Seabird Monitoring & Research Project
Isles of Scilly 2013-2017

Searching for Manx shearwater burrows. Photo: Ed Marshall

Vickie Heaney

Isles of Scilly Seabird Recovery Project Officer

Vickie.heaney@rspb.org.uk

September 2017

Summary of Seabird Monitoring and Research

Monitoring of seabird numbers and productivity on St Agnes and Gugh

- Decline in herring and lesser black-backed gulls (68% and 30% respectively) 2013 -2017
- Manx shearwater
    - breeding population increased from 22 pairs in 2013 (pre- rat eradication) to 59 pairs in 2017 (post rat eradication)
    - sub-colony site expansion and new areas colonised Kittern Hill and Castella Down
    - 43 'star-gazing' chicks recorded in 2017 (10 St. Agnes, 33 Gugh), none in 2013
    - no fledging recorded at sub-colonies with rat presence (Bryher, St. Martins, Peninnis, Tresco) and clear evidence of predation on St. Helens
    - observation of 'dug out' shearwater burrows on Bryher, Gugh and St. Marys (dogs)
- Storm petrel
    - recorded breeding successfully St. Agnes & Gugh 2015-17 – first time in living memory
    - 5 calling chicks so far recorded on Gugh in 2017
    - 6 storm petrel nest boxes installed in dry stone walling on St. Agnes
- Lesser black-backed gull
    - colony on Gugh stable at 400 pairs 2013-16, reduced 26% to 296 pairs in 2017
    - productivity ranging from 0.34 to 0.61 chicks per pair, no obvious impact of rat removal
    - Feral cat predation pressure in 2006-7 on Gugh

Productivity monitoring work across the archipelago

- Herring gulls: selected sub-colonies on Tresco, Samson and Hugh Town
    - desertion of sub-colony on Gimble Porth Tresco in 2014 (was 50 pairs in 2008)
    - productivity ranging from 0.30 to 0.68 chicks per pair on Samson
    - consistently higher breeding success at the small Hugh Town sub-colony (n = 14)
- Kittiwakes: all sub-colonies
    - 89% reduction in breeding pairs since 2006 and loss of 6 sub-colonies
    - total breeding failure 6 of the last 12 years
    - low productivity or failures related to food supply (weather and predation)
- Fulmars: selected sub-colonies Menawethan and Daymark
    - productivity ranging from 0.16 to 0.64 chicks per pair, particularly low recently
- Common terns: all sub-colonies
    - 65% reduction in breeding pairs since 2006
    - total breeding failure 7 of the last 12 years
    - low productivity or failures related to food supply and tidal inundation
    - 2016 and 17 extremely late in settling and laying (late June/ early July)
- Shags: selected sub-colony on Samson
    - Productivity estimated in 2016 at 1.3 chicks per pair, but high disturbance issues

Population monitoring work on Annet

- sub-colony of lesser black-backed gulls (281 pairs in 2006) lost altogether
- 38% reduction in puffin numbers 2006 to 2015 – corresponding increase on Mincarlo
- 58% reduction in shag numbers 2006 to 2015 – reduced 21% across archipelago
- Sample beach on Annet surveyed for breeding storm petrel
    - increase in breeding numbers at study beach on south shore 2006-2017
    - negative influence of winter storms on beach profile and availability of nesting sites

Introduction - Isles of Scilly Seabird Heritage & Data set

The full Special Protection Area (SPA) count conducted in 2015/16 confirmed Scilly as supporting a greater diversity of seabirds than any other site in England, with over 8,000 pairs of 13 species of regularly breeding seabird. Seabirds are a named feature in the SPA and many of the SSSI designations for the area and are a vitally important part of our natural heritage. We have;

- Internationally important numbers of lesser black-backed gull and storm petrel
- Nationally important numbers of great black-baked gull, Manx shearwater and shag (possibly the largest colony in the UK)
- Regionally important numbers of puffin, razorbill, common tern and fulmar
- One of only two sites in England where Manx shearwater and storm petrel breed (the other being Lundy).

The Isles of Scilly Seabird Recovery Project is a partnership project which aims to provide a safe future for these internationally important seabird populations on the Isles of Scilly. Working with communities and visitors on the Isles of Scilly, the project aims to protect our seabird heritage, maintaining and enhancing the conservation value of the islands through a programme of targeted conservation action and community participation and learning.

Scilly's seabird breeding records comprise one of the best long term environmental data sets we have for the islands. Regular all-island counts have been completed since 1970 as well as annual records for breeding numbers on Annet since 2006 and for St Agnes and Gugh since 2012. Sadly these records have documented alarming declines in many of our seabird populations;

- Overall number of breeding seabird pairs declined by 9.8% since 2006 and by 31.3% since 1983
- Five species of seabird have declined in numbers across Scilly by more than 20% since 2006 (kittiwake 89%; common tern 65%; lesser black-backed gull 26%; herring gull 22%; shag 21%)
- Annual counts of Annet breeding numbers down by 12% since 2006 (mainly a reduction in herring and lesser black-backed gull numbers)

Birds are widely accepted as excellent indicators of environmental health; their changing populations often providing clues to the overall health of their habitat. These declines in the seabird populations of Scilly show that there is a clear need to take action. Measurement of variables over time in a systematic way informs management priorities and actions for maintaining and recovering our seabird populations. If we miss years in this data set we will not know what happened. This is particularly important in the variable marine environment where isolated good or bad years can have a big impact, but also need to be analysed in the context of the long-lived seabirds' life history. Continuous data sets allow a much more useful picture of what is going on between the stark numbers of the periodic full SPA counts.

