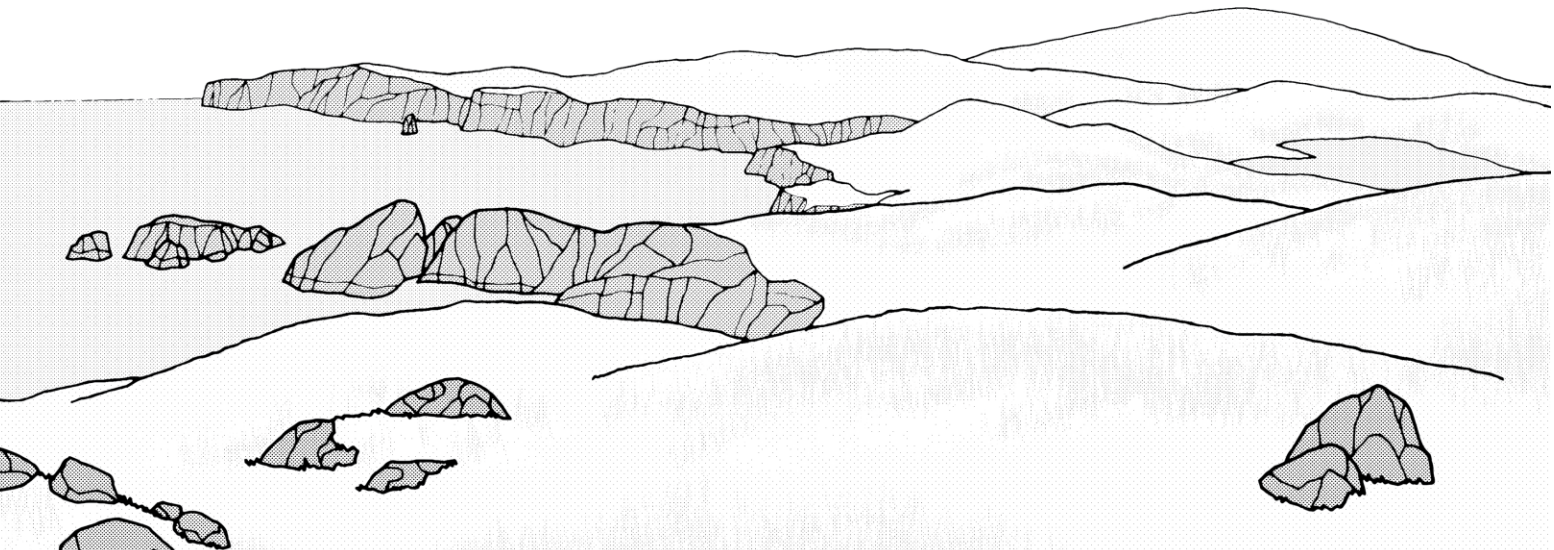
SOTEAG

Ornithological monitoring programme in Shetland 2018

A report to the Shetland Oil Terminal Environmental Advisory Group

by

University of St Andrews



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SOTEAG ORNITHOLOGICAL MONITORING PROGRAMME

2018 REPORT

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2018 Executive Summary

1. Monitoring of cliff-nesting seabirds

Northern Fulmar *Fulmarus glacialis*. Population counts (AOS) were very similar to the 2017 counts. Mean breeding success across the four monitored sites (0.40 chicks fledged per AOS) was similar to the 1985–2017 average (0.42).

European Shag *Phalacrocorax aristotelis*. Population counts (nests) at Sumburgh Head and No Ness were similar to 2017. Breeding success at Sumburgh Head and Burravoe was higher than in 2017, but Sumburgh was below the average for all monitored years (2018 = 1.07 chicks fledged per laying pair; 1988–2017 average = 1.12) whereas Burravoe was above it (2018 = 1.55; 2012–17 average = 1.11). Two coastline transects for Shag population monitoring were added to the monitoring programme.

Black-legged Kittiwake *Rissa tridactyla*. The population count at Compass Head was 45 nests, compared with 46 in 2017. Mean breeding success across six monitored sites was high (0.95 fledged per laying pair) and well above the 1988–2016 average (0.39). Two coastline transects including more nests for Kittiwake population monitoring were added to the monitoring programme.

Common Guillemot *Uria aalge*. The monitored populations (individuals) had increased since 2017. The mean population index (49.8; 1978 = 100) was 50% higher than in 2017. Breeding success at Sumburgh Head (0.54 fledged per laying pair) was higher than in 2017 (0.42) and equal to the 1989–2017 average (0.54). Chick diet at the Sumburgh Head monitoring plot was 80% gadids and 11% sandeels.

Razorbill *Alca torda*. Population counts (individuals) were higher than in 2017 at all monitored sites, but the mean population index (41.7; 1978 = 100) was below the 1976–2017 average (63.0). Breeding success at Sumburgh Head was 0.46 chicks fledged per laying pair, closely similar to the 2011–16 average (0.45).

2. Pre-breeding season population counts of Black Guillemots *Cepphus grille*. Changes in population counts (breeding plumage individuals) since the most recent previous surveys were variable across the annual monitoring sites, although the long-term pattern at most sites is stability. A survey of the Sullom Voe Oil Terminal tanker jetties recorded 88 breeding plumage individuals around the tanker jetties and nesting within the jetty structures – an unusual and relatively large breeding colony in Shetland.

3. Monitoring of breeding Red-throated Divers *Gavia stellata*. Population surveys of the monitored area in Northmavine confirmed 16 breeding attempts, down from 23 in 2017. Breeding success was 0.50 chicks fledged per breeding attempt, up from 0.43 in 2017.

4. Population counts of moulting Common Eiders *Somateria mollissima*. The total count in the Yell Sound and Sullom Voe monitoring areas in 2018 was 297 birds, an increase since 2017 (201 birds) but low compared with totals in 2009 to 2013 (yearly average = 605 birds).

5. Winter counts of seaduck and diving seabirds. Hascosay, Bluemull and Colgrave Sounds and South Unst were surveyed on 2nd January in perfect conditions. Numbers of Common Eiders and Great Northern Divers were similar to recent years, but counts of Cormorants, Shags and Black Guillemots were considerably higher that during the 2016/17 survey.

6. Beached Bird Surveys. Ten oiled seabirds were found in January to April, all lightly oiled. Four samples were taken, three were fuel oil and the fourth crude oil, likely of Middle-eastern origin. Fourteen oiled seabirds were found in May to August and two samples were taken, both fuel oil. On the evening of 8th June, a large quantity of oil was reported on Sandwick beach, Unst. Analyses determined the oil was crude oil, had similarities with crude oils from the West Shetland Basin, and had likely been released accidentally or from an illegal bilge discharge. There were no incidences of oiling in September through to the end of the year, or of abnormally high mortality of any seabird species during the year.

In summary, there was no evidence that the operation of the Sullom Voe Terminal, or its associated tanker traffic, had any detrimental impact on Shetland's seabird populations during 2018.

1. Monitoring of cliff-nesting seabirds

1.1. Weather during the 2018 seabird breeding season

Unusually severe easterly storms and low temperatures dominated March. In April, strong westerly and southerly winds and heavy sea swells reduced opportunities for pre-breeding counts of Black Guillemots. Weather conditions during May to August were relatively calm, dry and clear and generally had little impact on fieldwork. The only exceptions were 1–2 days of strong winds, rain and heavy sea swells in mid-May, early June and mid-June, and occasional days of fog during late-May, June and July. Two days of heavy sea swell on 14th and 15th June washed away three Shag nests located on the lowest rock platforms in Smithfield Geo, on the west side of Sumburgh Head.

Table 1.1. Summary of conditions for population plot counts of Fulmars, Common Guillemots and Razorbills at the four monitored sites in 2018, including observer, date, time, wind (direction and force), general sea state and cloud conditions (0–8 cloud coverage score).

Sumburgh Head	Observer: Will Miles			
Date	**Time (BST)**	**Wind**	**Sea state**	**Cloud cover**
3rd June 2018	1400–1600	W 2	Calm	8/8
6th June 2018	1530–1730	NW 4	Heavy swell	3/8
8th June 2018	1300–1530	NE 3	Moderate swell	8/8
13th June 2018	1400–1600	SW 3	Light swell	8/8
16th June 2018	1300–1615	S 2	Moderate swell	3/8
Troswick Ness	Observer: Will Miles			
Date	**Time (BST)**	**Wind**	**Sea state**	**Cloud cover**
3rd June 2018	1030–1140	WNW 2	Calm	8/8
6th June 2018	1000–1050	NE 2–4	Moderate swell	6/8
8th June 2018	0930–1030	NE 3	Moderate swell	8/8
13th June 2018	0945–1100	SW 2	Calm	8/8
16th June 2018	1000–1100	S 1–2	Calm	6/8
Esha Ness	Observer: Mick Mellor			
Date	**Time (BST)**	**Wind**	**Sea state**	**Cloud cover**
4th June 2018	0930–1130	NE 3	Moderate swell	8/8
6th June 2018	1230–1330	NE 4	Moderate swell	4/8
11th June 2018	1300–1400	NW 2–3	Moderate swell	5/8
13th June 2018	1200–1300	SSW 3–4	Moderate swell	8/8
16th June 2018	1245–1345	SE 4	Heavy swell	6/8
Burravoe, Yell	Observer: Mick Mellor			
Date	**Time (BST)**	**Wind**	**Sea state**	**Cloud cover**
3rd June 2018	0910–1000	NW 3	Calm	8/8
6th June 2018	1000–1030	NE 4	Moderate swell	4/8
9th June 2018	0930–1000	NE 4	Moderate swell	8/8
11th June 2018	1010–1030	NW 3–4	Light swell	8/8
16th June 2018	0945–1015	SW 0–2	Calm	8/8

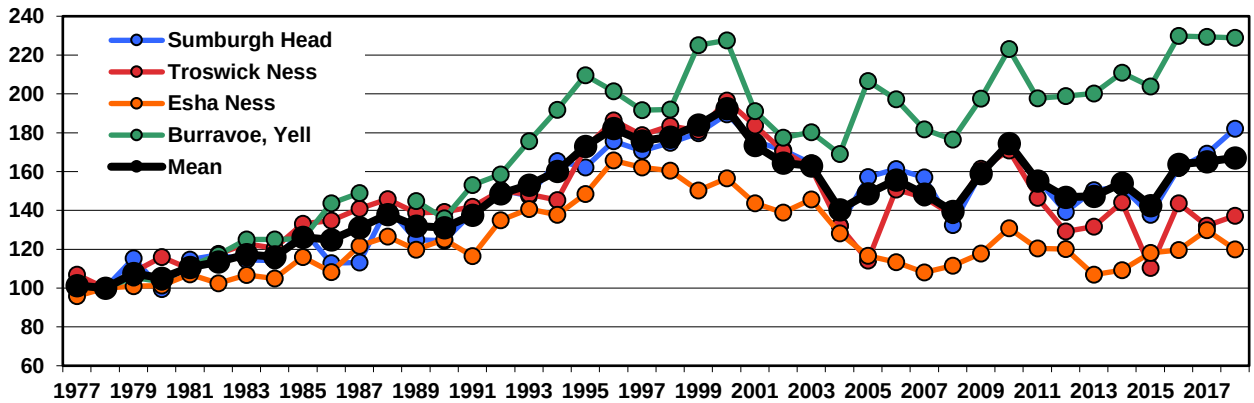
1.2a. Northern Fulmar *Fulmarus glacialis*: population counts

Population counts at the four monitored sites in 2018 were very similar to counts in 2017 (**Table 1.2**). The mean population index across all sites had changed little; in 2018 it was 167.0 compared to 165.1 in 2017 (**Figure 1.1**). At Esha Ness, the mean count of individuals had decreased by 14.6% since 2017, but this was the only site where a population change of more than ±10% since 2017 was recorded (**Table 1.2**). Population index values at each site have remained generally stable across the last three years, except at Sumburgh Head where there has been a slight increase (**Figure 1.1**). Between 1977 and 2000, Fulmar population index values generally increased at all the monitored sites, but since 2000 changes have been more variable across sites (**Figure 1.1**). The mean population index increased between 1977 and 2000, decreased between 2000 and 2003, but thereafter has remained generally stable. In comparison with the other monitored cliff-nesting species, numbers of Fulmars remain high at all the monitored sites (mean individuals and AOS >200 at all colonies).

Table 1.2. Fulmar population summary statistics for counts of individual birds (Individuals) and apparently occupied nest sites (AOS) at four monitoring sites, 2017–18: total counts (n), range, mean, standard deviation (SD), coefficient of variation (CV), % change since 2017 (% ch.) and population index for AOS where 1978 = 100 (Index).

Colony	Unit	Year	n	Range	Mean	SD	CV	% ch.	Index
Sumburgh Head	Individuals	2017	5	287–323	306.6	14.15	0.05		
		2018	5	279–360	310.4	30.36	0.09	+1.2	
	AOS	2017	5	240–256	248.2	7.29	0.03		169.2
		2018	5	252–295	267.0	16.46	0.06	+7.6	182.0
Troswick Ness	Individuals	2017	5	943–1034	993.8	34.74	0.03		
		2018	5	919–1075	1017.4	60.7	0.06	+2.4	
	AOS	2017	5	778–871	815.6	38.57	0.05		132.1
		2018	5	795–898	847.4	46.69	0.06	+3.9	137.2
Esha Ness	Individuals	2017	5	368–511	415.4	55.37	0.13		
		2018	5	288–407	354.8	42.8	0.12	–14.6	
	AOS	2017	5	295–343	312.0	18.43	0.06		129.8
		2018	5	257–314	288.4	21.05	0.07	–7.6	119.9
Burravoe	Individuals	2017	5	230–311	259.4	32.96	0.13		
		2018	5	252–272	259.6	7.83	0.03	+0.1	
	AOS	2017	5	199–235	213.6	14.93	0.07		229.4
		2018	5	199–221	213.2	8.37	0.04	–0.2	228.9

Figure 1.1. Annual population index (1978 = 100) of Fulmar apparently occupied sites (AOS) at the four monitored colonies and the mean index for the four colonies, 1977–2018.



1.2b. Northern Fulmar *Fulmarus glacialis*: breeding success

In 2012 the 'marked photograph' method (here termed 'method a') was adopted by SOTEAG so that the same monitoring methodology was used as at other sites in Shetland and elsewhere (Walsh *et al.* 1995). Previously, since 1985, breeding success had been calculated by dividing the number of chicks present in the population monitoring plots in mid-August by the mean count of AOS in June ('method b'). Both methods are now used.

Mean breeding success was 0.56 using method a and 0.39 using method b and variation around the mean was low for each method (**Figure 1.2, Table 1.3**). The large difference between the two measures of mean breeding success in 2018 occurred because at the monitored sites the difference between the number of nest sites where an AOS was recorded on all three checks (in late-May / first week of June) and the mean of the five population counts (in early to mid-June) was often unusually high. Reasons for this are unclear, but possibly the population counts were inflated by some pairs that began breeding late (after the first week of June) and abandoned early (before mid-August), having returned to the colonies in poor condition after the severe weather conditions in March. As is usual for method a, there were a few sites where chicks were recorded but where there had not been an AOS recorded on all three early-season checks, but these 'extra' sites were not unusually numerous in 2018 (**Table 1.3**; Heubeck *et al.* 2017).

Mean breeding success in 2018 measured using method a was the highest on record, joint with 2013, and had increased by 33% since 2017 (**Figure 1.2**). Mean breeding success measured using method b was not particularly high in comparison with previous years, although had increased by 12% since 2017. Overall, mean breeding success generally decreased from 1985 to 2008, a marked increase occurred between 2008 and 2009, and since then it has remained generally stable but with high annual variation (**Figure 1.2**).

Figure 1.2. Mean Fulmar breeding success (± SE) at 3–4 monitored sites, 1985–2018 (Burravoe, the fourth site, only from 2003), calculated as the number of chicks present in mid-August divided by the mean of five counts of apparently occupied nest sites (AOS) in June (black), and by the number of nest sites recorded as AOS on each of three dates in early May and early June (red).

