya	+ 10 [P 9]	2007-2016 (9)	90.3 (2.4, 222)	Hatching success	0.74 (0.05, 87)
				Breeding success [5]	0.64 (0.06, 77)

1) *Including empty nests.* ***2)*** *Excluding empty nests.* ***3)*** *Results not yet available.* ***4)*** *No eggs produced, or eggs predated immediately after laying.* ***5)*** *Medium-sized chicks/egg laid.* ***6)*** *Mink disturbance 2015-2016.* ***7)*** *Very few birds attending the colony.* ***8)*** *250 plots.* ***9)*** *25 plots.*

Table A5 *Key population parameters (SE, n) of seabirds on* ***Jan Mayen*** *in 2016.*

Species	**Population change** %	**Annual adult survival** Period (yrs)	Estimate %	**Reproductive performance** Sampling unit	Estimate
Fulmar	+ 13 [p]	*No data*		Chicks/nest [1]	0.75 (0.04, 96)
Common guillemot	− 13 [p]	2011-16 (5)	91.5 (3.8, 69)	Breeding success [2]	0.79 (0.11, 14)
Brünnich's guillemot	− 3 [p]	2014-15 (1)	84.1 (4.7, 118)	Breeding success [2]	0.28 (0.06, 58)
Great skua	+ 23 [p]	*No data*		Large chicks/nest [3]	1.00 (0.11, 38)
Glaucous gull	+ 57 [p]	*No data*		Large chicks/nest [3]	1.24 (0.16, 41)
Great black-backed gull	− 50 [p 4]			Large chicks/nest [3]	0.00 (*n*=1)
Lesser black-backed gull	0 [p 4]				

1) *Recorded early in the chick-rearing period when most chicks were still small/medium sized. Due to late start of fieldwork, the initial number of active nests was probably underestimated; hence, reproductive performance is probably overestimated.* ***2)*** *Number of chicks ≥ 15 days old divided by number of breeding pairs (n). Due to late start of fieldwork, the initial number of breeding pairs was probably underestimated; hence, reproductive performance is probably overestimated.* ***3)*** *Number of chicks large enough for ringing divided by number of active nests (n).* ***4)*** *Very few breeding pairs.*

Table A6 *Key population parameters (SE, n) of common eider on* ***Grindøya*** *in 2016.*

Species	**Population change** %	**Annual adult survival** Period (yrs)	Estimate %	**Reproductive performance** Sampling unit	Estimate
Common eider	+ 28 [t 2]	2014-2015 (1)	99.8 (0.06, 1411)	Clutch size	4.40 (0.15, 123)

1) *No. of males in a larger breeding area.* ***2)*** *Nest counts.*

Table A7 *Key population parameters (SE, n) of seabirds on* ***Anda*** *in 2016.*

Species	**Population change** %	**Annual adult survival** Period (yrs)	Estimate %	**Reproductive performance** Sampling unit	Estimate
Shag	+ 17 [t]			Clutch size [1]	1.31 (0.35, 16)
				Clutch size [2]	2.63 (0.16, 8)
Herring gull	+ 11 [t]			Clutch size [3]	0.81 (0.14, 53)
				Clutch size [4]	1.79 (0.15, 24)
Kittiwake	− 4 [p]	2014-15 (1)	75.7 (4.1, 399)	Clutch size/pair [5]	1.78 (0.06, 59)
				Large chicks/nest	0.64 (0.02, 492)
Puffin	− 6 [p]	2014-15 (1)	72.6 (4.5, 390)	Hatching success	0.96 (0.03, 47)
				Chicks ≥ 20d/ nest	0.90 (0.04, 44)
				Chicks ≥ 30d/ nest	0.71 (0.04, 44)
Black guillemot	− 49 [t]				

1) *Including empty nests, counted on 24 June.* ***2)*** *Excluding empty nests, counted on 24 June.* ***3)*** *Including empty nests, counted on 20 June.* ***4)*** *Excluding empty nests, counted on 20 June.* ***5)*** *Excluding empty nests, counted on 20 June.*

Table A8 *Key population parameters (SE, n) of seabirds on* ***Røst*** *in 2016.*