The data collected in Scilly also contributes to national seabird records and allows comparison between different regional populations. In particular Scilly provides a useful comparison site for many seabird species whose other more studied colonies are located in the North Sea e.g. Kittiwake, shag, storm petrel. Unbroken long-term data sets also provides us with a reliable baseline measure against which to compare the impact of any unexpected isolated events (e.g. Pollution, disease, wrecks)

The scope of this report

Since the full SPA survey in 2006 annual productivity data for key seabird species have been collected at key sites across the islands. This is building up a picture of various breeding successes and failures to add to the picture in the interim periods between full counts and helping us to get an idea of the causes of the major species trends observed. Productivity for the species recorded here were collected using standard methods as set out in *The Seabird Monitoring Handbook* (Walsh *et al*. 1995).

This report summarises the results of this seabird fieldwork conducted between April and September 2013 to 2017 as part of the Seabird Recovery Project, with some additional data collected between 2006 and 2013. The results of the full SPA survey of breeding seabird numbers across the whole archipelago are presented in a separate report (Heaney & St. Pierre 2017).

Monitoring of seabird numbers and productivity on St Agnes and Gugh

- Annual counts of all breeding seabirds before and after rat removal
- Manx shearwater playback surveys and monitoring of productivity
- Storm petrel playback survey of sample habitat and productivity
- Monitoring of lesser black-backed gull productivity on Gugh

Productivity monitoring work across the archipelago

- Herring gulls: selected sub-colonies on Tresco, Samson and Hugh Town
- Kittiwakes: all sub-colonies
- Fulmars: selected sub-colonies Menawethan and Daymark
- Common terns: all sub-colonies
- Shags in Samson sub-colony
- Manx shearwaters on Bryher, St. Martins, Tresco, Peninnis and St Helen's

Population monitoring work on Annet

- Annual counts of breeding seabirds on Annet
- Sample beach on surveyed for breeding storm petrel

Results: Monitoring of seabird numbers and productivity on St Agnes and Gugh

A full survey of all seabird species breeding on St. Agnes and Gugh has been conducted annually since 2012 with the results from this and the two previous SPA counts included in Tables 1 and 2 below. Over this period the number of both herring and lesser black-backed gulls has decreased, whilst the number of breeding fulmars has increased. This is in line with population trends across the islands as a whole (Heaney & St. Pierre 2017). Kittiwakes first bred on St. Agnes at the Turks Head in 2009 following the desertion of a number of sub-colonies elsewhere in the archipelago. In 2017 following two years of failure at this site a small number of birds have returned to breed at their former site on the eastern side of Gugh.

During this time period the big event is of course the removal of rats from St. Agnes and Gugh in the winter of 2013/14 (although not officially declared rat free until February 2016). The most obvious change following this has been the increase in both breeding numbers, productivity and range of Manx shearwaters and the first recording in living memory of storm petrels breeding on St. Agnes in 2015 and Gugh in 2016. Anecdotally, both ringed plover and oystercatcher appear to be having more success in fledging chicks also, although gull predation, tide inundation and human disturbance continue to be limiting factors here (Dawson 2012).

Table 1. Breeding seabirds on St. Agnes

	FUL	MX	LBBG	HG	GBBG	KIT	COT	SP	RPL	OYC	Total
2000	0	5	2	25	0	0	3	0	-	-	**35**
2006	0	8	0	15	1	0	0	0	-	-	**24**
2012	0	8	8	61	0	24	0	-	2	9	**112**
2013	2	5	8	32	0	38	0	0	1	8	**94**
Rat Removal											
2014	3	9	16	27	1	62	0	0	1	10	**129**
2015	4	12	14	11	1	75	0	6	1	7	**131**
2016	6	22	15	12	1	5	0	9	2	8	**80**
2017	8	23	1	7	0	0	0	11	2	10	**62**

SH – shag; GBBG – great black-backed gull; LBBG – lesser black-backed gull; HG – herring gull; RAZ – razorbill; FUL – fulmar; KIT – kittiwake; COT – common tern; SP – storm petrel; MX – Manx shearwater; PUF – puffin; OYC –oystercatcher; RPL – ringed plover.