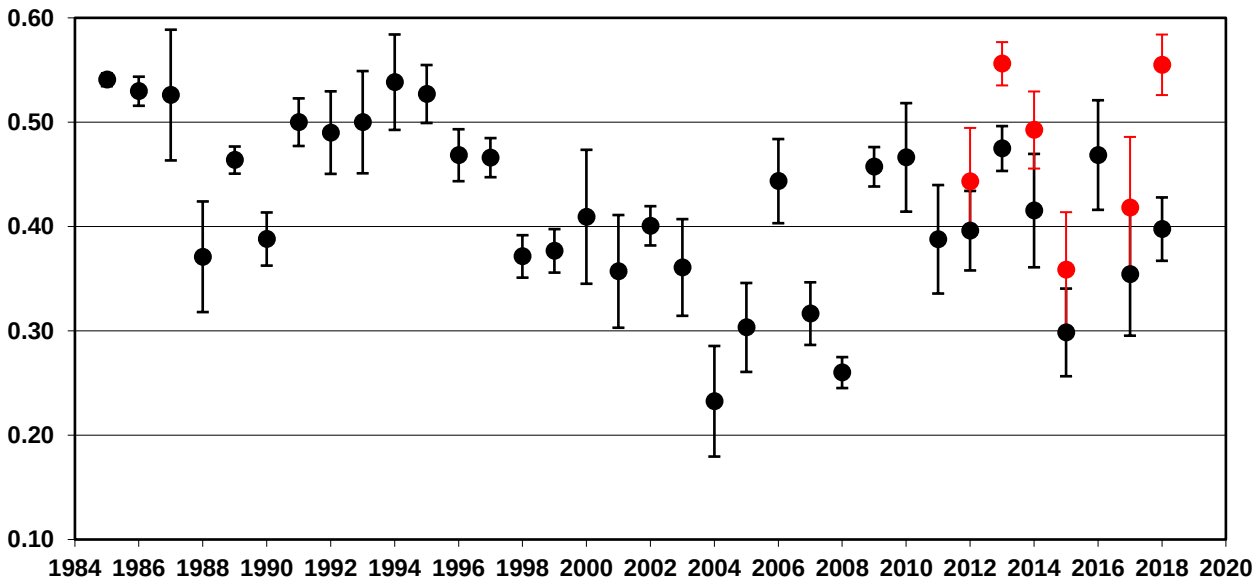


Table 1.3. Fulmar breeding success summary statistics for four monitoring sites, 2018: the dates of visits to the monitoring plots, the total number of nest sites recorded as an AOS on one or more of three checks in May/June (AOS), the number of nest sites recorded as an AOS on all three checks in May/June (AOSx3), the mean of the five Fulmar population monitoring counts of AOS (Mean), the number of nest sites where chicks were present in mid-August (Chicks), the number of nest sites at which chicks were present but where an AOS was recorded on only one, two or none of the May/June checks (Extra), and breeding success ± SE calculated using the marked photograph method (Success A = Chicks/[AOSx3+Extra]) and the population count method (Success B = Chicks/Mean; with 2017 figures in brackets).

Sumburgh Head: 28th May, 31st May, 3rd June, 13th August							
Plot	**AOS**	**AOSx3**	**Mean**	**Chicks**	**Extra**	**Success A**	**Success B (2017)**
Greystane Geo	41	16	31.8	11	0	0.69	0.35 (0.54)
Geo of Toun South	206	144	183.4	100	4	0.68	0.55 (0.45)
Geo of Parks North	58	30	48.4	17	0	0.57	0.35 (0.59)
Sum	305	190	263.6	128	4	0.66	0.49 (0.49)
Mean						**0.64**	**0.42 (0.53)**
± SE						0.04	0.06 (0.04)
Troswick Ness: 28th May, 31st May, 3rd June, 13th August							
Plot	**AOS**	**AOSx3**	**Mean**	**Chicks**	**Extra**	**Success A**	**Success B (2017)**
Brei Geo	392	236	341.8	122	5	**0.51**	0.36 (0.30)
Sandvis Geo			505.6	131			0.26 (0.33)
Sum			847.4	248			0.29 (0.32)
Mean							**0.31 (0.31)**
± SE							0.05 (0.01)
Esha Ness: 28th May, 2nd June, 4th June, 14th August							
Plot	**AOS**	**AOSx3**	**Mean**	**Chicks**	**Extra**	**Success A**	**Success B (2017)**
Calders Geo	252	155	195.2	106	8	0.65	0.54 (0.32)
Main Colony	42	28	31.0	12	0	0.43	0.39 (0.38)
Fulmar Geo	67	40	52.6	23	2	0.55	0.44 (0.09)
Sum	361	223	278.8	141	10	0.61	0.51 (0.28)
Mean						**0.54**	**0.45 (0.26)**
± SE						0.06	0.04 (0.09)
Burravoe: 28th May, 30th May, 4th June, 16th August							
Plot	**AOS**	**AOSx3**	**Mean**	**Chicks**	**Extra**	**Success A**	**Success B (2017)**
	248	152	213.2	88	13	**0.53**	**0.41 (0.31)**

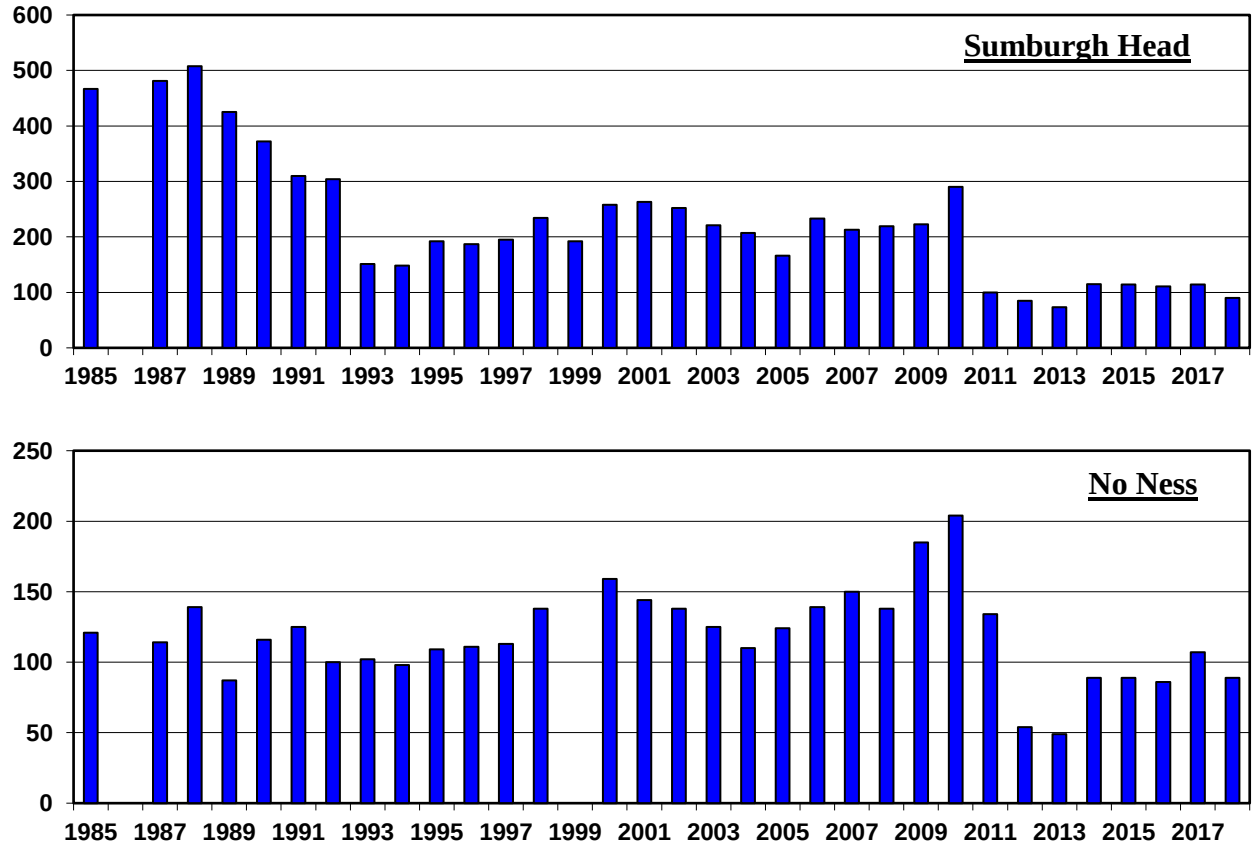
1.3a. European Shag *Phalacrocorax aristotelis*: population counts

Population counts of nests at Sumburgh Head and No Ness made from land were slightly lower than in 2017 (**Table 1.4**). Since 2014, a high proportion of nests (>82%) have been 'active' during counts (i.e. apparently incubating or containing chicks). The timing of Shag nesting is often highly asynchronous, so not all nesting attempts in a season will be captured by a single count of nests, since some nests may fail and disintegrate prior to the count date and some may be built subsequently. However, observations from the Shag breeding success plots at Sumburgh suggested that a high proportion of nests were visible on 8th June and timing was appropriate for the counts. On June 4th, for example, 70% of all recorded nesting attempts in the breeding success plots at Sumburgh were visible, either as trace (3%) or fully-built active nests (67%). Breeding numbers at Sumburgh are currently stable, although are c.75% lower than numbers in the late 1980s (**Figure 1.3**). The 50% decrease between 1992 and 1993 followed the January 1993 *Braer* oil spill. There was no similarly timed decrease at No Ness, where breeding numbers peaked at 204 nests in 2010 but since 2012 have been much lower (2012–18 average = 80 nests; **Figure 1.3**).

Table 1.4. Counts of Shag nests (total including trace, empty, and active) at Sumburgh Head and No Ness, the percentage of nests which were active, and count date, 2006–2018. These two colonies are counted annually from land. When more than one count from land was made in a year the highest nest total is given (*).

Coastline	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Sumburgh Head	**233***	**213***	**219***	**223***	**290***	**100***	**85***	**73***	**115**	**114**	**111**	**114**	**90**
	97%	99%	95%	93%	97%	67%	54%	33%	85%	92%	94%	91%	83%
	13/6	22/6	31/5	16/6	8/6	27/5	30/5	10/6	9/6	13/6	5/6	6/6	8/6
No Ness	**139***	**150***	**138***	**185***	**204***	**134***	**54***	**49***	**89**	**89**	**86**	**107**	**89**
	97%	95%	94%	89%	95%	84%	48%	47%	87%	93%	92%	92%	82%
	13/6	22/6	13/6	23/5	9/6	27/5	12/6	10/6	12/6	16/6	1/6	7/6	7/6

Figure 1.3. Counts from land of Shag nests at Sumburgh Head and No Ness, 1985–2018.



In 2018, two transects of coastline with relatively large numbers of breeding Shags were surveyed by boat, as a pilot survey to determine whether these transects could be added to the existing regularly monitored sites for annual Shag population monitoring.

To maximise data-return from survey days in the boat (which can be irregular because of poor weather), the two transects selected for this work were the same as those used for pilot Kittiwake population monitoring (see p. 11). Both transects are located on the more sheltered east coast of Shetland (more reliably accessible every year by boat) but are in different areas, namely 1) the south Mainland and 2) east Yell and Fetlar (**Figure 1.4**). An important factor in the selection of the transects was that each was thought to have a relatively large sample size of Shag and Kittiwake nests (M. Heubeck pers. comm.). Also, it was important that one transect was as close as possible to Yell Sound and Sullom Voe, as in these areas the risk of oil spills is relatively high and seabird population monitoring by SOTEAG is especially useful and relevant. The east Yell and Fetlar transect was the closest possible location to Yell Sound and Sullom Voe where enough Shag and Kittiwake nests occurred for long-term population monitoring to be potentially viable.

In 2018, each transect was surveyed once by boat during peak incubation (judged from breeding success monitoring) and all visible Shag nests (AON and trace nests) were counted and mapped. The south Mainland transect was surveyed on 14th June and a total of 235 AON and 21 trace nests recorded (this included a count of No Ness from the sea). The east Yell and Fetlar transect was surveyed on 14th June and a total of 162 AON and one trace nest recorded. Both transects appeared suitable for annual Shag population monitoring using one survey visit per year by boat, as currently both hold relatively large numbers of nests compared with the regularly monitored colonies. Monitoring of both transects is planned for future years, alongside the existing Shag population monitoring.

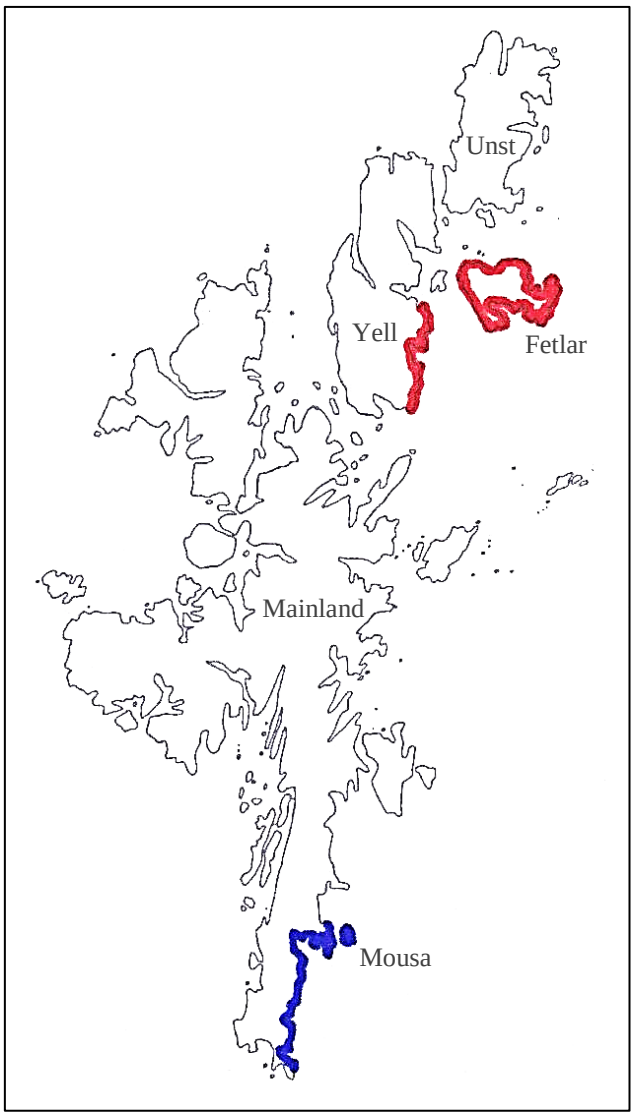


Figure 1.4. Location of Shag and Kittiwake population monitoring transects, pilot surveyed in 2018. The south Mainland transect (blue) begins in the south at The Slithers (OS grid reference: HU407092) and ends further north at the Taing of Sandsayre (HU437251), but also includes the entire coast of Mousa. The east Yell and Fetlar transect (red) begins in the south east corner of Yell at Ladies Hole (HU531801) and ends on Yell further north, at the Wick of Vatsetter (HU535896), but also includes the entire coast of Fetlar.

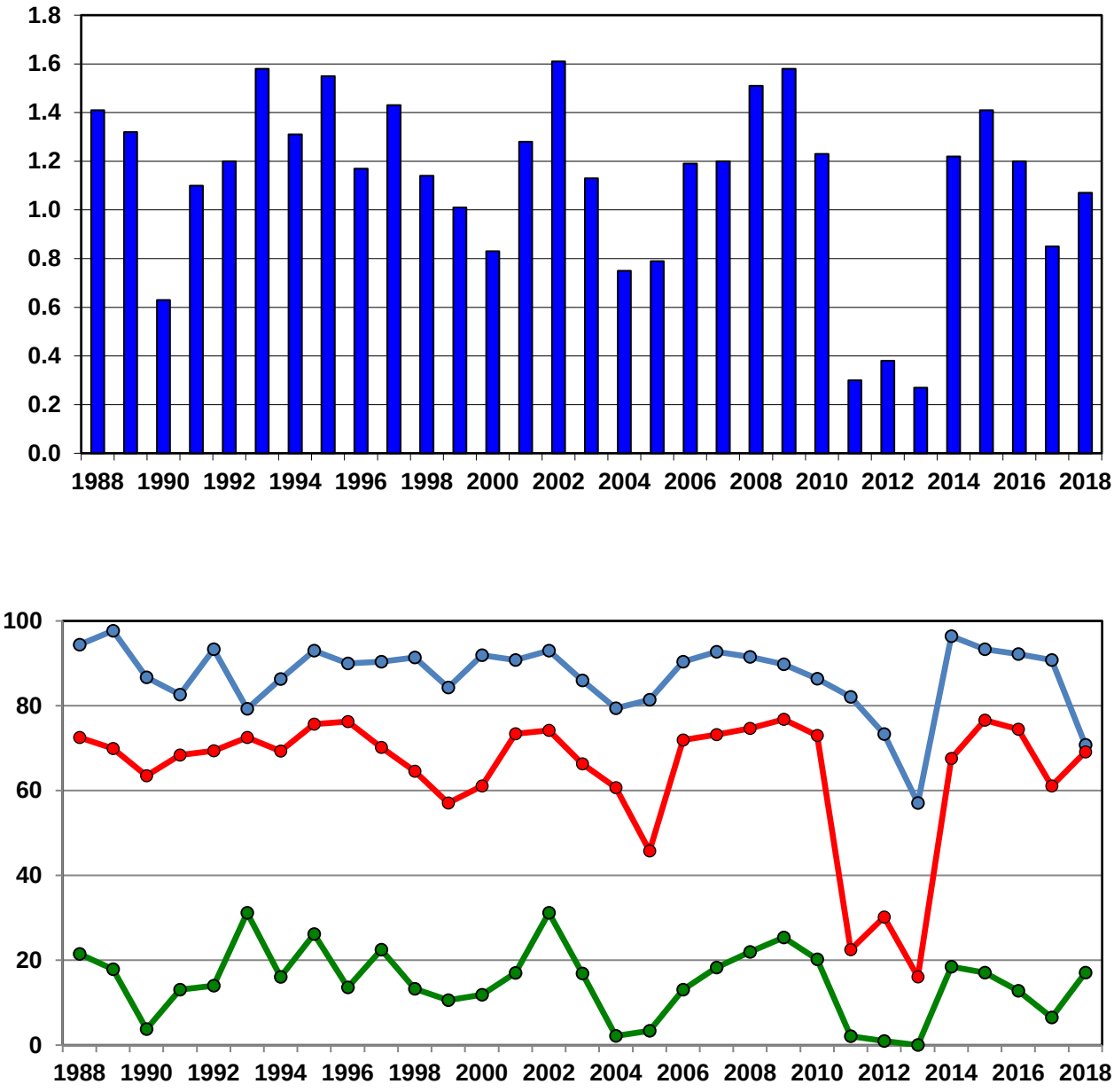
1.3b. European Shag *Phalacrocorax aristotelis*: breeding success

Shag breeding success was again monitored at plots at Sumburgh Head (26 checks, 6th April–21st September) and Burravoe (29 checks, 4th April–13th August). At both sites, breeding success and mean brood size at fledging were higher than in 2017 (**Table 1.5**). At Sumburgh, the percentage of nests that progressed to incubation was lower than in 2017, but the percentage of incubated nests that hatched chicks and the percentage of nests that fledged three chicks were slightly higher (**Figure 1.5**). Overall, many pairs failed to lay, but many of those that did lay were successful in hatching and fledging young. Possibly, for a high proportion of adults, severe storms and low temperatures in March may have reduced their condition to a level where laying was not possible.