Species	Population change %	Annual adult survival		Reproductive performance	
		Period (yrs)	Estimate %	Sampling unit	Estimate
Fulmar	− 76 [p]				
Great cormorant	+ 8 [t]			Clutch size [1,2]	2.19 (0.31, 16)
				Large chicks/nest [3]	0.82 (*n*=55)
Shag	− 20 [p]	2014-15 (1)	87.6 (5.4, 502)	Clutch size [4,5]	2.07 (0.05, 224)
				Clutch size [1,5]	1.86 (0.06, 262)
				Large chicks/nest [4]	0.88 (0.25, 16)
Common eider	− 23 [p]			Clutch size	3.75 (0.28, 16)
Great skua	− 13 [t 6]			Clutch size	2.00 (0.00, 4)
				Breeding success	0.71 (0.29, 7)
Common gull	+ 2 [p]			Clutch size [4]	2.57 (0.08, 69)
				Large chicks/nest [4]	0.13 (*n*=86)
Lesser black-backed gull	+ 9 [p]			Clutch size [4]	2.39 (0.10, 51)
				Large chicks/nest [4]	0.55 (*n*=49)
Herring gull	− 44 [p]			Clutch size [4]	2.30 (0.11, 43)
				Large chicks/nest [4]	0.71 (*n*=31)
Great black-backed gull	+ 16 [p]			Clutch size [4]	2.43 (0.07, 93)
				Large chicks/nest [4]	0.91 (*n*=87)
Kittiwake *Vedøy*	− 38 [p 7]			Large chicks/nest [7]	0.04 (0.02, 57)
Gjelfruvær	+ 32 [t 8]			Large chicks/nest	0.39 (0.04, 232)
Kårøy area	+ 10 [t 9]	2014-15 (1)	71.5 (5.3, 313)	Clutch size/pair [10]	1.97 (0.10, 33)
				Clutch size/pair [11]	1.58 (0.07, 149)
				Large chicks/pair [10]	0.45 (0.10, 33)
				Large chicks/nest [12]	0.23 (0.02, 809)
Arctic tern				*No breeding 2016*	
Common guillemot	− 9 [p 13]	*No data 2016*		Breeding success	*No data 2016*
Razorbill	− 38 [p 13]				
Puffin	+ 8 [p]	2014-15 (1)	85.0 (3.4, 538)	Hatching success	0.68 (0.05, 84)
				Breeding success	0.06 (0.03, 83)
Black guillemot	*Not analysed*	1997-16 (19)	83.3 (1.6, 117)	Clutch size	1.73 (0.10, 22)
				Large chicks/clutch	0.53 (0.12, 17)

1) *Including empty nests.* ***2)*** *Second largest colony on 12 June, when none clutches had hatched. When including the three other colonies visited on 5 July, overall clutch size was 1.96 (SE=0.15, n=55).* ***3)*** *Minimum estimates for all four colonies on 5 July when 27 (38%) of the chicks were still small (i.e. maximum estimate was 1.31).* ***4)*** *Excluding empty nests.* ***5)*** *On 1 July, estimated by linear regression of mean values for counts on six different days between 14 June and 8 July.* ***6)*** *5 breeding pairs in 2016.* ***7)*** *Main colony with about 1500 pairs in 2016.* ***8)*** *Small cliff-breeding colony 9 km SW of Vedøy with 232 pairs in 2016.* ***9)*** *Population of 809 pairs in 2016 breeding on/near buildings in Røst harbour.* ***10)*** *On main ledges monitored at regular intervals (plot VIII only).* ***11)*** *All nests monitored at regular intervals (plot VIII only).* ***12)*** *Based on total counts of entire colony on buildings.* ***13)*** *Only very small numbers on open ledges (quasi-extinct colony).*

Table A9 *Key population parameters (SE, n) of lesser black-backed gull on* ***Horsvær*** *in 2016.*

Species	Population change %	Annual adult survival		Reproductive performance	
		Period (yrs)	Estimate %	Sampling unit	Estimate
Lesser black-backed gull	− 31	2005-16 (11)	90.5 (1.2, 180)	Clutch size	2.40 (0.08, 86)
				Fledged juv./pair	0.00 (*n*=100) [1]