Table 2. Breeding seabirds on Gugh

	FUL	MX	SH	LBBG	HG	GBBG	KIT	SP	RPl	OYC	Total
2000	2	22	0	1123	159	3	155	0	-	-	1464
2006	3	9	0	875	69	4	131	0	-	-	1091
2012	4	16	2	361	53	10	0	-	0	7	453
2013	1	17	0	418	51	7	0	0	0	10	504
Rat Removal											
2014	5	17	0	411	30	5	0	0	0	10	478
2015	1	45	0	419	30	6	0	2	1	5	509

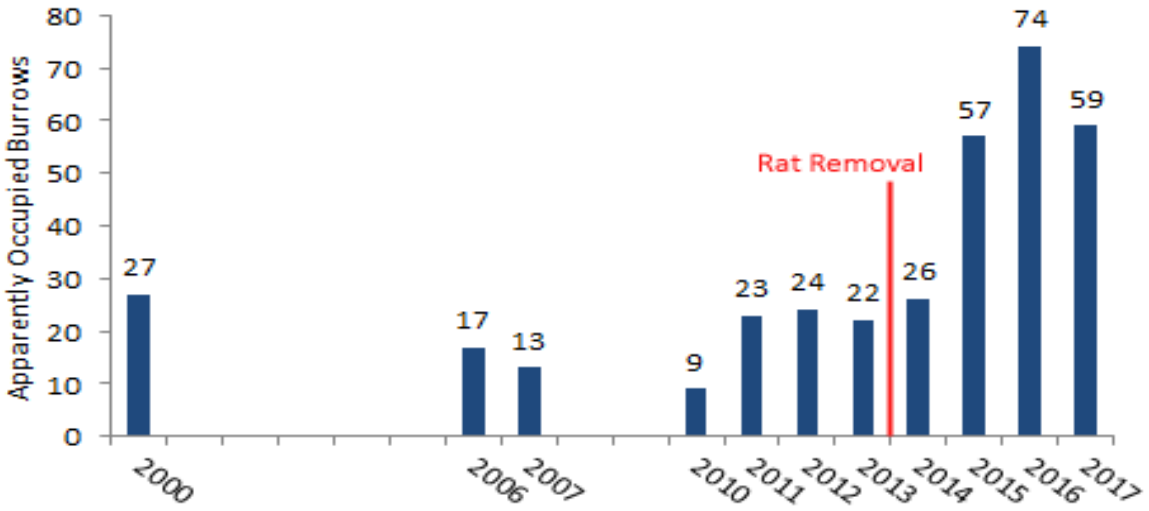
2016	1	52	0	400	36	5	0	4	0	10	508
2017	3	36	2	296	20	2	30	3	0	9	401

Manx shearwater settlement and productivity

The numbers of apparently occupied Manx shearwater burrows on both St. Agnes and Gugh have increased dramatically since the removal of rats in the winter of 2013-4. In addition, new areas have been colonised with a new and growing sub-colony site at Castella Down and further expansion of burrows at Kittern Hill, Clapper Rocks and Wingletang (see Figure 1 & Map 1). Between 2006 and 2015/16 the number of Manx shearwaters breeding in Scilly as a whole increase two-fold from an estimated 171 to 523 pairs (Heaney & St. Pierre 2017). The only other site in England where these birds breed is Lundy which has seen a ten-fold increase in pairs to over 3000 pairs following rat-removal in 2002-4 (Booker & Price 2014).

In the years of the study apparently occupied burrows have been identified during the incubation period using diurnal playback across all of St. Agnes and Gugh each year as well as various surveys of St. Helen's, Peninnis, Annet, Bryher and Tresco (Table 3 below). Although playback is still the best census method we have for these nocturnal burrow nesters the response rate can be highly variable. In 2000 we conducted a response rate survey over a week during peak incubation on Annet. We obtained a response rate of 0.93 (Heaney et al. 2002) and have accordingly used a correction factor of 1.08 applied to all subsequent counts of burrow responses from Scilly. It is clear from repeated surveys that response rates can vary greatly depending on the time of day, the kit used, and the weather, the sex of the bird incubating and yearly variations in peak incubation dates. Where possible these factors are controlled, but in particular in 2017, data from Lundy suggest that laying may have been late which may account for the lower responses recorded on St. Agnes and Gugh. This is supported by the increased number of chicks recorded fledging in 2017.

Figure 1. Manx Shearwater numbers St Agnes & Gugh



Map 1 Location of Manx shearwater sub-colonies on St. Agnes and Gugh

Table 3. Manx shearwater breeding numbers – selected counts across Scilly

	Gugh	St. Agnes	Bryher	St. Helen's	Peninnis, St. Mary's	Annet	Tresco
2000	22	5	12	5	0	123	0
2006	9	8	13	9	0	-	0
2007	8	5	-	-	-	-	-
2010	6*	3*	-	-	4	-	-
2011	13	10	-	39	7	-	-
2012	16	8	-	-	4	-	-
2013	17	5	12	-	2	(21)	-
2014	17	9	12	27	4	(20)	-
2015	45	12	39	36	8	229	46
2016	52	22	(16)	42	7	-	-
2017	36	23	(16)	-	4	-	(28)