Table 1.5. Shag breeding success summary statistics for two Shetland sites, 2012–18: the number of former nest sites where an adult but no nest material was recorded (Ad), trace nests (Tr), well-built but empty nests (AON), and incubated nests (Inc), the percentage of all nests which progressed to incubation (% Inc.), the percentage of incubating nests at which chicks were recorded (% H), the percentage of incubating nests from which no chicks fledged (0 Fl), the number of chicks fledged (Ch), mean brood size at fledging (Brood), and sum breeding success (SBS [=Ch/Inc]).

Sumburgh Head										
Year	**Ad**	**Tr**	**AON**	**Inc**	**% Inc**	**% H**	**0 Fl**	**Ch**	**Brood**	**SBS**
2012	51	21	14	96	73.3	30.2	76.0	36	1.57	**0.38**
2013	36	15	27	56	57.1	16.1	83.9	15	1.67	**0.27**
2014	25	2	2	108	96.4	67.6	36.1	132	1.91	**1.22**
2015	10	5	3	111	93.3	76.6	28.8	157	1.99	**1.41**
2016	12	2	6	94	92.2	74.5	36.2	113	1.88	**1.20**
2017	6	6	5	108	90.8	61.1	50.9	92	1.74	**0.85**
2018	15	11	17	68	70.8	69.1	38.2	73	1.78	**1.07**
Burravoe, Yell										
Year	**Ad.**	**Tr.**	**AON**	**Inc.**	**% Inc.**	**% H.**	**Fl. 0**	**Ch.**	**Brood**	**SBS**
2012	-	6	2	36	81.8	52.8	50.0	26	1.44	**0.72**
2013	2	2	1	39	92.9	64.1	46.2	36	1.71	**0.92**
2014	6	4	2	27	81.8	81.5	25.9	42	2.10	**1.56**
2015	2	2	0	35	94.6	54.3	51.4	28	1.65	**0.80**
2016	0	3	0	22	88.0	72.7	31.8	31	2.07	**1.41**
2017	1	2	2	26	86.7	69.2	38.5	33	2.06	**1.27**
2018	4	2	2	20	83.3	60.0	40.0	31	2.58	**1.55**

Figure 1.5. Shag breeding parameters at Sumburgh Head, 1988–2018. **Upper**: Chicks fledged per incubated nest. **Lower**: The percentage of nests that progressed to incubation (blue), incubating nests where chicks were recorded (red) and laying pairs that fledged a brood of three chicks (green).



1.4a. Black-legged Kittiwake *Rissa tridactyla*: population counts

Kittiwake nests at Compass Head were counted from the sea on 17th June. This colony has been regularly monitored from the sea since 1981. The 2018 count total was very similar to the 2017 total (45 and 46 nests, respectively; **Table 1.6**). Since 1981, the colony has substantially decreased, and the 2018 nest total is the lowest on record (**Table 1.6**).

Table 1.6. Counts of Kittiwake nests (sum total incubating, empty and trace nests) at Compass Head in 1981 (baseline count) and from 2009-2018. All counts were made from the sea.

	1981		**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Compass Head	464		146	163			90	109		65	46	45

The sites where Kittiwake breeding population size has been regularly monitored by SOTEAG, such as Compass Head and Sumburgh Head, now have few breeding pairs. In 2018, two transects of coastline with relatively large numbers of breeding Kittiwakes were surveyed by boat, as a pilot survey to determine whether these could be added to the existing regularly monitored sites.

To maximise data-return from survey days in the boat (which can be irregular because of poor weather), the two transects selected for this work were the same as those used for pilot Shag population monitoring (see p. 8 and location map). Both transects are located on the more sheltered east coast of Shetland (more reliably accessible by boat each year) but in quite different areas.

An important factor in the selection of the transects was that each was thought to have a relatively large sample size of Kittiwake and Shag nests (M. Heubeck pers. comm.). Also, one transect was as close as possible to Yell Sound and Sullom Voe where the risk of oil spills is relatively high in these areas, so seabird population monitoring here is especially useful and relevant. The east Yell and Fetlar transect was the closest possible location to Yell Sound and Sullom Voe where enough Kittiwake and Shag nests occur for long-term monitoring to be potentially viable.

In 2018, each transect was surveyed once by boat during peak incubation (judged from breeding success monitoring) and all visible Kittiwake AON and trace nests were counted and mapped.

The south Mainland transect was surveyed on 14th June and a total of 195 AON and 28 trace nests recorded. The east Yell and Fetlar transect was surveyed on 14th June and a total of 150 AON and four trace nests recorded. Both transects appear suitable for annual monitoring using one survey visit per year by boat and each has relatively large numbers of nests compared with the regularly monitored colonies. Monitoring of both transects is planned for future years, alongside the existing Kittiwake population monitoring.

1.4b. Black-legged Kittiwake *Rissa tridactyla*: breeding success

Kittiwake breeding success was monitored at the same six sites as in 2017 (**Table 1.7**). Mean breeding success in 2018 was 0.95 chicks fledged per apparently laying pair, the joint-highest value on record (with 2005) and a considerable increase on 2017, when mean breeding success was 0.09 (**Figure 1.6**). At each monitored site, breeding success was higher in 2018 than in 2017, except for at St Ninian's Isle where in 2018 it was zero (**Table 1.7**). Although no predation attempts on Kittiwake eggs, chicks or adults were witnessed at St Ninian's Isle, it seems likely that some occurred, possibly by Great Skuas or gulls, as has occurred in some previous years.

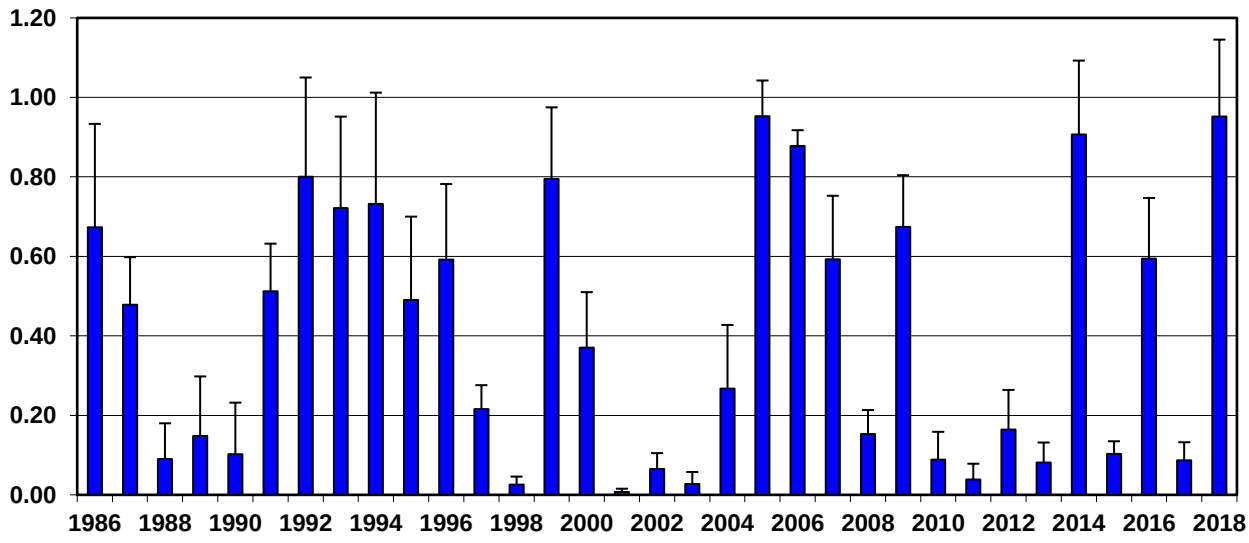
Table 1.7. Kittiwake breeding success summary statistics for six monitoring sites, 2009–18: the number of nests (Total nests [= full nests + trace nests]); the number of nests where incubation was recorded or assumed (Incubating); the percentage of nests where incubation was recorded or assumed (% Incubating [= (Incubating / Total nests) x100]); The number of sites where adults were seen but no nests (Sites adult(s) only); the percentage of incubated nests where at least one chick was known to have hatched (% Nests hatched); the percentage of hatched nests where two chicks were seen (% Nests hatched b/2); the percentage of hatched nests where one or more dead chicks were seen (% Hatched with dead); the percentage of incubated nests that failed (% Nests failed); the total number of chicks fledged (Chicks fledged); and breeding success (Sum success [= Chicks fledged / Incubating]). Mean success and standard error are calculated at Sumburgh Head only, from values of breeding success for the different plots at this site; all the other sites are treated as having only one plot.

Sumburgh Head	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Total nests	177	177	145	139	138	150	135	142	148	151
Incubating	128	151	94	93	89	115	117	119	119	116
% Incubating	72.3	85.3	64.8	66.9	64.5	76.7	86.7	83.8	80.4	76.8
Sites adult(s) only	39	22	39	35	40	29	21	29	22	30
% Nests hatched	80.5	86.8	21.3	60.2	32.6	85.2	59.8	82.4	58.8	83.6
% Nests hatched b/2	24.3	11.5	15.0	1.8	0	46.9	2.9	31.6	5.7	47.4
% Hatched with dead	3.9	8.4	10.0	26.8	20.7	2.0	2.9	4.1	17.1	0.0
% Nests failed	44.5	88.1	100	84.9	100	20.9	71.8	43.7	72.3	17.2
Chicks fledged	75	18	0	14	0	132	33	79	34	139
Sum success	**0.59**	**0.12**	**0**	**0.15**	**0**	**1.15**	**0.28**	**0.66**	**0.29**	**1.20**
Mean success	0.51	0.11	0	0.13	0	1.20	0.19	0.65	0.24	1.26
SE	0.09	0.06		0.04		0.10	0.06	0.18	0.07	0.17
No Ness	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Total nests	45	50	29	22	19	17	14	12	11	12
Incubating	39	38	21	16	14	14	13	12	10	10
% Incubating	86.7	76.0	72.4	72.7	73.7	82.4	92.9	100	90.9	83.3
Sites adult(s) only	0	0	8	9	5	4	3	8	4	0
% Nests hatched	74.4	50.0	38.1	31.3	0	71.4	61.5	66.7	50.0	80.0
% Nests hatched b/2	34.5	15.8	0	0	0	60.0	0	12.5	0	62.5
% Hatched with dead	6.9	5.3	0	20.0	0	0	0	0	10.0	0.0
% Nests failed	51.3	100	100	100	100	35.7	92.3	66.7	100	20.0
Chicks fledged	23	0	0	0	0	15	1	5	0	12
Sum success	**0.56**	**0**	**0**	**0**	**0**	**1.07**	**0.08**	**0.42**	**0**	**1.20**
St Ninian's Isle					**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Total nests					58	61	61	46	42	39
Incubating					38	54	41	44	40	35
% Incubating					67.9	88.5	68.3	95.7	95.2	89.7
Sites adult(s) only					5	6	5	5	7	3
% Nests hatched					13.2	77.8	0	81.8	70.0	22.9
% Hatched b/2					0	61.9	-	8.3	3.6	0.0
% Hatched with dead					0	0	-	2.8	14.3	0.0
% Nests failed					100	27.8	100	34.1	95.0	100.0
Chicks fledged					0	64	0	31	2	0
Sum success					**0**	**1.19**	**0**	**0.70**	**0.05**	**0.00**

Table 1.7. continued.

Ramna Geo, Burra	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Total nests	111	117	76	64	48	68	37	32	29	39
Incubating	81	74	45	24	34	64	30	28	25	30
% Incubating	73.0	63.2	59.2	37.5	70.8	94.1	81.1	87.5	86.2	76.9
Sites adult(s) only	14	11	22	15	8	13	8	11	9	1
% Nests hatched	85.2	18.9	2.2	0	35.3	6.2	66.7	75.0	76.0	80.0
% Hatched with b/2	62.3	7.1	0	0	0	0	0	4.8	5.3	75.0
% Hatched with dead	0	14.3	0	0	8.3	0	5.0	4.8	21.1	0.0
% Nests failed	17.3	98.6	100	100	70.6	100	93.3	85.7	100	26.7
Chicks fledged	103	1	0	0	10	0	2	4	0	35
Sum success	**1.27**	**0.01**	**0**	**0**	**0.29**	**0**	**0.07**	**0.14**	**0**	**1.17**
Esha Ness									**2017**	**2018**
Total nests									38	32
Incubating									27	24
% Incubating									71.1	75.0
Sites adult(s) only									0	8
% Nests hatched									3.7	87.5
% Hatched with b/2									0.0	52.4
% Hatched with dead									0.0	0.0
% Nests failed									96.3	25.0
Chicks fledged									1	28
Sum success									**0.04**	**1.17**
Burravoe, Yell	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Total nests	113	135	117	128	130	114	98	100	82	87
Incubating	99	107	87	94	99	95	84	84	69	71
% Incubating	87.6	79.3	74.4	73.4	76.2	83.3	85.7	84.0	84.1	81.6
Sites adult(s) only	4	8	12	9	15	16	14	12	9	16
% Nests hatched	72.7	69.2	28.7	51.1	40.4	76.8	73.8	86.9	72.5	94.4
% Hatched with b/2	51.5	6.8	8.0	43.8	2.5	60.3	13.1	58.9	12.0	55.3
% Hatched with dead	1.4	8.1	4.0	2.1	15.0	1.4	4.9	2.7	4.0	2.1
% Nests failed	35.4	53.3	78.2	59.6	87.9	32.6	79.8	29.8	87.0	32.4
Chicks fledged	95	52	20	49	12	100	17	89	10	69
Sum success	**0.96**	**0.49**	**0.23**	**0.52**	**0.12**	**1.05**	**0.20**	**1.06**	**0.14**	**0.97**

Figure 1.6. Mean Kittiwake breeding success (+ SE) at monitored sites (4–7 per year), 1986–2018. Breeding success is defined as chicks fledged per apparently laying pair.



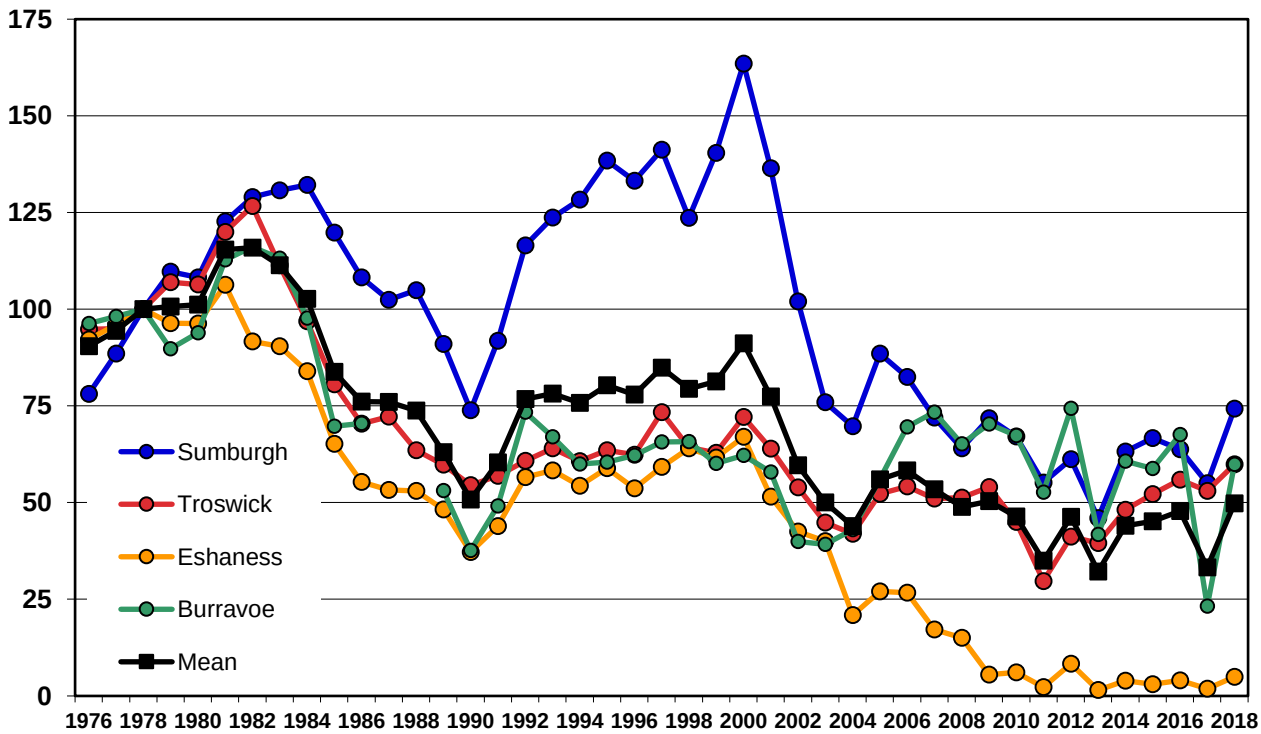
1.5a. Common Guillemot *Uria aalge*: population counts

In 2018, mean population counts were higher than in 2017 at all four monitored sites (**Table 1.8)**. The mean population index in 2018 was 49.8, the highest value since 2009 and an increase of 49.5% on 2017 (**Figure 1.7**). The 2018 mean population index continues the pattern of low but comparatively stable mean index values since 2009. At all four sites, variation in the five population counts made at each site was lower than in 2017. (**Table 1.8)**. There were relatively substantial percentage increases in numbers at Burravoe and Esha Ness, although this is partly an artefact of total numbers at these sites being low compared with at Sumburgh and Troswick, especially at Burravoe where there was total breeding failure in 2017 (**Table 1.8)**.