1) *Extensive predation on the nests, mainly from ravens.*

Table A10 *Key population parameters (SE, n) of seabirds on* ***Sklinna*** *in 2016.*

Species	Population change %	Annual adult survival		Reproductive performance	
		Period (yrs)	Estimate %	Sampling unit	Estimate
Fulmar	− 44 [t]				
Great cormorant	− 27 [t]			*No data 2016*	
Shag	− 1 [t]	2014-15 (1)	76.1 (5.3, 458)	Clutch size [1]	1.86 (0.05, 390)
				Hatching success/nest	0.69 (*n*=51)
				Clutch size hatching	1.35 (0.15, 51)
				Chicks ≥ 10d/nest	1.88 (*n*=34)
				Chicks ≥ 20d/nest	1.74 (*n*=31)
				Chicks ≥ 30d/nest	2.13 (*n*=8)
Common eider	− 68 [t]			Clutch size	4.07 (0.24, *n*=29)
Common gull				*No estimate yet available*	
Herring gull [2]	+ 7 [p]			Clutch size [3]	1.18 (0.21, 33)
				Clutch size [4]	2.17 (0.17, 18)
Great black-backed gull	+ 17 [p]			Clutch size [5]	1.53 (0.18, 36)
				Clutch size [6]	2.04 (0.14, 27)
Kittiwake *Sklinna*	0 [t 7]				
Sør-Gjæslingan	− 78 [t 8]	2014-15 (1)	62.9 (7.4, 285)	Large chicks/nest [9]	0.27 (*n*=111)
Common guillemot	+ 18 [t]	2008-16 (8)	90.4 (1.1, 297)	*No quantitative estimate* [10]	
Razorbill	− 18 [t]				
Puffin	+ 17 [p]	*No estimate yet possible* [11]		Hatching success/nest	0.50 (0.14, 14)
				Chicks ≥ 10d/hatched	1.00 (0.00, 7)
				Chicks ≥ 20d/hatched	1.00 (0.00, 7)
Black guillemot	+ 8 [p]	2008-16 (8)	88.3 (2.6, 60)		

1) *On 3-4 June.* ***2)*** *Monitoring of adult survival was discontinued in 2010.* ***3)*** *On 7 June, including empty nests.* ***4)*** *On 7 June, excluding empty nests.* ***5)*** *On 5 June, including empty nests.* ***6)*** *On 5 June, excluding empty nests.* ***7)*** *No kittiwakes have bred on Sklinna since 2010.* ***8)*** *Based on numbers of breeding birds counted from pictures taken in mid-May.* ***9)*** *Based on nest count in May and June and chick count on 8 July.* ***10)*** *Quantitative estimates difficult to obtain because the birds breed in shelter under big boulders.* ***11)*** *Colour ringing was initiated in 2007, but re-sighting rate in all later years has been very low because few birds have attended the colony by sitting out in the open.*

Table A11 *Key population parameters (SE, n) of seabirds on* ***Runde*** *in 2016.*

Species	Population change %	Annual adult survival		Reproductive performance	
		Period (yrs)	Estimate %	Sampling unit	Estimate
Common eider	− 0 [t]				
Gannet	? [t 1]			Large chicks/nest [2]	0.87 (0.01, 723)
Shag	0 [p 3]	*No estimate yet possible* [4]		*No breeding in 2016*	
Great skua	− 4 [t 1]			Large chicks/nest	0.78 (*n*=80)
Kittiwake *Runde*	0 [p 3]			*No breeding in 2016*	
Sildegarnsholmen	− 7 [t]	2011-16 (5)	81.5 (2.0, 199)	Large chicks/nest	0.59 (*n*=641)
Common guillemot	0 [p 3]			*No breeding on open ledges in 2016*	
Puffin	− 13 [p 1]	2007-16 (9)	87.3 (1.2, 263)	Hatching success/nest	0.83 (0.06, 46)
				Chicks 20d/hatched	0.89 (0.05, 38)
				Chicks ≥ 40d/hatched	0.81 (0.06, 38)
				Fledged/hatched [5]	0.63 (0.07, 38)