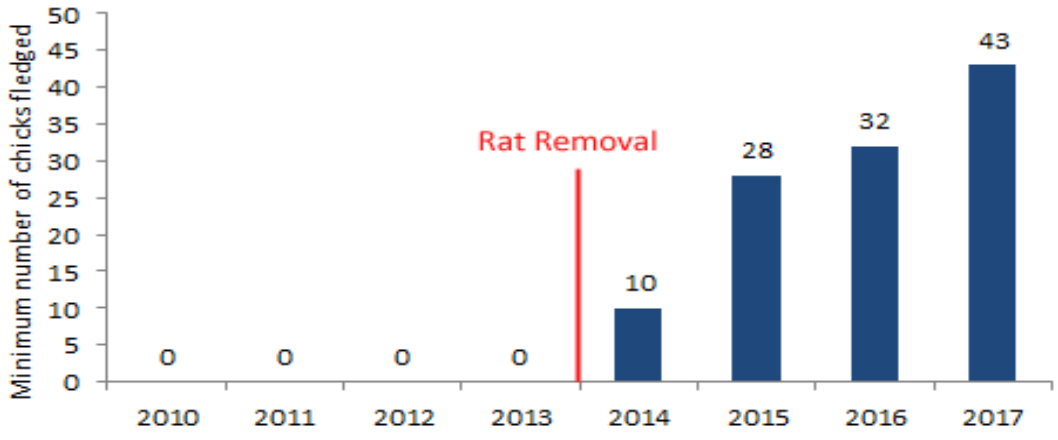
*AOBs recorded mid-June, likely to be an underestimate; Numbers in brackets represent only a sample of total; Dash means no count. All breeding pair counts above include a correction of 1.08 to account for incubating birds that did not respond.

In many UK colonies where Manx shearwaters are studied (e.g. Skomer) burrows appear to be relatively short and straight allowing investigation by hand or by removable turf or rock hatches above the nest chamber. In Scilly the small number of easily accessible burrows and their long and convoluted nature has so far precluded this. In the past we tried to ascertain burrow success by looking for signs of occupation as the season progressed (evidence of feathers, droppings and digging with little vegetation overgrowth of the entrance) and by checking by hand for the presence of chick down and nesting material deeper in the burrow in November. This was not particularly satisfactory, giving a flawed estimate of success at best. Use of a burrow-scope has helped in some cases, but again the length and turns in the burrows caused problems in confirming occupancy.

In order to give a much more accurate although minimal estimate of fledging success for the shearwaters nesting on St. Agnes and Gugh we now do 'Chick check walks'. Previous studies have shown that '*occasionally from the age of 50 days and more or less nightly during the desertion period, young Manx shearwaters shuffle along the burrow to the entrance and beyond to the open air. In the final nights before fledging they exercise vigorously on the ground, standing on tip toe and whirring their wings enthusiastically*.' (Brooke 1990) The chicks then tend to return to their natal burrows again soon after midnight and well before dawn. It is suggested that they are possibly learning the position of their natal colony from the stars in order that they can return in future years. Figure 2 shows the total number of these 'stargazing' fledglings recorded over a number of calm moonless nights from mid-August until mid-October each year from 2013 (zero counts for 2010-2012 are based on previous fledgling check methods described above). Peak counts generally run from the last week of August until the third week of September, with calm overcast nights proving best (Riou & Hamer 2008, *pers. obs*.).

In 2017 a total of 43 chicks were recorded by this method. Although the emergence of chicks is highly variable and many chicks will be missed altogether, this number can be compared favourably to the 32 seen in 2016, 28 in 2015 and just 10 in 2014. This gives a minimum breeding success of 0.73 chicks per pair compared to 0.62-0.76 ch/pr recorded on Lundy in 2007 and a national average breeding success of 0.66 ch/pr between 1986 and 2015 (JNCC 2015).

Figure 2. Manx shearwater breeding success St Agnes & Gugh



The devastating effect of rat predation on Manx shearwater breeding success is well documented (Brooke 1990, Thompson *et al*. 1998, Upton *et al.* 2000) and data from this project further support these findings, with no firm evidence of successful breeding at sites in Scilly where rats are present. In previous years returning to the sites where apparently occupied burrows were recorded earlier in the season resulted in little evidence of continued occupation or fledging and in 2017 we also conducted chick checks after dark on Tresco, Bryher and St. Martin's. Unfortunately as expected with continued rat presence, no stargazing fledglings were seen and particularly on Bryher a large number of nocturnally active rats were seen at the Shipman Head Down site. In addition, a daytime check of the

St. Helen's sub-colony in late August showed ample and distressing evidence of chick predation around the previously occupied breeding burrows (see pictures below).

Evidence of rat predation at Manx shearwater burrows on St. Helen's in 2017


Photographs by Jaclyn Pearson.