Table 1.8. Common Guillemot population counts summary statistics, 2017–18: total counts (n), range, mean, standard deviation (SD), coefficient of variation (CV), % change since 2017 (% ch.) and population index where 1978 = 100 (Index). The population counting unit for Common Guillemot is individual birds.

Colony	Unit	Year	n	Range	Mean	SD	CV	% ch.	Index
Sumburgh Head	Individuals	2017	5	682–829	729.4	60.45	0.08		55.0
		2018	5	965–1029	985.8	25.65	0.03	+35.2	74.3
Troswick Ness	Individuals	2017	5	278–326	291.4	19.69	0.07		53.0
		2018	5	313–352	329.6	14.35	0.04	+13.1	59.9
Esha Ness	Individuals	2017	5	0–21	13.0	8.57	0.66		1.9
		2018	5	26–43	33.4	6.58	0.19	+156.9	4.9
Burravoe	Individuals	2017	5	3–194	77.4	75.82	0.98		23.2
		2018	5	189–217	199.8	10.85	0.05	+158.1	59.9

Figure 1.7. Annual population index (1978 = 100) of Common Guillemots (individuals) at four monitoring sites and the mean index for the four sites, 1976–2018.



1.5b. Common Guillemot *Uria aalge*: breeding success and chick diet at Sumburgh Head

The Sumburgh Head breeding success plot was checked daily from 20th April until 31st July. In 2018, breeding success was 0.54 chicks fledged per egg laid (**Table 1.9** and **Figure 1.8**), up from 0.42 in 2017 and equal to the long-term mean of 0.54 (1989–2017).

At the start of each daily check the total number of adults attending the site was recorded. As in previous years, the number of adults fluctuated greatly at the start of the season, with a peak of 192 on 21st April, down to 0 on 23rd, 24th and 25th, back up to 184 on 27th, down to 20 on 2nd May, back up to 165 on 5th May, falling to 41 on 8th May, back up to 159 on 11th May and 121 on 15th May. Adult attendance thereafter remained relatively stable, with over 100 present every day until 20th July (**Figure 1.9**).

The first egg was seen on 8th May (**Table 1.9** and **Figure 1.9**), after which laying was rapid, with the median laying date falling on the 17th or 18th May (laying data are almost entirely post-event observations, precluding greater phenological precision).

The first chicks (three) were seen on 9th June, after which chick numbers increased every day, up to a peak of 75 on 24th, 25th, 27th, 28th and 29th June (**Figure 1.9**). The first chick was assumed to have fledged on the evening of 1st July. Chick numbers decreased through July until the 30th, when the last two chicks were assumed to have fledged. Great Black-backed Gulls and Herring Gulls were seen around the colony occasionally through the chick-rearing period, but no instances of predation were observed.

Table 1.9. Common Guillemot breeding parameters at Sumburgh Head, 2008–2018, including breeding success calculated as chicks fledged per egg laid.

	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Attended sites	169	169	164	163	155	158	153	150	142	176
Sites with egg laid	144	154	142	140	98	122	135	132	130	134
% sites laid	85%	91%	87%	86%	63%	77%	88%	88%	92%	76%
First egg seen	2/5	2/5	29/4	4/5	7/5	6/5	5/5	4/5	9/5	8/5
Median laying date	10/5	9/5	9/5	14/5	19/5	16/5	14/5	13/5	15/5	17-18/5
% Hatched first egg	65%	68%	21%	68%	11%	66%	70%	74%	68%	63%
Chicks fledged	91	78	2	55	0	66	70	94	54	72
Fledged/site	0.54	0.46	0.01	0.34	0.00	0.42	0.46	0.63	0.38	0.41
Fledged/egg	**0.63**	**0.51**	**0.01**	**0.39**	**0.00**	**0.54**	**0.52**	**0.71**	**0.42**	**0.54**

Figure 1.8. Common Guillemot breeding success in the study plot at Sumburgh Head, 1989–2018.

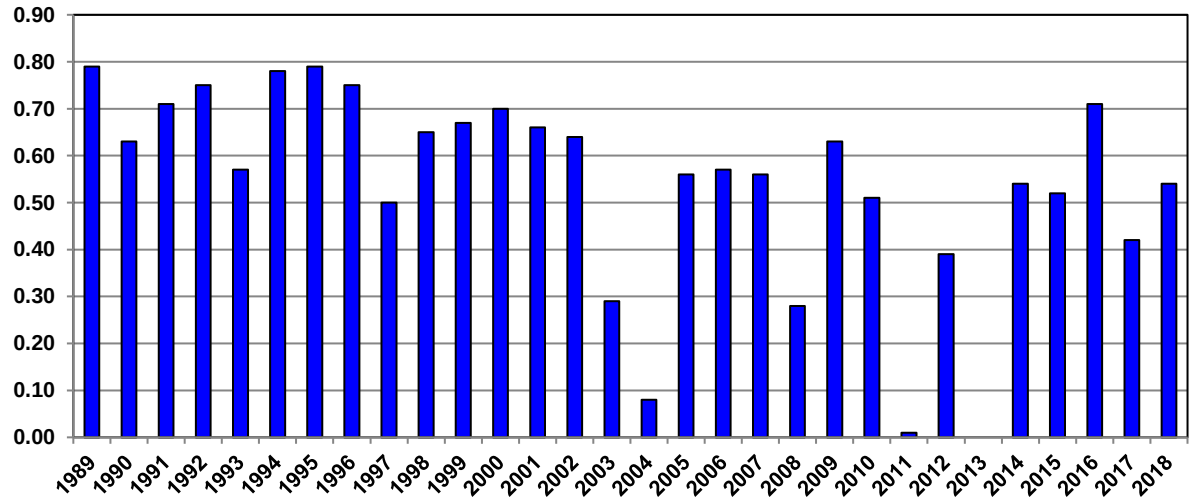


Figure 1.9. Day to day summary of the breeding success plot at Sumburgh Head in 2018: the daily number of adults (A), first eggs and relay eggs (B), and first egg chicks and relay egg chicks (C), the cumulative number of fledged first-egg chicks and relay-egg chicks (D), and the number of lost eggs and chicks, that were missing from the previous day or known to have been lost that day (E).

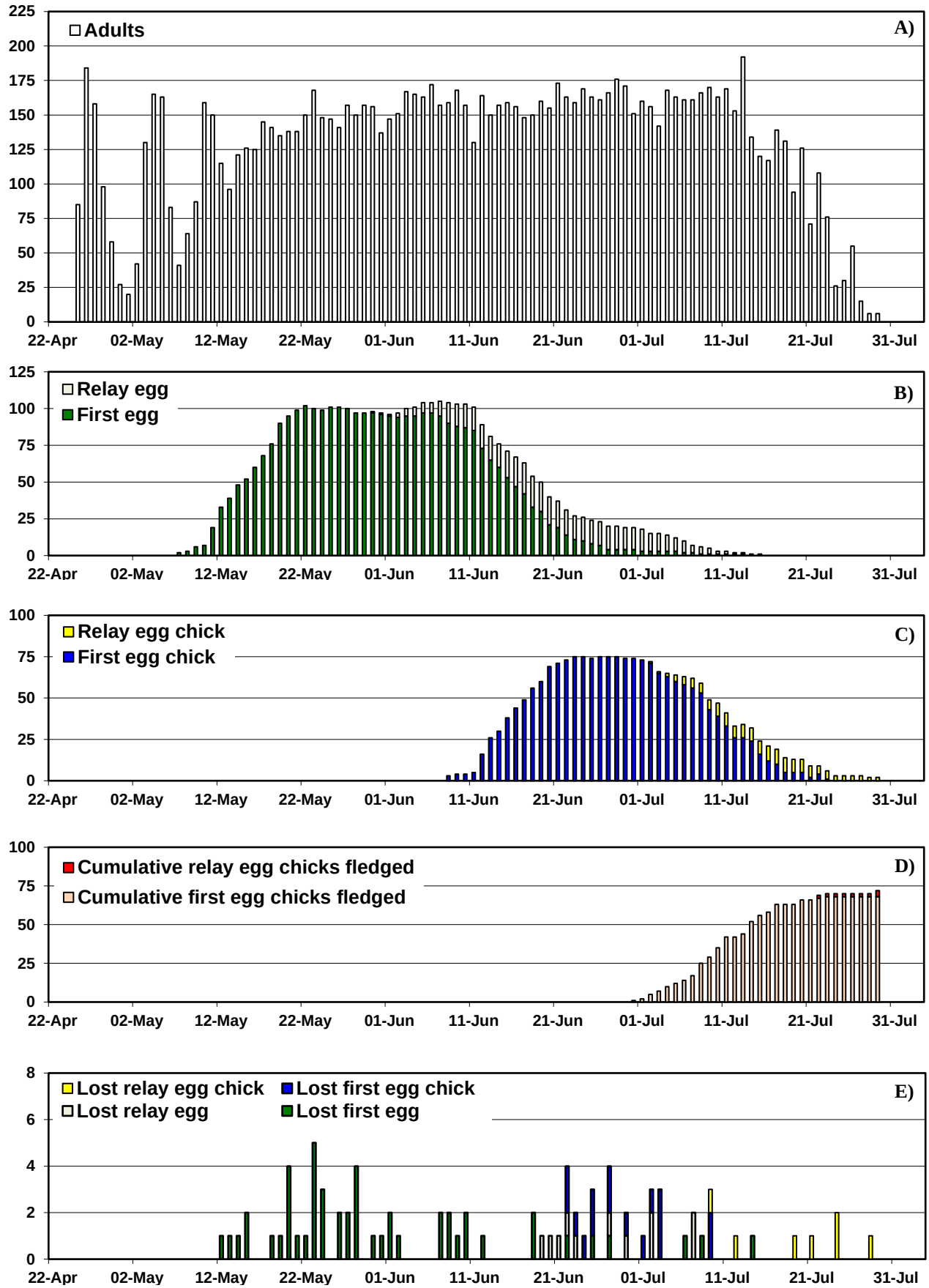


Table 1.10. Outcome (%) of Common Guillemot breeding attempts in the study plot at Sumburgh Head.

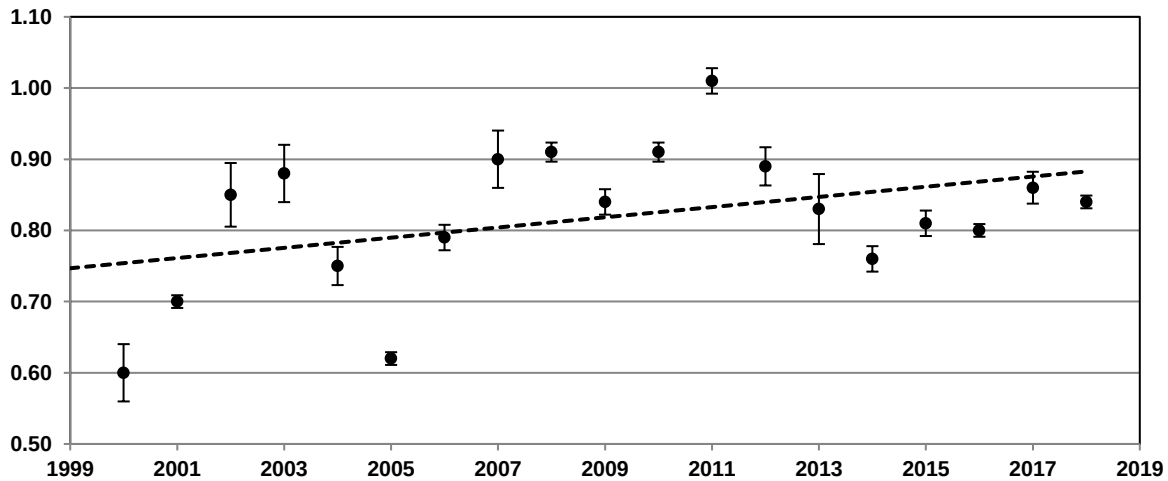
	2014	2015	2016	2017	2018
Number of breeding pairs	122	135	132	130	134
Lost first egg before possible hatching (< 29 days), no relay	11.5	8.1	9.8	16.9	18.7
Lost first egg around possible hatching (29–37 days), or chick died hatching	7.4	7.4	3.0	2.3	0.7
Presumed infertile first egg, incubated 38+ days	2.5	3.7	4.5	1.5	1.5
Lost relay egg before possible hatching (< 29 days)	4.9	7.4	3.8	9.2	7.5
Lost relay egg around possible hatching (29–37 days), or chick died hatching	0.8	0.0	0.8	1.5	0.7
Presumed infertile relay egg, incubated 38+ days	0.8	0.0	0.0	0.0	0.0
First egg chick missing before presumed fledging (< 15 days)	12.3	8.1	3.8	23.8	11.9
First egg chick seen dead	0.0	5.2	0.8	3.8	0.0
First egg chick seen predated	0.8	0.7	0.0	0.0	0.0
First egg chick missing 15+ days, assume predated	2.5	5.9	0.0	3.1	0.0
Relay chick missing before presumed fledging (< 15 days)	3.3	0.7	2.3	0.0	4.5
Relay chick seen dead	0.0	0.0	0.0	0.0	0.0
Relay chick missing 15+ days, assume predated	0.0	0.7	0.0	0.0	0.7
Fledged chick from first egg	50.8	50.4	68.9	40.8	50.7
Fledged chick from relay egg	3.3	1.5	2.3	0.8	3.0

During the five Sumburgh Head population monitoring counts, adult attendance at the breeding success plot (mean of 120 adults per 100 breeding pairs) was slightly higher than in 2017 (mean of 116), giving a mean *k*-value of 0.84 in 2018, compared with 0.86 in 2017 (**Table 1.11**). The linear regression of *k*-values on years (2000-2018) suggests that, on average, *k*-values are slowly increasing (**Figure 1.10**).

Table 1.11. Population counts of Common Guillemots in the Sumburgh Head breeding success plot in 2018 (with mean and standard deviation), the total number of breeding pairs in the plot in 2018, and derived *k*-values (with mean and standard deviation).

Count date in 2018	**3/6**	**6/6**	**8/6**	**13/6**	**16/6**	**Mean**	**SD**
Time (BST)	1400	1530	1300	1400	1300		
Total birds in plot (n)	160	163	157	164	157	160.2	3.27
Total breeding pairs (b)	134	134	134	134	134		
***k*-value breeding pairs (b/n)**	**0.84**	**0.82**	**0.85**	**0.82**	**0.85**	**0.84**	**0.02**

Figure 1.10 Mean (± SE) *k*-values at the Common Guillemot breeding success plot on the dates of the five annual counts of adults in the population monitoring plots, 2000–18.



Between 24th June and 6th July inclusive, Guillemot chick feeding watches were carried out on nine days at the standard chick diet monitoring plot at Sumburgh (which includes the breeding success plot). During watches, each adult Guillemot flying in to the plot was checked to see if it was carrying a fish, and if so the adult was watched to see if its fish was presented to a chick. The identification of each fish presented to a chick was recorded to the lowest possible taxon and the time recorded. All watches lasted 90 minutes, from 0900 to 1030 BST.

In 2018, a total of 478 fish were observed during feeding watches; 79.7% were gadids and 10.9% sandeels (**Table 1.12**). This contrasted with 2017, when gadids comprised 50.7% of chick diet and sandeels 46.4% (**Figure 1.12**). On each day that feeding watches were carried out in 2018, most fish presented to chicks were gadids (>60% each day) and sandeels occurred relatively infrequently (≤20% each day; **Figure 1.11**). As in previous years, the occurrence of clupeids and squid was rare in 2018 (**Table 1.12** & **Figure 1.12**).

Table 1.12. The percentages (and number) of different general prey types and sizes (n prey = 492) fed to Common Guillemot chicks at the Sumburgh Head chick diet monitoring plot, during feeding watches on 9 dates in 2018 (date range: 24/6–6/7).

Prey type	Large	Medium	Small	Total
Sandeel	3.1 (15)	7.3 (35)	0.4 (2)	10.8 (52)
Gadoid	2.9 (14)	72.6 (347)	4.2 (20)	79.7 (381)
Clupeid	1.5 (7)	5.7 (27)	0.2 (1)	7.3 (35)
Squid	0.4 (2)	0	0	0.4 (2)
Not identified / too quick	-	-	-	1.7 (8)

Figure 1.11. The percentages of different general prey types (n prey = 492) fed to Common Guillemot chicks at Sumburgh Head during feeding watches on 9 dates in 2018 (date range: 24/6–6/7).