1) *Not counted in 2016.* ***2)*** *Counted in 4 study plots on 5 August.* ***3)*** *As in the preceding year, no breeding was recorded in the study plots in 2016.* ***4)*** *Colour ringing was initiated in 2008, but sample size is still too low.* ***5)*** *Maximum estimate.*

Table A12 *Key population parameters (SE, n) of seabirds on the different localities in* ***Hordaland*** *in 2016.*

Species	**Population change** %	**Annual adult survival** Period (yrs)	Estimate %	**Reproductive performance** Sampling unit	Estimate
Lesser black-backed gull	+ 22 [t]	2009-16 (7)	81.6 (5.2, 45)	Clutch size [1]	1.88 (0.13, 85)
				Fledged chicks/nest	0.77 (*n*=97)
Herring gull	− 13 [t]	2014-15 (1)	61.2 (17.1, 100)	Clutch size [1]	2.22 (0.05, 325)
				Fledged chicks/nest	0.61 (*n*=330)

1) *Including empty nests.*

Table A13 *Key population parameters (SE, n) of shag in* ***Rogaland*** *in 2016.*

Species	**Population change** %	**Annual adult survival** Period (yrs)	Estimate %	**Reproductive performance** Sampling unit	Estimate
Shag	+ 37 [p]	*No estimate yet available* [1]		Clutch size [2]	2.49 (0.09, 49)
				Breeding success [3]	1.30 (0.17, 49)

1) *Colour-ringing of adults was initiated in 2014, but few birds were ringed in the first year.* ***2)*** *On 27 May, when no empty nests were found.* ***3)*** *"Maximum" estimate based on number of chicks alive on 1 July (i.e. excluding 6 nests that still contained only eggs).*

Table A14 *Key population parameters (SE, n) of seabirds on the different sites in* ***Vest-Agder*** *in 2016.*

Species	**Population change** %	**Annual adult survival** Period (yrs)	Estimate %	**Reproductive performance** Sampling unit	Estimate
Great cormorant	+ 13	*No estimate yet available* [1]		Clutch size	3.35 (0.09, 254)
				Large chicks/nest	1.89 (*n*=254)
Common eider	+ 3 [2]			Clutch size	3.44 (0.18, 52)
				Small chicks on sea [3]	1.17 (*n*=310)
				Large chicks on sea [3]	0.62 (*n*=310)
Lesser black-backed gull		2001-16 (15)	80.9 (1.3, 600) [4]		
Slettingene	+ 88			Clutch size [5]	2.48 (0.07, 190)
				Fledged juv./pair	1.58 (*n*=190)
Storøy	+ 8			Clutch size [5]	2.42 (0.10, 91)
				Fledged juv./pair	0.00 (*n*=91)
Klovholmene	− 14			Clutch size [5]	1.48 (0.26, 23)
				Fledged juv./pair	1.67 (*n*=24)
Rauna	− 2	1999-16 (17)	82.4 (0.7, 1094)	Clutch size [5]	2.04 (0.21, 25)
				Fledged juv./pair	1.60 (*n*=2105)
Herring gull		2001-16 (15)	81.0 (1.9, 356) [4]		
Slettingene	+ 48			Clutch size [5]	2.52 (0.09, 73)
				Fledged juv./pair	1.08 (*n*=130)
Storøy	− 22			Clutch size [5]	2.26 (0.13, 58)
				Fledged juv./pair	0.62 (*n*=89)
Klovholmene	+ 13			Clutch size [5]	2.19 (0.21, 26)
				Fledged juv./pair	1.92 (*n*=26)
Rauna	− 12	2002-16 (14)	78.0 (3.0, 141)	Clutch size [5]	2.77 (0.17, 22)
				Fledged juv./pair	1.30 (*n*=236)

1) *Colour-ringing of chicks for later monitoring of survival rates was initiated in 2008.* ***2)*** *Based on counts of adult males in Farsund municipality.* ***3)*** *Based on the total number of males around Rauna on 12 May and the number of ducklings observed in June and July.* ***4)*** *General estimate for birds from Slettingene, Storøy and Klovholmane.* ***5)*** *Including empty nests.*

Cover photo:
The population of common guillemots on Bjørnøya has fully restored since the collapse in the 1980s (© Hallvard Strøm)

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