Storm petrel settlement and productivity

It is well established that where rats are present storm petrels do not breed (Moors & Atkinson 1984, de Leon *et al.* 2006) and the three most recent full SPA surveys of Scilly support this, with no record of breeding on islands with rats (Heaney & St. Pierre 2017). As with Manx shearwater, diurnal playback surveys have been used in Scilly since Seabird 2000 to establish storm petrel breeding and estimate the number of apparently occupied sites. All records for Scilly are multiplied by a correction factor of 2.86 to allow for non-response (Heaney et al. 2000). Following rat removal, storm petrels first returned to breed on St. Agnes and Gugh in 2015 at Carnew Point and Kittern Hill respectively (see Map 2).

Although storm petrel chicks do not stargaze like shearwater fledlings, they do cheep noisily from their burrows towards the end of their fledgling period allowing confirmation of successful breeding. In 2015 4 chicks were heard calling on St. Agnes and Gugh (2 each), in 2016 the total was 6 (2 St Agnes, 4 Gugh) and in 2017 the total was 5 (2 St Agnes, 3 Gugh). The amount of potentially suitable storm petrel nesting habitat across St. Agnes and Gugh is extensive and with continued 'rat-free' vigilance these totals look set to increase year on year.

In addition, 6 storm petrel nest boxes were placed within a short section of stone walls at Castella Down. These have an enclosed nest chamber made from clear plastic tubs fixed together and accessed by a plastic entrance tube. They will be monitored for any activity or settlement in subsequent years with the hope that if settled it may be possible to access and view the nest whilst causing minimal disturbance.

Map 2 Location of storm petrel sub-colonies on St. Agnes and Gugh

Due to the extent of suitable storm petrel breeding habitat across St. Agnes and Gugh a limited survey sample area on both islands that takes in both rocky vegetated areas, stone walls and boulder beach habitat has been identified for annual survey (see above).

Lesser black-backed gull productivity

The number of lesser black-backed gulls breeding in Scilly has fallen dramatically in recent years, with a decline of 26% between 2006 and 2015 to just under 2,500 breeding pairs (Heaney & St. Pierre 2017). This decline is significantly greater than that recorded at coastal sites in the southwest between 2000 and 2006 – just 9% (Porter, Brown & Lock 2010). The majority of the birds in Scilly now breed in three main sub-colonies; Samson, St. Helen's and Gugh. Since 2012 the numbers and productivity at the Gugh sub-colony have been recorded annually (see Table 4 and Figure 3). In line with the overall decline in numbers across the islands the size of the Gugh sub-colony has decreased from 1123 in 1999 and 875 in 2006 to just under 300 birds in 2017. Fledging success estimated by observing nests from a vantage point above the colony suggests a fledging success ranging from 0.34 to 0.61 chicks per pair. 2017 has been a particularly poor year with a 25% reduction in numbers settling and a fledging success well below that needed to maintain a stable population. Across the UK measurements of productivity for lesser black-backed gulls at 'natural' coastal colonies show large fluctuation between years with average figures generally below 0.6 ch/pr and as low as 0.14 ch/pr in 2015 (JNCC 2015). Experimental research suggests that rat presence or absence is unlikely to have a significant effect on productivity as a result of egg predation in gulls (Prieto *et al.* 2003) and the results support this.

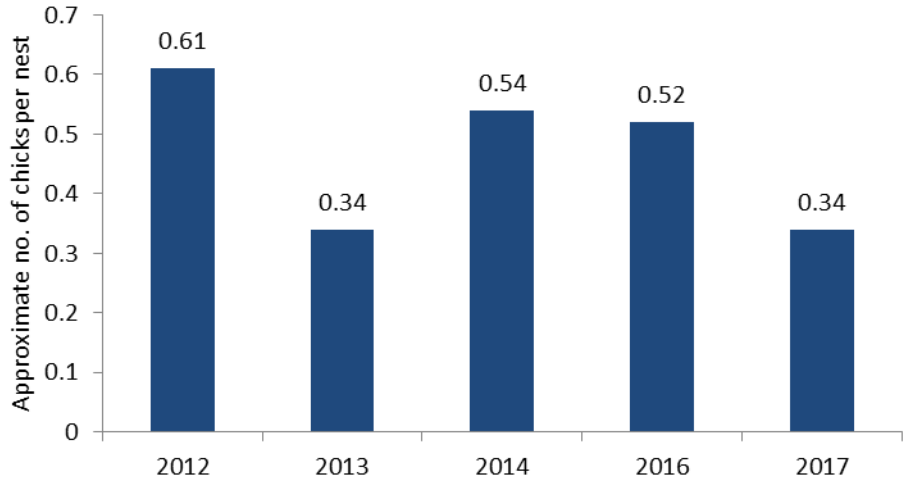
Table 4. Lesser black-backed gull productivity on Gugh

Year	LBBG	Productivity Estimates
2012	361	Approx. 180 chicks fledged from 262 nests South Col top colony (0.69 ch/pr); minimum 19 chicks fledged from 65 nests lower rocks colony