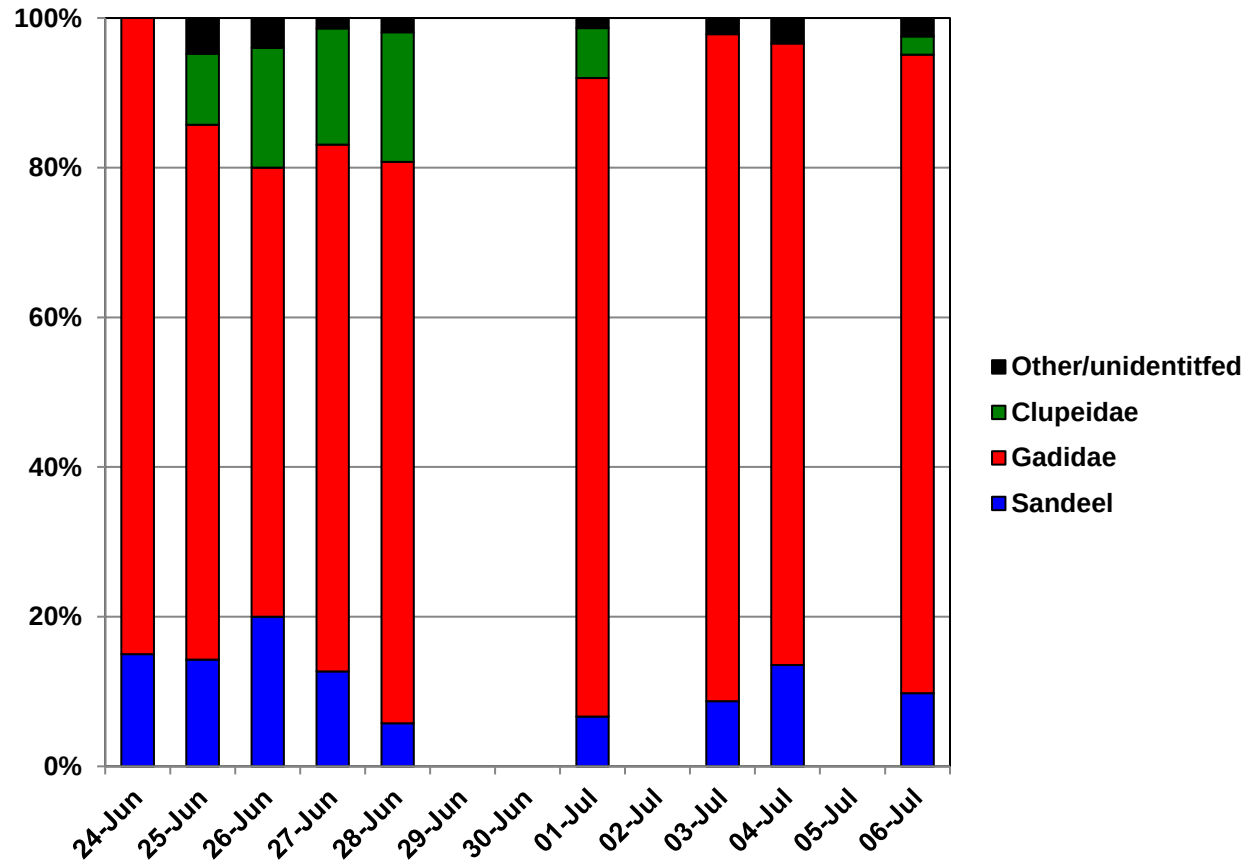
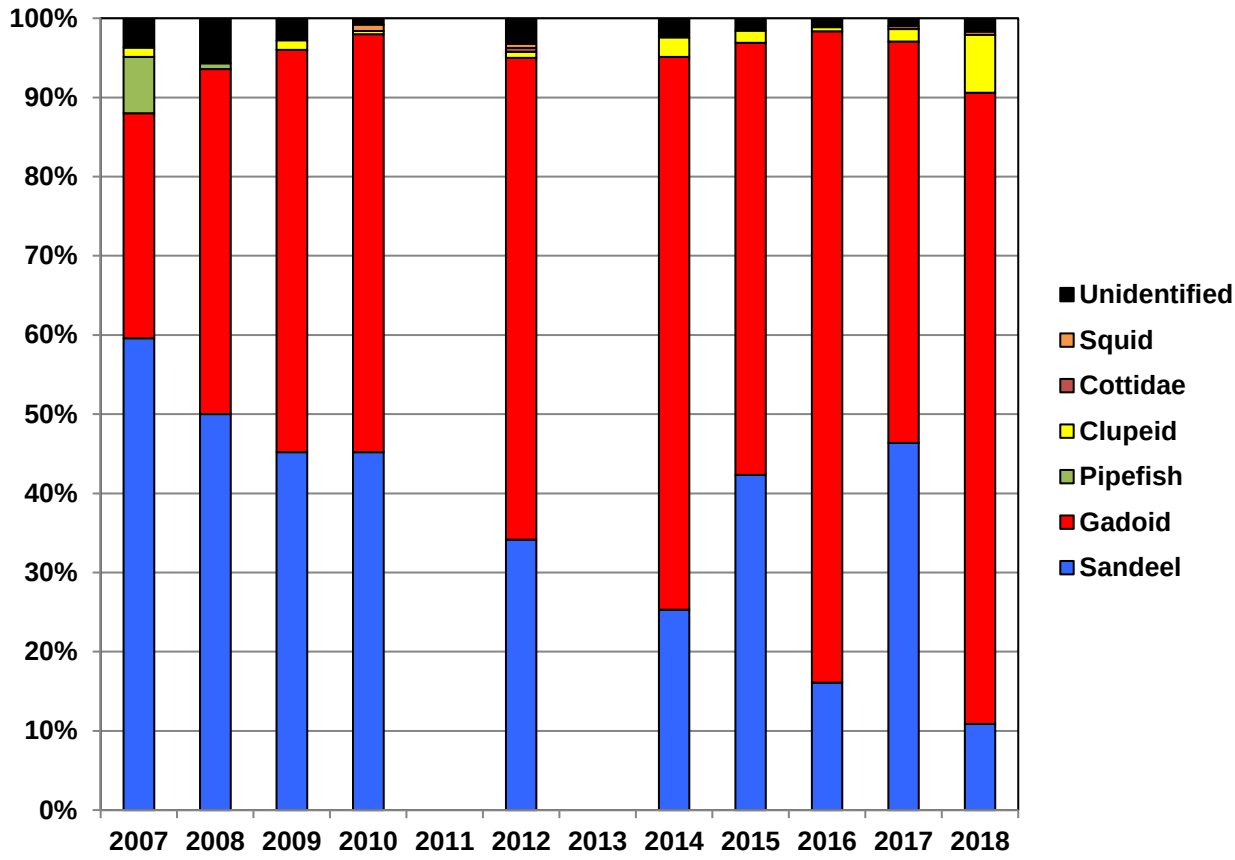


Figure 1.12. The percentages of different general prey types fed to Common Guillemot chicks at Sumburgh Head during feeding watches in 2007–2018. Prey sample sizes: 2007 = 324; 2008 = 140; 2009 = 250; 2010 = 250; 2012 = 401; 2014 = 629; 2015 = 515; 2016 = 790; 2017 = 509, 2018 = 492. Too few chicks survived long enough in 2011 and 2013 for meaningful observations.



1.5c. Common Guillemot *Uria aalge*: breeding success at Burravoe, Yell

The usual plot was monitored, as in 2012–17. The presence/absence of eggs is more difficult to confirm at this plot than at the Sumburgh Head plot because viewing distances are greater. When an adult was observed sitting tight (ST) throughout two consecutive monitoring visits then an egg was assumed to have been laid, even if no egg was ever seen (**Table 1.13**).

In 2017, breeding success was zero because the entire plot was deserted in mid-June – an unprecedented event in SOTEAG monitoring history. In contrast, 2018 was a comparatively normal breeding season and breeding success was relatively high at 0.69 chicks fledged per egg laid (**Table 1.13**). Egg laying in 2018 started late in comparison with previous years (**Table 1.13**). Reasons for this are unclear, but breeding may have been delayed by the harsh weather in March. Considering the events in 2017 though, possibly there is an alternative but unknown disturbance factor at the Burravoe plot.

Table 1.13. Common Guillemot breeding parameters at Burravoe, 2014–18, including breeding success calculated as young fledged per site where an egg was assumed to have been laid. Adults seen sitting tight during two or more consecutive checks of the colony (ST 2+) were assumed to be incubating and to have laid (a). Those seen sitting tight during just one check (ST1), or during two or more non-consecutive checks (ST2 non-consecutive), were assumed not to have laid an egg (b).

	2014	**2015**	**2016**	**2017**	**2018**
Date range visited	12/5–6/8	5/5–10/8	9/5–29/7	3/5–16/6	11/5–9/8
Checks (mean interval in days)	27 (3.2)	27 (3.6)	27 (3.0)	14 (3.1)	26 (3.5)
Date first egg seen / assumed incubation	12/5	5/5	18/5	18/5	25/5
Assumed laid, ST 2+ (a)	**90**	**97**	**104**	**24**	**85**
ST 1 / ST2 non-consecutive to 9/8 (b)	19	9	14	17	13
Other regularly attended sites (c)	34	29	15	77	23
% assumed to have laid (a/[a+b+c])	62.9%	71.9%	78.2%	20.3%	70.2%
Sites where chicks were seen	57	51	66	0	61
Minimum % hatched	63.3%	52.6%	63.5%	0	72.8%
Date first assumed fledged	30/6–3/7	29/6–3/7	8–11/7	-	19-21/7
Number assumed fledged (d)	55	49	62	0	59
Success (d/a)	**0.61**	**0.51**	**0.60**	**0.00**	**0.69**

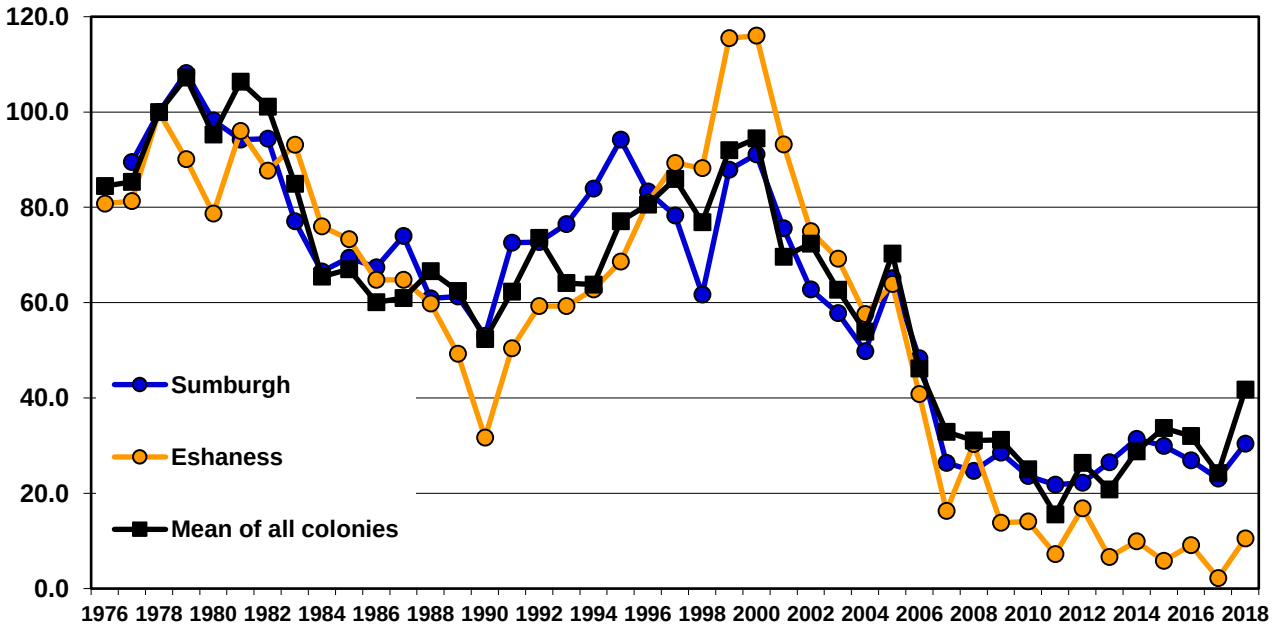
1.6a. Razorbill *Alca torda*: population counts

In 2018, the mean number of Razorbills at all four monitoring sites was higher than in 2017 (**Table 1.14**). The mean population index for 2018 was 41.7, the highest record since 2006 (**Figure 1.13**). However, the population counts of this species in June continue to be variable across all count visits (5 in total) and at all sites, with comparatively low numbers at all sites other than Sumburgh Head (**Table 1.14**). The 2018 population index for Sumburgh Head had increased slightly since 2017 but aligned with the general pattern since 2007 of a small but stable population at this site (**Figure 1.13**).

Table 1.14. Razorbill population counts summary statistics, 2017–18: total counts (n), range, mean, standard deviation (SD), coefficient of variation (CV), % change since 2017 (% ch.) and population index where 1978 = 100 (Index). The population counting unit for Razorbills is individual birds.

Colony	Unit	Year	n	Range	Mean	SD	CV	% ch.	Index
Sumburgh Head	Individuals	2017	5	42–92	66.8	17.92	0.27		23.1
		2018	5	74–112	88.0	18.09	0.21	+31.7	30.4
Troswick Ness	Individuals	2017	5	3–13	7.8	3.63	0.47		37.1
		2018	5	13–22	16.6	3.36	0.20	+112.8	79.0
Esha Ness	Individuals	2017	5	1–3	1.6	0.89	0.56		2.2
		2018	5	4–10	7.6	2.51	0.33	+375.0	10.5
Burravoe	Individuals	2017	5	2–7	5.6	2.07	0.37		34.6
		2018	5	6–10	7.6	1.52	0.20	+35.7	47.0

Figure 1.13. Annual population index (1978 = 100) of Razorbills (individuals) at Sumburgh and Esha Ness, and the mean index for these two sites plus Troswick and Burravoe, 1976–2018.



1.6b. Razorbill *Alca torda*: breeding success at Sumburgh Head

For the 8th consecutive year, Razorbill breeding success was monitored at Sumburgh Head using the same marked photographs and adding on new nest sites as they became apparent. The presence and number of attending adults and the presence of an egg or chick was recorded at potential nest sites. If no egg or chick was seen, pairs were assumed to have laid an egg if an adult was recorded as sitting tight (ST) on two consecutive monitoring visits (**Table 1.16**). An incubation period of 35 days, a minimum fledgling period of 15 days and the development of the juvenile plumage were all used to help assess probable hatching periods, chick ages and whether chicks could have fledged or not. The monitored nest sites are located all around Sumburgh Head, in areas where Razorbills are clearly visible, using a telescope and safe vantage points. The number and distribution of nests at Sumburgh Head is such that for this species the whole site is treated as one breeding success plot, rather than it being divided into multiple plots.

The first date that an egg was seen was 5th May. An egg and/or chick was seen at 61 sites in total, but the breeding pairs grand total (81) also included a further 20 sites where an adult was seen sat tight on two or more consecutive monitoring visits, but no egg or chick was seen. In total, chicks were seen at 41 sites and 37 chicks were judged to have fledged (**Table 1.15**). Breeding success was therefore 0.46 chicks fledged per breeding pair, a decrease of 23.3% from the 2017 total of 0.60 (**Table 1.15**).

Table 1.15. Razorbill breeding parameters at Sumburgh Head, 2013–2018, including breeding success calculated as young fledged per site where an egg was assumed to have been laid. Adults seen sitting tight during two or more consecutive checks of the colony (ST2+) were assumed to be incubating and to have laid (a). Those seen sitting tight during just one check (ST1), or during two or more non-consecutive checks (ST2 non-consecutive), were assumed not to have laid an egg (c).

	2013	**2014**	**2015**	**2016**	**2017**	**2018**
Date range visited	3/5–6/8	7/5–26/7	6/5–6/8	3/5–17/8	4/5–1/8	5/5–6/8
Checks (mean interval in days)	41 (2.4)	26 (3.1)	38 (2.4)	54 (2.0)	51(1.7)	47(2)
First egg seen / assumed incubation	8/5	7/5	9/5	5/5	9/5	5/5
ST2+ checks, no egg seen (a)	25	35	16	11	9	20
Egg / chick seen (b)	18	23	51	70	59	61
Breeding pairs (a + b)	**43**	**58**	**67**	**81**	**68**	**81**
ST1 / ST2 non-consecutive to 6/8 (c)	15	10	15	16	14	7
Other attended sites	14	19	14	13	16	16
Sites where chicks were seen	13	32	40	57	45	41
Date first assumed fledged	16/7	21–25/6	23–30/6	30/6–2/7	3/7	23-27/6
Chicks assumed fledged (d)	10	30	38	52	41	37
Success: d/(a+b)	**0.23**	**0.52**	**0.57**	**0.64**	**0.60**	**0.46**

2. Pre-breeding season population counts of Black Guillemots *Cepphus grylle*

Counts of pre-breeding Black Guillemots are only attempted in April (before egg laying) in dry conditions with little or no sea swell and little or no wind (or at most an offshore wind of Force 4). Ideally, two counts of each monitored coastal site are made each year, but this is not always possible due to limited days in April with the right conditions. During surveys, attempts are made to flush any birds on land out on to the sea, to join displaying groups that can be readily counted. The willingness of individuals to leave the land varies from day to day, however, and diminishes through April. Also, after about 0900 BST, birds tend to disperse to feed, but the timing of this varies, with birds occasionally departing the colony area unusually early. Counts are therefore subject to high variation, sometimes including low counts that are difficult to interpret.