		Cuckold's Carn (0.29 ch/pr).
2013	418	Minimum 103 chicks fledged from 355 nests South Col top colony (0.29 ch/pr)*; minimum 32 chicks fledged from 48 nests lower rocks colony Cuckold's Carn (0.67 ch/pr).
2014	411	Approx. 185 chicks fledged from 325 nests South Col top colony (0.57 ch/pr); minimum 28 chicks fledged from 70 nests lower rocks colony Cuckolds Carn (0.40 ch/pr)
2016	400	Approx. 182 chicks fledged from 359 nests South Col top colony (0.51 ch/pr); minimum 24 chicks fledged from 40 nests lower rocks colony Cuckolds Carn (0.60 ch/pr)
2017	293	Approx. 79 chicks fledged from 249 nests South Col top colony (0.32 ch/pr)*; maximum 21 chicks fledged from 44 nests lower rocks colony Cuckolds Carn (0.48 ch/pr)

***** High vegetation means this count was probably an under-estimate

Figure 3. Lesser black-backed gull productivity on Gugh



Herring gull productivity

In 2015 herring gulls were red-listed as a species of conservation concern due to recent declines in their numbers nationally (estimated 72% loss of abundance between 1969 and 2014, JNCC 2015). Numbers across Scilly of this species have been falling at a similarly rapid rate with a decline of 22% between 2006 and 2015/6 to just 556 breeding pairs (Heaney & St. Pierre 2017). Since 2008 the productivity of herring gulls at three sub-colonies on St. Marys, Tresco and Samson has been recorded. The results are presented in Table 7 and n Figure 4 below. Unfortunately following a number of years of failure the Tresco colony at Gimble Porth has been deserted altogether (the kittiwakes which also nested here annually deserted in 2010). The other two sub-colonies followed are the roof-top population in Hugh Town St. Marys and a sub-section of the birds nesting on Samson – those on the discrete high-backed beaches of the north and west coasts. Fledging success is estimated by returning to mapped nests and observing for chicks from a distance as well by searching amongst the rocks at the site. Every effort is made to record all chicks but even when nearly fledged it is possible that chicks hiding amongst the boulders may be missed.

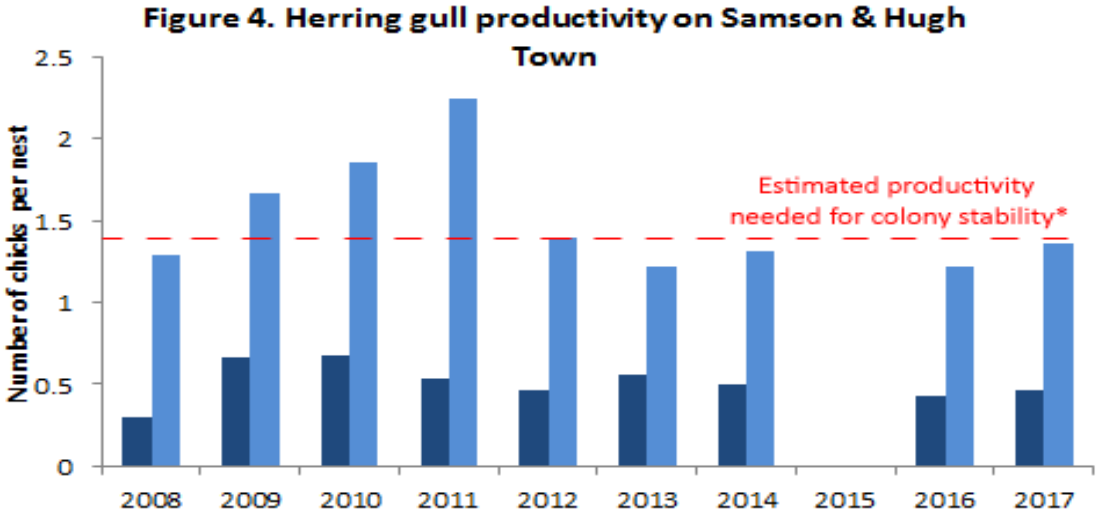
Over the years of this study the small roof-top colony in Hugh Town which presumably relies on more anthropomorphic food sources than those on Samson has fared consistently better. Whilst the absolute number of birds nesting on the study beaches on Samson has declined the number of birds in town, although low, has been increasing. The fledging success in Hugh Town is also substantially higher and well above that needed for colony stability, thus potentially fuelling growth. Unfortunately the

gulls nesting in town are not universally welcomed and the amount of suitable undisturbed roof space very limited.

Across the UK the mean productivity recorded for herring gulls was 0.75 chicks per pair, declining at a rate of 0.016 chicks per pair per year (Cook & Robinson 2010), they estimate for the population to stabilize a productivity of 1.3-1.5 ch/pr/yr would be needed.

Table 7. Herring gull productivity estimates

Year	Gimble Porth	Samson	Hugh Town
2008	0.48 (*n*=50)	0.30 (*n*=84)	1.29 (*n*=7)
2009	0 (*n*=41)	0.66 (*n*=73)	1.67 (*n*=6)
2010	0 (*n*=17)	0.68 (*n*=63)	1.86 (*n*=7)
2011	0 (*n*=9)	0.54 (*n*=71)	2.25 (*n*=8)
2012	0 (*n*= 3)	0.46 (*n*=56)	1.4 (*n*= 10)
2013	0 (*n*=2)	0.56 (*n*=55)	1.22 (*n*=9)
2014	Deserted	0.50 (*n*=34)	1.31 (*n*=13)
2015	Deserted	(*n*=56)	(*n*=14)
2016	Deserted	0.43 (*n*=53)	1.22 (*n*=9)
2017	Deserted	0.46 (*n*=44)	1.36 (*n*=14)



*Cook and Robinson (2010) estimate that an average productivity of 1.3-1.5 chicks per pair per year is needed for colony stability.

Kittiwake productivity

In 1999 and 2006 there were 281 and 266 respectively pairs of breeding kittiwakes spread across 6 sub-colonies in Scilly. Since then there has been a dramatic decline in population and since 2014 only one breeding sub-colony (See Table 8 & Figure 5). This reduction is in line with national trends with their numbers declining particularly rapidly from the 1990s onwards so that by 2015 the UK index of abundance for this species was 60% below that of 1986 (JNCC 2015).

As at the national level the productivity of these birds has also been consistently low, with a number of years of complete failure. Although a small number of chicks were fledged in 2017 at the former site on

the east side of Gugh, at no time in this study has the productivity of the kittiwakes in Scilly approached the level of 1.5 chicks per pair per year, estimated to be needed for colony stability (Cook & Robinson 2010). Previous years have seen failure at the nest building stage (2016) and more commonly in early chick-rearing (2006-9 & 2012) suggesting a problem in finding enough food in early Spring to gain breeding condition or later in the season to adequately provision chicks. In 2015 predation by a single great black-backed gull pair resulted in the failure of the Turks Head colony.

Table 8. Kittiwake breeding numbers across Scilly

SUB-COLONY SITE	1999	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Gugh	155	131	69	50	41	26	0	0	0	0	0	0	30
Gimble Porth, Tresco	54	37	39	30	29	0	0	0	0	0	0	0	0
St. Helen's	7	36	31	35	18	2	0	0	0	0	0	0	0
Samson North Hill	28	25	26	21	9	0	0	0	0	0	0	0	0
Samson South Hill	10	22	15	10	0	0	0	0	0	0	0	0	0
St. Martin's, Daymark	27	15	21	27	22	47	69	54	21	0	0	0	0
Turk's Head, St. Agnes	0	0	0	0	1	1	5	24	38	62	75	5	0
Total Breeding Pairs	**281**	**266**	**201**	**173**	**120**	**76**	**74**	**78**	**59**	**62**	**75**	**5**	**30**
Total Chicks Fledged	**-**	**0**	**0**	**0**	**1**	**54**	**9**	**0**	**36**	**31**	**0**	**0**	**9**

Figure 5. Kittiwake breeding numbers in Scilly

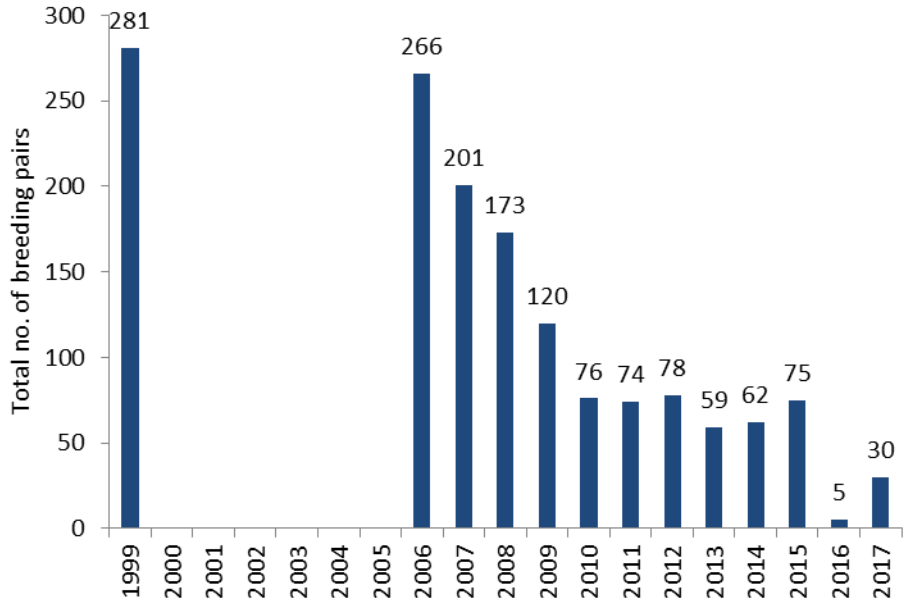
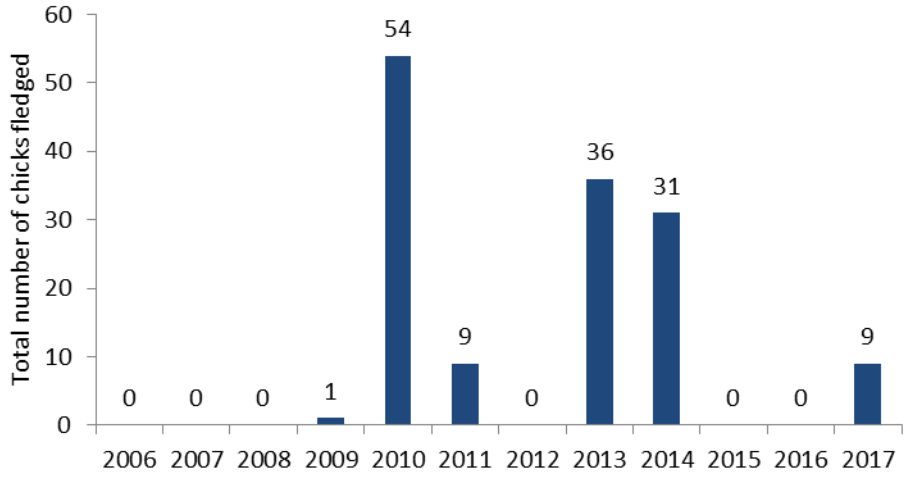