In 2018, strong westerly and southerly winds and heavy sea swells in April reduced the number of days in the month when counts could be made. Efforts were focused on surveying the standard annual monitoring sites, which were all visited at least once in good conditions. In 2017, Black Guillemots were seen around the tanker jetties at Sullom Voe oil terminal and breeding was suspected. Therefore, in 2018, all the oil terminal jetties and piers were surveyed as a new monitoring site.

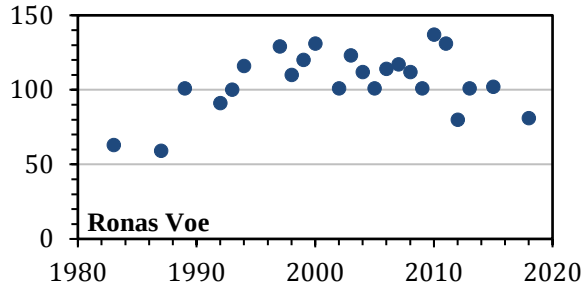
Changes in count totals since the most recent previous surveys were variable across the monitoring sites; numbers had increased at Kirkabister, Aithsetter, West Burra and Mousa, but had decreased at Ronas Voe, Hillswick Ness, Levaneap, and Mu Ness to Wats Ness (**Table 2.1**). The greatest increase was recorded at Aithsetter (+38.7%) and decrease at Mu Ness to Wats Ness (-51.2%). The low counts at Mu Ness to Wats Ness and at Leveneap in 2018 were surprising, as conditions were good and tight groups of displaying birds remained close inshore throughout the count. Future surveys of these sites may indicate whether the 2018 count totals represent genuine population decreases. At most of the monitored sites, numbers of Black Guillemots have generally been stable across many years, with the exceptions of slight long-term increases at Hillswick Ness and West Burra and a decrease at Mousa (**Figure 2.1**).

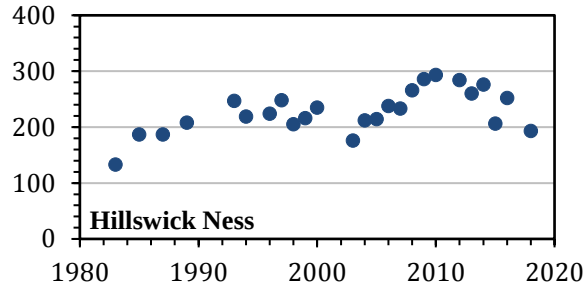
The survey at Sullom Voe oil terminal recorded a total of 88 adults, displaying and flying to and from apparently active nest holes and crevices. The terminal jetties and piers cover an area of approximately 0.3km^2. Given this limited area and that the habitat is entirely artificial, the 2018 count total represents a relatively large and extremely unusual Shetland colony (the natural habitat within c.10km of the terminal appears unsuitable for nesting). As such, this colony is to be added in to the annual monitoring scheme.

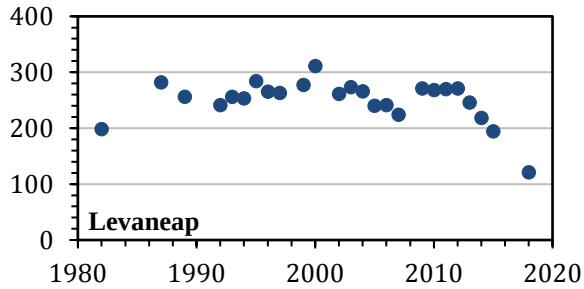
Table 2.1. Counts of pre-breeding adult Black Guillemots at ten monitored sites, 2010–18. Data presented are the highest early spring day counts for the year, with sites listed north to south. Percentage change is between 2018 and the most recent previous count (% ch.). Sullom Voe Terminal was first surveyed in 2018. In 2016 and 2017 Black Guillemots counts for the national census of sections of the Shetland coastline elsewhere were prioritised over the monitoring sites (see 2016-17 SOTEAG ornithological monitoring reports).

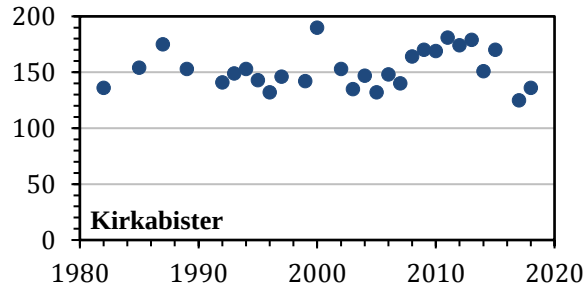
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**% ch.**
Ronas Voe	137	131	80	101		102			81	-20.6
Sullom Voe Terminal									88	
Hillswick Ness	293	249	284	260	276	206	252		193	-23.4
Levaneap	268	270	271	246	218	194			121	-37.6
Kirkabister	169	181	174	179	151	170		125	136	+8.8
Mu Ness - Wats Ness		264	351	285	286	287			140	-51.2
Aithsetter	112	125	114	116	112	112		62	86	+38.7
West Burra		258	279	244	228	140		196	251	+28.1
Mousa	194	182	176		154	132	106		112	+5.7
Virkie-Boddam	120	136	132	131	115	119		113	96	-15.0

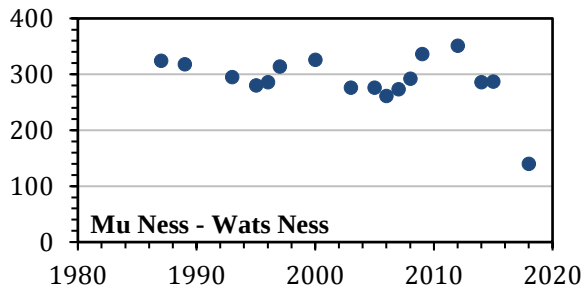
Figure 2.1. Counts of pre-breeding adult Black Guillemots at nine monitored sites, 1982–2018. Data presented are the highest early spring day counts for the year.

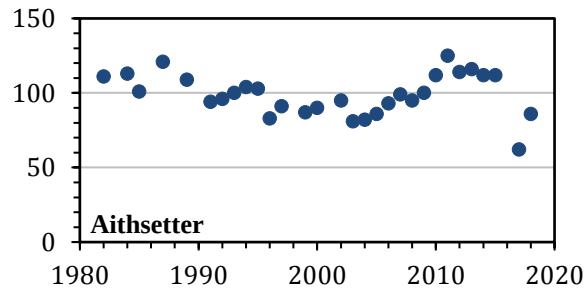


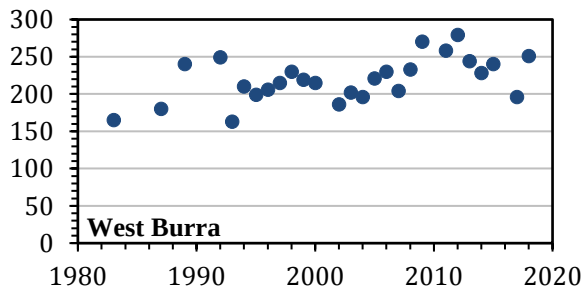


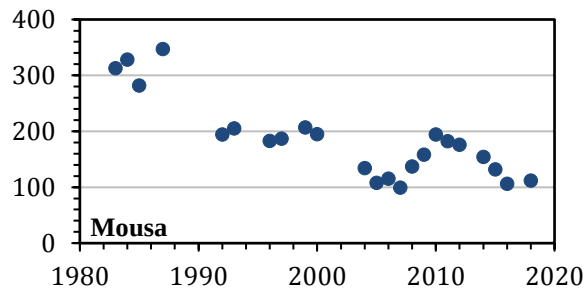


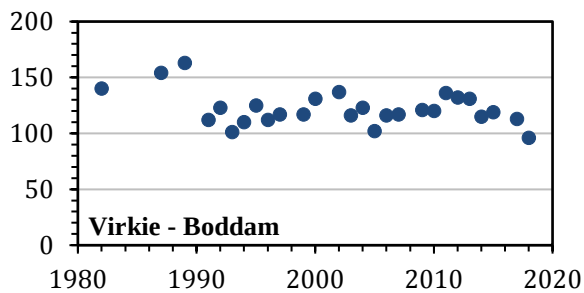












3. Monitoring of breeding Red-throated Divers *Gavia stellata*

The study area of moorland and lochs at Northmavine (between Sullom Voe and St Magnus Bay) has been surveyed for breeding Red-throated Divers biennially since 1994 (but annually in 1981–83 and 1989–93). Up to 2011, two checks were made to establish the number of breeding pairs, but in 2013, 2015, 2017 and 2018 follow-up visits were made later in the summer to determine the outcome of breeding attempts and measure breeding success. Red-throated Divers make a shallow nest scrape (or several scrapes) at the water's edge and lay a clutch of one or two eggs, so are capable of fledging up to two chicks in a season.

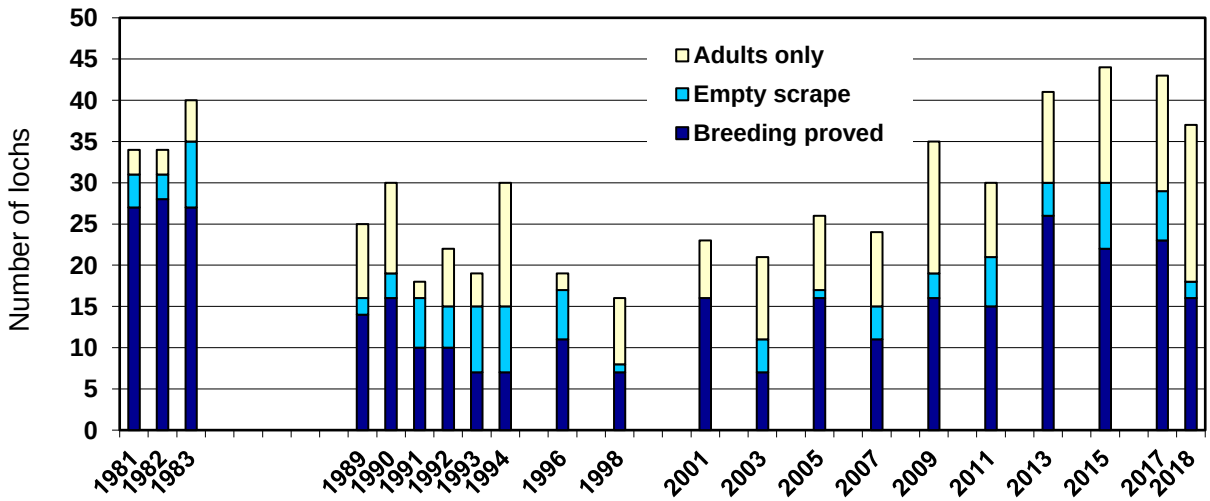
In 2018, all 71 lochs and pools in the study area were visited. The first visits were made between 18th and 26th June, when 13 breeding pairs were confirmed. A further three breeding pairs were confirmed during the second visits (10th to 14th July). During the third visits (8th and 9th August) only seven lochs still had adults present, and all had large chicks of a size that could fledge (therefore all were assumed to have fledged; eight chicks in total).

In 2018, the total number of confirmed breeding pairs was low in comparison with the three previous years, but breeding success was relatively high (**Table 3.1, Figure 3.1**). There was a relatively high number of lochs this year where only adults were recorded and no nest scrapes (**Table 3.1, Figure 3.1**). As with some of the other monitored species, possibly the severe weather in March caused the condition of some returning divers to be relatively poor, to the extent that breeding was not attempted.

Table 3.1. Red-throated Diver nesting activity and breeding success in the Northmavine study area in 2013, 2015, 2017 and 2018.

Northmavine study area	**2013**	**2015**	**2017**	**2018**
Lochs with adults present only	11	14	14	19
Lochs with empty nest scrapes only	4	8	6	2
Confirmed breeding pairs	**26**	**22**	**23**	**16**
Broods known to have hatched	15	9	11	8
Broods assumed to have fledged	8	7	9	7
Chicks assumed to have fledged	10	10	10	8
Mean brood size at fledging	1.25	1.43	1.11	1.14
Breeding success	**0.38**	**0.45**	**0.43**	**0.50**

Figure 3.1. Red-throated Diver nesting activity in the Northmavine study area, 1981–2018.



4. Population counts of moulting Common Eiders *Somateria mollissima*

A Shetland-wide census of moulting Common Eiders in August 2015 located a total of 4,610 birds (including juveniles). The next census is scheduled for August 2019. In the years between the Shetland-wide censuses, counts of moulting Common Eiders are limited to South and North Yell Sound and Sullom Voe (i.e. the Sullom Voe Harbour Oil Spill Plan area).

Southern Yell Sound, including Dales Voe, Colla Firth, and Lunna Ness, was surveyed on 10th August using a telescope from various vantage points on land. In total, 126 individuals were recorded, up from 55 in 2017 but still a low count compared with totals in 2009-2013 (**Table 4.1**). Mostly, the birds were in small flocks (<30 individuals) located close to mussel lines. No definite males were seen; the total count comprised female/juvenile-types only.

North Yell Sound and Sullom Voe were surveyed by boat on 21st August. In North Yell Sound, 15 individuals were recorded in total (**Table 4.1**), this year located at Little Holm (14) and Skea Skerries (one). All were female/juvenile-type birds.

The Sullom Voe total was 156 individuals, compared with 146 in 2017 (**Table 4.1**). The largest flock was around Ungam and comprised 62 males and 10 female/juvenile-types. A flock of 10 female/juvenile-types was off Scatsta Ness and a flock of four female/juvenile-types was under the piers of Jetty 2 of the oil terminal. The only other birds seen were just north of Jetty 4: a flock of 60, comprising 30 males and 30 female/juvenile-types.

Table 4.1. Counts of moulting Common Eiders in Yell Sound and Sullom Voe, 2006–18 (nc = no count; totals with incomplete coverage in italics).

Area	**2006**		**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
South Yell Sound	109		666	771	386	499	494	151	240	86	55	126
North Yell Sound	0		3	nc	nc	12	nc	0	8	5	nc	15
Sullom Voe	0		4	nc	nc	72	118	59	160	210	146	156
Total	**109**		**673**	***771***	***386***	**583**	***612***	**210**	**408**	**301**	***201***	**297**

5. Winter counts of seaduck and diving seabirds

5.1. Hascosay, Bluemull and Colgrave Sounds (HBC), and South Unst.

A survey on 2nd January was in perfect conditions throughout, with glass-calm seas and thin, high cloud (2/8 coverage). The normal route was surveyed in reverse because of a forecast of a southeasterly breeze by early afternoon, but this only materialized as the survey ended. The total of 1,335 Common Eiders was similar to that recorded in the previous three winters (**Table 5.1**), the main concentrations being 1,100 feeding in open water 1 km south of Linga (approximate depth of water = 25m), 60 at salmon cages in Sand Wick, Yell, 48 at salmon cages in Djuba Wick, Hascosay, and 60 in open water in Hascosay Sound. None were seen at the salmon cages off Uyea, or at the extensive mussel lines in Skuda Sound or Basta Voe. A lone female King Eider was at mussel lines in Mid Yell Voe, while a male Surf Scoter was with the main Common Eider flock, presumably the returning male from 2016/17. Small numbers of Long-tailed Duck were scattered throughout the area, but the main concentration (564) was associated with the salmon cages along the west side of Uyea; for the first time a flock (50) was also found feeding at the salmon cages in Djuba Wick. The presumed returning White-billed Diver was to the north of Urie Lingey, while the rather high count (for recent winters) of 36 Great Northern Divers comprised 17 along the HBC route, 11 off south Unst, and eight in Basta Voe. Large numbers of Shags and Cormorants were mostly in feeding flocks rather than in roosts, while the excellent sea and light conditions will have contributed to the rather high count of Black Guillemots, many of which were in transitional moult and easier to see than in full winter plumage. This was the only winter boat survey of 2018. Most of the surveys for the 2017/18 winter period were completed in 2017 and surveys for the 2018/19 winter period began in 2019, due to strong winds and heavy seas preventing surveys in December 2018.

As in January 2017, Basta Voe was surveyed in addition to the standard survey transect (**Table 5.2**). As in previous years, despite the extensive mussel lines in Basta Voe, no **Common Eiders** were seen in the area; they appear to prefer feeding at natural sites or at salmon cages.

Table 5.1. Counts of seaduck and diving seabirds in Hascosay, Bluemull and Colgrave Sounds (HBC), and off South Unst. Count conditions: ** = moderate to good, *** = good or excellent throughout.

Winter	**2007/08**	**2009/10**	**2011/12**	**2012/13**	**2013/14**	**2015/16**	**2016/17**	**2017/18**
Date	2/12	23/12	22/1	8/2	18/2	17/1	16/2	2/1
No. observers	3	4	2	3	3	3	3	3
Count Conditions	***	***	**	***	**	***	***	***
Common Eider	1241	1084	978	1458	1394	1319	1305	1335
King Eider	0	0	0	0	2	0	0	1
Long-tailed Duck	144	317	365	555	720	707	930	764
Common Scoter	0	3	1	2	4	2	0	2
Velvet Scoter	0	0	0	0	1	0	0	0
Surf Scoter	0	0	0	0	0	0	1	1
Goldeneye	7	25	11	12	0	51	0	1
Red-breasted Merganser	17	13	36	26	20	33	13	32
Red-throated Diver	12	16	20	21	12	0	21	9
Great Northern Diver	23	17	9	18	18	13	32	28
White-billed Diver	0	0	0	1	0	2	1	1
Slavonian Grebe	0	0	0	0	0	0	0	1
Cormorant	96	90	252	243	157	261	180	351
Shag	1496	569	554	804	306	808	637	1480
Common Guillemot	3	2	2	6	13	6	8	0
Razorbill	0	0	0	1	1	0	1	0
Black Guillemot	367	506	277	885	364	451	379	645
Little Auk	0	0	0	0	0	1	0	0
Puffin	0	0	1	0	0	1	0	0
Total	**3406**	**2642**	**2506**	**4032**	**2974**	**3655**	**3504**	**4651**

Figure 5.1. Counts of Long-tailed Duck (upper) and Great Northern Divers (lower) along the Hascosay, Bluemull and Colgrave Sounds (HBC) survey route, and off south Unst (added to the route in 1991/92 and 1992/93 and included on every survey from 2001/02). Until 1991/92 up to three surveys were made each winter and the highest count per winter is plotted; from 1992/93 a single count per winter has been made.

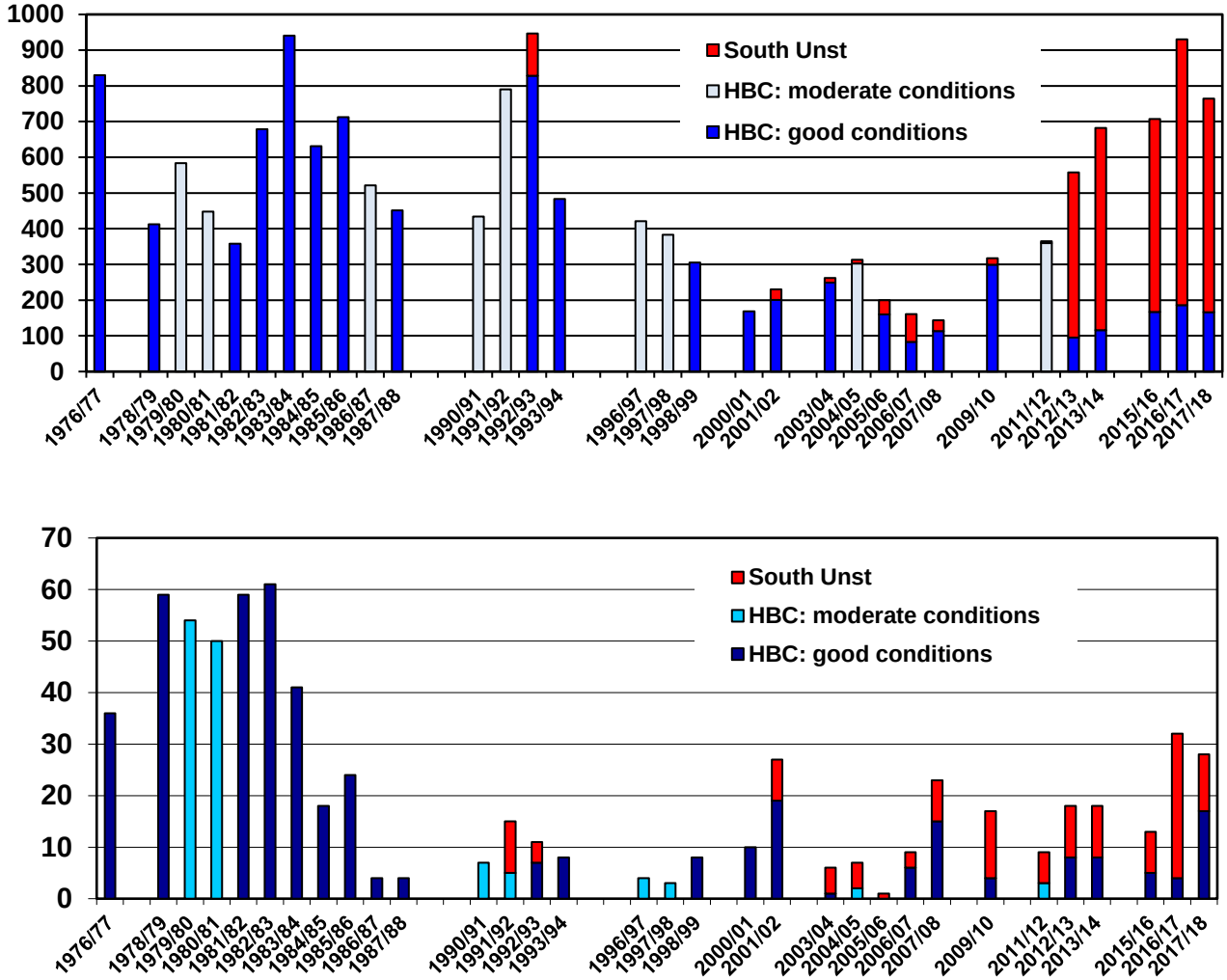


Table 5.2. Counts of diving seabirds and seaduck in Basta Voe, Yell. Count conditions were good or excellent throughout the survey on all three dates.

Winter	**2011/12**	**2015/16**	**2016/17**	**2017/18**
Date	22/1	17/1	16/2	2/1
No. of observers	2	3	3	3
Common Eider	1	0	2	0
Long-tailed Duck	1	0	0	0
Goldeneye	0	0	1	1
Red-breasted Merganser	33	47	7	37
Goosander	0	4	0	1
Red-throated Diver	7	6	3	3
Great Northern Diver	2	5	0	8
Cormorant	48	7	1	15
Shag	125	23	10	93
Common Guillemot	0	9	2	0
Razorbill	0	0	2	0
Black Guillemot	91	46	67	93
Total	**308**	**147**	**98**	**251**

6. Beached Bird Surveys

The Shetland-wide monthly beached bird survey has operated continuously since March 1979 and is carried out by the authors and a coordinated team of volunteers. All seabird corpses down to a single wing with all primary feathers present are identified to species, aged externally as far as possible, and examined for oil contamination. Selected samples of oiled plumage or oil residues found on beaches are sent for analysis. Following an external review, in 2016 some particularly unproductive beaches were dropped from the survey. The main long-term trends have been decreases in the number of seabirds found per km surveyed and decreases in the proportion of corpses found oiled (**Table 6.1**).

Table 6.1. Summary details for the Shetland Beached Bird Survey for the 10 years to 2018. *A reduction in coverage in 2016 means these figures are not directly comparable with earlier years.

Year	Km.	Corpses	Oiled	Total/km	% Oiled	Oiled/km.
2009	553.90	942	40	1.701	4.25	0.072
2010	551.30	857	46	1.555	5.37	0.083
2011	577.80	935	23	1.618	2.46	0.040
2012	579.20	1031	21	1.780	2.04	0.036
2013	581.12	811	49	1.396	6.04	0.084
2014	587.52	1,152	11	1.961	0.96	0.019
2015	585.17	691	27	1.181	3.91	0.046
2016	389.42	752	35	*1.931	4.65	*0.090
2017	387.82	523	25	*1.349	4.78	*0.064
2018	**367.10**	**828**	**24**	***2.255**	**2.89**	***0.065**
5-Year Annual Means: 1979–1983				4.064	9.98	0.408
1984–1988				3.933	7.86	0.311
1989–1993				3.990	7.19	0.285
1994–1998				4.307	9.50	0.409
1999–2003				3.171	2.39	0.073
2004–2008				2.163	2.97	0.061
2009–2013				1.610	4.04	0.063
2014–2018				***1.744**	**3.57**	***0.060**

6.1. Incidence of oiling

January to April: Four lightly oiled Fulmars, four lightly oiled Herring Gulls, a lightly oiled Shag and a lightly oiled Kittiwake were found. Five of these were found on Gulberwick beach, in the south Mainland. Fuel oil sampled from the Kittiwake, found at Gulberwick on 24th of January, was closely similar to fuel oil on a Herring Gull found at Gulberwick on 24th January and an exact match to fuel oil on a Fulmar found at Bannaminn North on 25th February (**Table 6.2**). Analysis of an oil sample from a Fulmar found at Gulberwick on 2nd April determined it was crude oil likely of Middle-eastern origin.

May to August: On the evening of 8th June, the public reported a large quantity of oil on Sandwick beach, Unst. The oil was sampled by SOTEAG staff and analyses determined that it was crude oil, had similarities with crude oils from the West Shetland Basin, and had likely been released accidentally or from an illegal bilge discharge. Eleven lightly oiled Fulmars and a lightly oiled Great Black-backed Gull, Gannet and Iceland Gull were found during the period. Fuel oil sampled from a Fulmar found on 23rd May at Urafirth, north Mainland, was an exact match to a fuel oil sample from a Fulmar found on 27th June at Culswick, west Mainland (**Table 6.2**).

September to December: There were no incidences of oiling during these four months.

Table 6.2. Results of analyses of oil samples collected in 2018. L = lightly oiled (< 10%); M = moderately oiled (10–25%); H = heavily oiled (> 25%). **Exact match between numbered samples. *Similarities but no exact match between numbered samples.

No.	Date	Location	Sample	Type	Source information
270	24/1	Gulberwick, S Mainland	Kittiwake L	Fuel**[1]	Probably illegal discharge or tanker washings
271	24/1	Gulberwick, S Mainland	Herring Gull L	Fuel*[1]	Probably illegal discharge or tanker washings
272	24/2	Gulberwick, S Minaland	Herring Gull L	Fuel	Probably illegal bilge discharge or accidental release
273	25/2	Bannaminn North, Burra	Fulmar L	Fuel**[1]	Probably illegal discharge or tanker washings
274	2/4	Gulberwick, S Mainland	Fulmar L	Crude	Probably illegal discharge or accidental release
275	23/5	Urafirth, N Mainland	Fulmar L	Fuel**[2]	Probably illegal discharge or accidental release
276	9/6	Sandwick beach, Unst	Beach	Crude	Similar but not exact match to East Shetland Basin; probably illegal discharge or accidental release
277	27/6	Culswick, W Mainland	Fulmar L	Fuel**[2]	Probably illegal discharge or accidental release

6.2. Non-oiled mortality

January to April: Few corpses were found in January and February relative to the high number (>200 in total) found in March and April (**Table 6.3**), following a prolonged period of gale force easterly winds and low temperatures in March. The most frequently recorded species in the March and April surveys were Fulmar, Common Guillemot and Shag (**Tables 6.3 and 6.4**). A freshly-dead, ringed, Red-throated Diver was found on 26th April at Urafirth, North Mavine. It was ringed as a chick at Nibon, North Mavine, on 27th July 1985 and at 32 years old is the longest-lived diver of any species on record.

May to August: Relatively high numbers of corpses (>80) were found during all four surveys, with Fulmar by far the most numerous species (**Table 6.3**). Unusually, a Glaucous Gull and two Iceland Gulls were found during the period.

September to December: Comparatively low numbers of corpses were found during these months (≤42), especially in October and November (16 and 18 found, respectively). Gannet and Fulmar were the most numerous species found and a Velvet Scoter was the most uncommon species, discovered on Sandwick beach, Unst, on 26th November, during an arrival of scoters to the Shetland (**Table 6.3**).

Table 6.3. Monthly totals of seabirds and seaduck found on beached bird surveys in 2018. Species numbers are total corpses found, with the number that were oiled given in parentheses. Other species found in 2018: Whooper Swan 1, Greylag Goose 21, Mallard 1, Grey Heron 6, Sparrowhawk 1, Curlew 2, Oystercatcher 11, Turnstone 3, Woodcock 2, Rock Dove 6, Long-eared Owl 1, Hooded Crow 2, Raven 6, Starling 2. Birds found tangled in nets/ropes/hooks in 2018: Fulmar 2 (rope), Gannet 2 (1 hook/line, 1 rope), Shag 1 (rope).

SPECIES	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**	**SUM**
Common Eider	1				2	1	1	2					7
Velvet Scoter											1		1
Long-tailed Duck													0
Red-breasted Merganser							1						1
Red-throated Diver				3	2			1		1			7
Fulmar	9	5(2)	25(1)	39(1)	54(4)	75(5)	35(2)	59	20	6	4	8	339(15)
Gannet	1	1	9	10		11(1)	1	6	6	5	2	7	59(1)
Cormorant		2	1			1					2	1	7
Shag	2	3	9(1)	16	15	12	2	1	3			3	66(1)
Great Skua				1	2	2		2					7
Arctic Skua							1						1
Black-headed Gull							3	1					4
Common Gull		3	1	1	1	3	8	4				1	22
Lesser Bl.-backed Gull					2	1	2						5
Herring Gull	4(2)	4(1)	2	4(1)	6	9	6	2	3	3	3	2	48(4)
Great Bl.-backed. Gull	2	3	1	5	4(1)	7	3	3	1		2	5	36(1)
Kittiwake	1(1)	4	5	2	3	4		6	1		3	3	32(1)
Glaucous Gull		1			1								2
Iceland Gull	1					1(1)	1						3(1)
Arctic Tern							1	1	3	1			6
Common Guillemot	2	4	27	47	15	17	11	8	4		1	4	140
Razorbill		1		1	3	1	6	1					13
Black Guillemot				2	3	2	1		1				9
Puffin				2	1	7	1	2					13
Total	**23**	**31**	**80**	**133**	**114**	**154**	**84**	**99**	**42**	**16**	**18**	**34**	**828**
Oiled	**3**	**3**	**2**	**2**	**5**	**7**	**2**	**0**	**0**	**0**	**0**	**0**	**24**
Km. surveyed	31.5	30.5	30.5	31.5	30.5	30	28.5	31.5	30.5	30.7	30.7	30.7	367.1
Corpses / km.	0.7	1	2.6	4.2	3.7	5.1	2.9	3.1	1.4	0.5	0.6	1.1	2.242
% oiled	**13**	**9.7**	**2.5**	**1.5**	**4.4**	**4.5**	**2.4**	**0**	**0**	**0**	**0**	**0**	**3.167**
Oiled / km.	**0.1**	**0.1**	**0.1**	**0.1**	**0.2**	**0.2**	**0.1**	**0**	**0**	**0**	**0**	**0**	**0.075**
Oiled after death	0	0	0	1	0	0	0	0	0	0	0	0	1
Net/rope/hook tangled	0	1	1	0	1	1	0	0	0	1	0	0	5
Other species	3	1	1	7	12	9	10	8	5	0	3	6	65

Table 6.4. Age composition of Common Guillemots found on beached bird surveys in 2018. No white tips to the greater underwing coverts means birds were older than their first year (>12 months old), white tips means they were in their first year (≤12 months old). Percentages given are of the total of aged corpses only.

Month	**January**		**February**		**March**		**April**		**May**		**June**	
Guillemot	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
No white tips	2	100	1	33.3	3	21.4	17	39.5	8	57.1	13	81.3
White tips	0	0	2	66.7	11	78.6	26	60.5	6	42.9	3	18.7
Unaged	0		1		8		4		1		1	
Total	2		4		22		47		15		17	

Month	**July**		**August**		**September**		**October**		**November**		**December**	
Guillemot	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
No white tips	9	81.8	6	85.7	0	0	0	0	0	0	1	25
White tips	2	18.2	1	14.3	3	100	0	0	1	100	2	50
Unaged	0		1		1		0		0		1	
Total	11		8		4		0		1		4	

7. Publications

Keogan, K., Daunt, F., Wanless, S., Phillips, R. A., Alvarez, D., Anker-Nilssen, T., Barrett, R. T., Bech, C., Becker, P., Berglund, P-A., Bowhuis, S., Burr, Z. M., Chastel, O., Christensen-Dalsgaard, S., Descamps, S., Diamond, T., Elliott, K., Erikstad, K-E., Harris, M., Sundberg, J. H., **Heubeck, M.**, Langset, M., Lorentsen, S-H., Mallory, M., **Mellor, M., Miles, W. T. S.**, Moe, B., Mostello, C., Newell, M., Nisbet, I., Reiertsen, T. K., Rock, J., Lewis, S. & Phillimore, A. B. 2018. Variance and covariance in the timing of breeding of North Atlantic seabirds across multiple spatial scales. Submitted to: *Global Change Biology*.

8. Acknowledgements

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Winter counts of diving seabirds and seaduck: Paul Harvey, Martin Heubeck, Glen Tyler, Gina Tyler and Jonathan Wills.

Pre-breeding census counts of Black Guillemots: Roger Moore, Roger Riddington and Kristopher Wilson.

June census counts of cliff-nesting seabirds: Paul Harvey, Martin Heubeck, Peter Hunter, Jane Outram, Mike Pennington, Brydon Thomason and Glen Tyler.

9. References

Heubeck, M., Mellor, M. & Miles, W. *SOTEAG Ornithological Monitoring Programme 2017 Report*. Shetland Oil Terminal Environmental Advisory Group, The Scottish Oceans Institute, School of Biology, University of St Andrews.

Walsh, P.M., Halley, D.J., Harris, M.P., del Nevo, A., Sim, I.M.W., & Tasker, M.L. 1995. *Seabird monitoring handbook for Britain and Ireland*. Published by JNCC / RSPB / ITE / Seabird Group, Peterborough.

Appendix 1. Seabird monitoring on Foula in 2018, conducted by Sheila Gear (Foula Ranger Service).

Common Eider. This year, male Eider numbers had increased but female numbers appeared stable. The count was done on 12th August by Penny Gear and Sheila Gear. Conditions were good, with light NE wind and sun. Breeding was late, with the first chicks not seen until 15th June, and, despite the later than usual count date, some chicks were still small. Breeding success was low, though slightly better than in 2017.

	27/7/09	**24/7/10**	**26/7/11**	**27/7/12**	**25/7/13**	**27/7/14**	**25/7/15**	**24/7/16**	**29/7/17**	**12/8/18**
Males	110	48	74	108	94	81	33	81	45	64
Females	89	66	51	50	71	87	52	68	69	65
Adults	**199**	**114**	**125**	**158**	**165**	**168**	**85**	**149**	**114**	**129**
Chicks	53*	19	26	81	27	49	21	70	38	47
Total	**252**	**133**	**151**	**239**	**192**	**217**	**106**	**219**	**152**	**176**
Brood/1	10	8	7	7	15	5	3	14	4	10
Brood/2	12	3	6	12	3	11	2	7	6	6
Brood/3	4	0	1	8	2	6	2	7	6	7
Brood/4	1	0	1	4	0	1	2	4	1	1
Brood/5	0	1	0	2	0	0	0	1	0	0
Mean Br.	**1.85**	**1.58**	**1.73**	**2.45**	**1.35**	**2.13**	**2.33**	**2.12**	**2.38**	**1.96**

Red-throated Diver. Red-throated Divers had a somewhat better season than in 2017. Twelve sites were occupied with 11 breeding attempts. Divers on three pools failed. Nine chicks survived long enough to have possibly fledged. The summer was exceptionally dry and hot and the water level in two pools became too shallow for divers. None of the pools had Greylag Geese nesting on them this year.

Foula Red-throated Divers	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Sites occupied at least once	12	10	13	12	13	13	12	15	11	12
Breeding attempts	11	9	11	8	12	12	12	13	10	11
Sites where chicks hatched	7	5	7	6	7	11	11	11	6	9
Minimum number of chicks	10	5	9	8	9	17	12	12	7	14
Chicks presumed fledged	9	4	5	5	4	15	10	6	5	9
Breeding success	**0.82**	**0.44**	**0.45**	**0.63**	**0.33**	**1.25**	**0.83**	**0.46**	**0.50**	**0.82**

Northern Fulmar. Four of the Foula plots were picked at random and monitored by Sheila Gear. The weather during incubation and the small chick stage was very dry and no nest sites were flooded out. Predation of eggs by Ravens was frequently observed. Mean productivity across the plots was 0.58 (mean across all sites of young counted in August / nest sites recorded as an AOS on three occasions in June).

Plot	**Total AOS**	**AOS on all 3 checks (%)**	**Chicks at all-3-check sites + 'extra' sites**	**Success**
1	77	27 (35.1%)	8 + 9	17/36 = 0.47
3	93	46 (49.5%)	25 + 8	33/54 = 0.61
5	57	28 (49.1%)	13 + 5	18/33 = 0.54
6	47	23 (48.9%)	14 + 6	20/29 = 0.69
	274	124 (45.30%)	60 + 28	88/152 = 0.58
Mean ± SE of 4 plots				**0.58 ± 0.05**

Breeding success was the same as in 2017 and slightly higher than at sites elsewhere in Shetland (see P.5).

Fulmar	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Qualifying AOS	111	140	119	196	135	113	123	137	119	124
'Extra' sites	9	5	0	0	0	33	16	10	18	28
Chicks in August	51	88	57	125	96	97	45	80	79	88
Mean success	**0.45**	**0.62**	**0.48**	**0.64**	**0.73**	**0.67**	**0.33**	**0.56**	**0.58**	**0.58**

European Shag. The number of nests in the monitoring plot was slightly higher than in 2017 and productivity was high this year (1.83 compared with 0.55 in 2017).

Shag	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Trace nest only	2	1	0	4	3	0	1	1	2	5
Empty nest only	2	1	1	3	4	0	1	0	0	0
Incubating nests	44	41	27	10	4	35	29	26	22	24
% Incubating	91.7	95.3	96.4	58.8	36.4	100	93.5	96.3	91.7	82.8
Young fledged	55	56	20	5	3	66	23	19	12	44
Fledged / inc.	**1.25**	**1.37**	**0.74**	**0.50**	**0.75**	**1.89**	**0.79**	**0.73**	**0.55**	**1.83**

In 2018, a whole-island census of shag nests was carried out by Sheila Gear, Penny Gear and Paul Smith for the national seabird census (SNH attempted this in 2015 but due to rock fall were unable to reach the large area of the nests at the Sneck and Mucklebruik). Due to persistent swell this year, five small areas could not be reached safely (North Geo o da Gaads, Head o da Hurd, Granni Geo, north side of da Laamatuns and da Scrudhurdins). These areas were observed throughout the season from the cliff top, however, and from a boat. A further six nests on cliff ledges on the east coast could only be seen from the sea. A total of 324 nests were found, including two more nests found later in the monitoring plots on the east coast. It is likely that there were a few late layers on the west side of the island too, so the actual total may have been very slightly higher. In June 2000, a count by SNH and J and S Gear found and marked 2,277 nests. Therefore the 324 nests counted this year represents a massive decrease of 1,953 pairs through the last 18 years.

In mid-May, Nina O'Hanlon from University of Highlands and Islands surveyed Shag nests for marine plastic along the east coast of Foula, accompanied by Sheila Gear; 17% of nests were found to contain plastic debris.

Arctic Skua. The first bird was seen ashore on 27th April but most birds returned very late. There were 20 AOTs but only 14 pairs were seen to lay. Mean clutch size was 1.71 eggs per pair laid. A bad storm occurred on 14th June followed by several wet, windy days, during which time all but two pairs each with a single chick failed. However, this year the failed birds remained in the colony until the end of the season, unlike the previous few years, and both chicks fledged and survived. They were last seen with their parents on 31st August, after which all the Arctic Skuas left. Productivity was 0.14 compared with zero in 2017.

Arctic Skua	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
First seen on land	24/4	26/4	22/4		3/5	29/4	26/4	26/4	28/4	27/4
AOT	63	50	41	37	35	24	28	27	23	20
Pairs laid	49	39	32	27	26	21	26	17	17	14
Mean clutch	1.43	1.73	1.63	1.58	1.77	1.70	1.62	1.47	1.81	1.71
Fledged	22	(1)	0	4	0	18	17	4	0	2
Success/AOT	**0.35**	**0.00**	**0**	**0.11**	**0**	**0.75**	**0.61**	**0.15**	**0**	**0.14**

Great Skua. Great Skuas again returned very late, with the first bird seen on land on 12th April, although many did not come ashore until May. The sample plot in the Bitten was monitored and numbers of AOTs had slightly decreased (50 compared with 54 in 2017). Pairs were very aggressive, suggesting adults were in good condition. Mean clutch size was 1.8. Predation of chicks was high, although lower than in 2017, and 21 chicks survived to the last week of July. Predation continued and only 11 chicks were seen to survive to fledge. Two young chicks were still on the ground on 13th August. Overall, productivity was higher than last year, with 0.22 chicks fledged per AOT (0.04 in 2017).

Great Skua	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
First seen on land	10/4	6/4	2/4	28/3	10/4	10/4	3/4	2/4	4/4	12/4
AOT monitored	45	48	53	38	41	48	42	54	54	50
Mean clutch	1.94	1.87	1.74	1.76	1.54	1.88	1.62	1.77	1.69	1.8
Fledged	65	11	14	8	3	8	3	14	2	11
Success/AOT	1.44	0.23	0.26	0.21	0.07	0.17	0.07	0.26	0.04	0.22

Herring Gulls. Six pairs of Herring Gulls nested at the Swaa.

Black-legged Kittiwake. The whole-island count was made from the sea on 17th June, but there was too much swell to count accurately. However, numbers appeared similar to 2017. On 29th June conditions were better and an accurate count was made. Numbers were very slightly up on 2017 with a total of 262 complete attended nests and six empty nests.

Black-legged Kittiwake	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Census count (AON)	509	582	480	378	327	361	277	272	256	262
% change per year	-28.5	+14.3	-17.5	-21.3	-13.5	+10.4	-23.3	-1.8	-5.9	+2.3

At the Hodden sub colony, there were 27 well-built nests, a small increase from 23 in 2017. Nineteen chicks fledged, 15 pairs fledged single chicks and two pairs two chicks. Productivity was 0.70 (0.35 in 2017). Productivity was 0.00 chicks fledged per AON at the sub colony In Under da Stee, where four pairs attempted to nest again. Rock continues to come down from a large loose area of the cliff above the site, so only minimal monitoring was carried out.

Sub-colonies on the west side of the island did noticeably poorer than sub-colonies on the east side, fledging very few chicks, although they contained many more breeding birds compared with those on the east side.

In Under da Stee	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Completed nests	70	52	50	44	32	20	2	2	3	4
Fledged	23	3	0	0	0	0	1	1	0	0
Success	0.33	0.06	0	0	0	0	0.50	0.50	0.00	0.00
Hodden	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Completed nests	46	31	22	20	18	18	21	20	23	27
Fledged	22	0	2	0	0	15	4	9	8	19
Success	0.48	0	0.09	0	0	0.83	0.19	0.45	0.35	0.70
Mean success	**0.41**	**0.03**	**0.05**	**0**	**0**	**0.42**	**0.35**	**0.48**	**0.18**	**0.35**

Arctic Tern. Arctic Terns had a prolonged and unproductive season. The first birds were seen on 12th May at the airstrip and had increased to 41 by 15th May. Occasional scattered pairs laid through the season at the airstrip, near the Hametoon dyke and at the Cletts but most failed a few days later. The greatest number of adults counted was 86 at the south end and 26 on the Cletts on 7th Aug. On 20th Aug there were seven fledglings on the Cletts and two at the Hametoon dyke, one of which was feathered but not yet flying.

Common Guillemot. Guillemots appeared to have poor and late season. Numbers were apparently low and chicks very few and poorly attended. Prof Robert Furness returned to re-catch his sample of breeding birds with geolocators.

Razorbill. Razorbills appeared to do noticeably better than Guillemots this year. Numbers of adults appeared to be higher than in 2017 and seemingly a high proportion of them fledged a chick.

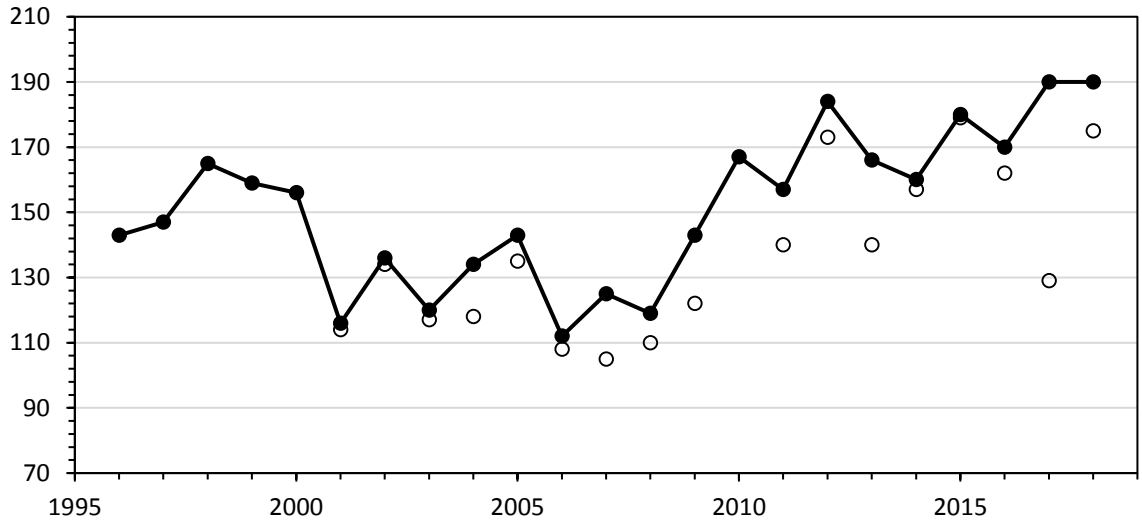
Atlantic Puffin. Numbers appeared to have declined further. The first birds were seen inshore on 21st April but were not seen on land until 6th May. Few birds appeared to be breeding and few to raise chicks successfully. None were observed coming in with sandeels. Apparent non-breeding individuals arrived first on 16h June and returned occasionally through the summer during spells of fine weather.

Black Guillemot. The stretch of coast monitored extends from Selchie Geo (HT952412) in the northwest of the island down along the entire east coast to Husawick (HT961370) in the southwest and is covered by two

observers. Conditions for counting were very good for the first count, on 21st April, but poor for the second count, on 28th April. The total for the first count (190) was exactly the same as in 2017 and is the highest total recorded for this section of coastline.

Area counted	Date & time	Weather & tide	Count
East coast	21/4: 7.10–9.50am	Wind WSW 3, sunny, 1 shower (drizzle), no swell	190 adults
East coast	28/4: 7.30-10.20 am	Wind W going NE 4, sun, heavy showers (rain & hail)	175 adults

Figure 1. Counts of adult Black Guillemots along the east coast of Foula, 1996–2018. Open symbols indicate the lower count when two were made in a year (symbols overlap in 2015).



Appendix 2. Seabird ringing in Shetland in 2018.

Ringing of seabirds provides valuable information on population distributions, individual movements, longevity and causes of mortality. SOTEAG has supported seabird ringing in Shetland since 1980 by contributing to the cost of seabird rings. Annual ringing totals have fluctuated due to variation in demographic factors and the number of adults and chicks available for ringing. Over the years, ringing totals have generally decreased in Shetland though, as seabird numbers have decreased and accessible colonies have become fewer.

The total of 1,708 seabirds ringed at breeding colonies in 2018 was higher than in 2017 (1,459), largely because species productivity was higher in 2018 and more chicks were available. The largest differences between the 2018 and 2017 ringing totals occurred in the following species: Great Skua (565 c.f. 287), Common Guillemot (436 c.f. 253) and Atlantic Puffin (126 c.f. 102).

Recommendation: SOTEAG offers reimbursement of ring costs for all species listed in Table 1, except for non-breeding European and Leach's Storm-petrels (as per existing policy). In late 2017, the British Trust for Ornithology increased the price of rings, in accordance with increases in manufacturing and administration costs. The total reimbursement cost in 2018 was £693.64, comprising £418.99 to Fair Isle Bird Observatory, £244.17 to Shetland Ringing Group (plus £14.85 for Red-throated Diver rings), and £15.63 to the University of Glasgow, which supplied all rings used on Foula.

Table 1. Seabirds ringed in Shetland in 2018. FI = Fair Isle Bird Observatory; SRG = Shetland Ringing Group; FO = Foula. Numbers of non-breeding adult storm-petrels are omitted as ringing costs are not covered by SOTEAG. The unit cost of British Trust for Ornithology (BTO) rings includes manufacturing costs and administration (e.g. of recovery data from live/dead ringed birds). BTO does not charge for Guillemot and Razorbill rings. Total (a) = site totals and grand totals for numbers ringed and cost; Total (b) = age and breeding category totals. *The cost of Red-throated Diver rings is covered by a separate SOTEAG grant to SRG.

	Chicks			**Breeding adults**			**Non-breeding adults**		**Total**	**Unit cost**	**Total cost**
Species	FI	SRG	FO	FI	SRG	FO	FI	SRG			
Red-throated Diver*	0	20	0	0	13	0	0	0	**33**	£0.45	**£14.85**
Northern Fulmar	102	32	0	0	1	0	0	3	**138**	£0.40	**£55.20**
European Storm Petrel	0	31	0	5	7	0	n/a	n/a	**43**	£0.46	**£19.78**
Leach's Storm Petrel	0	0	0	0	0	0	n/a	n/a	**0**	£0.18	**£0.00**
European Shag	1	12	0	2	6	0	0	0	**21**	£0.45	**£9.45**
Great Skua	330	214	21	0	0	0	0	0	**565**	£0.68	**£384.20**
Arctic Skua	1	0	2	4	0	1	0	0	**8**	£0.45	**£3.60**
Common Gull	2	22	0	0	0	0	0	0	**24**	£0.45	**£10.80**
Lesser Black-backed Gull	4	0	0	0	0	0	0	0	**4**	£1.90	**£7.60**
Herring Gull	29	9	0	0	0	0	0	0	**38**	£1.90	**£72.20**
Great Black-backed Gull	0	6	0	0	0	0	0	1	**7**	£0.68	**£4.76**
Arctic Tern	118	117	0	0	0	0	0	0	**235**	£0.23	**£54.05**
Common Guillemot	3	430	0	0	3	0	0	0	**436**	Free	-
Razorbill	22	2	0	5	0	0	0	0	**29**	Free	-
Atlantic Puffin	79	0	0	47	0	0	0	0	**126**	£0.45	**£56.70**
Black Guillemot	1	0	0	0	0	0	0	0	**1**	£0.45	**£0.45**
Total (a)	**692**	**895**	**23**	**63**	**30**	**1**	**0**	**4**	**1708**		**£693.64**
Total (b)	**1610**			**94**			**4**				

Appendix 3. National seabird census counts of cliff-nesting species, 2015–18.

In 2018, limited boat availability and periods of poor weather in early and mid-June restricted the number of days that census counting was possible. Boats were chartered on six days for census counts of cliff-nesting

species. The areas surveyed were the Yell Sound islands, Whalsay islands, Bluemull Sound islands, islands off east Unst, and sections of east Yell and the east coast of the south Mainland. The counts this year also included species of tern, for the whole-archipelago tern survey that was done in 2018 for the national census.

Figure 1. Sections of the Shetland coastline where cliff nesting seabirds have been counted for the national seabird census by SOTEAG, SNH and Shetland Amenity Trust in 2015–18 (red = completed areas; all counts done in June).