Figure 6. Kittiwake breeding success in Scilly



Fulmar productivity

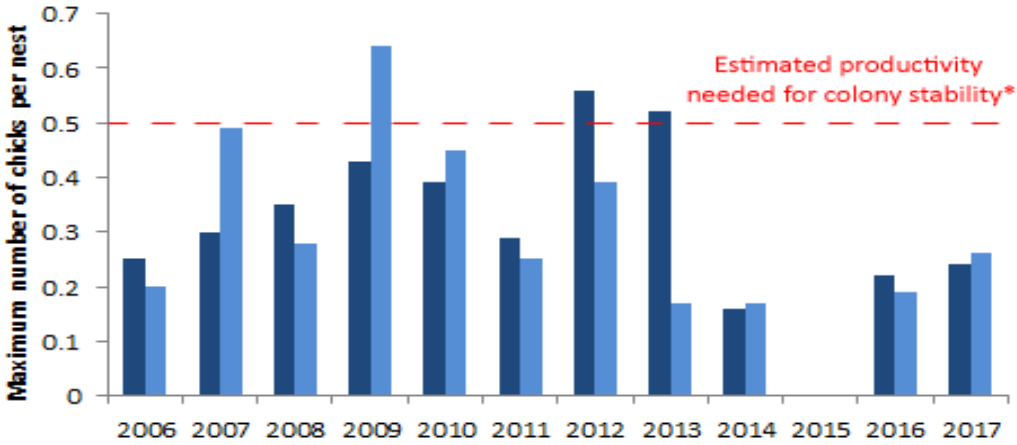
Fulmars first bred in Scilly in 1944. Following rapid growth from the 1970s onwards their numbers across the islands have now reached just under 300 pairs. However in recent years this growth rate has slowed with just a 3% increase in the number of breeding pairs between 2006 and 2015 (Heaney & St. Pierre 2017). Following a slowing in the spectacular growth rate of the early 20th century the numbers of fulmars across the UK are now starting to fall with a 31% decrease in the index of abundance between 2000 and 2015 (JNCC 2015).

Since 2006 two of the main discrete cliff-side sub-colonies, those on Menawethan and the Daymark St. Martin's, have been monitored from the sea. The numbers settling at the two sites have been fairly consistent over this time but the fledging success quite variable (see Table 9 and Figure 7). In particular in the last few years it has been consistently lower than the level needed to sustain the population (Cook & Robinson 2010) and this will go some way to explaining the recent slowing of population growth across Scilly. This poor success in recent years appears to have been repeated elsewhere on the islands, with very few chicks seen to fledge from Round Island or Annet either (W. Wagstaff., & *pers. obs.*). Across the UK the mean productivity recorded for fulmars between 1986 and 2008 was 0.39 chicks per pair per year, declining at a rate of 0.005 ch/pr/yr.

Table 9. Fulmar productivity estimates

	Menawethan	**Daymark**	**Total**
2006	0.25 (*n* = 44)	0.20 (*n* = 46)	90
2007	0.30 (*n* = 41)	0.49 (*n* = 45)	86
2008	0.35 (*n* = 37)	0.28 (*n* = 46)	83
2009	0.43 (*n* = 33)	0.64 (*n* = 36)	69
2010	0.39 (*n* = 30)	0.45 (*n* = 51)	81
2011	0.29 (*n* = 24)	0.25 (*n* = 49)	73
2012	0.56 (*n* = 25)	0.39 (*n* = 59)	84
2013	0.52 (*n* = 27)	0.17 (*n* = 54)	81
2014	0.16 (*n* = 44)	0.17 (*n* = 52)	96
2015	(n = 43)	(n = 46)	89
2016	0.22 (n = 45)	0.19 (n = 57)	102
2017	0.24 (*n* = 34)	0.26 (*n* = 54)	98

Figure 7. Fulmar productivity in Scilly



*Cook and Robinson (2010) estimate that an average productivity of 0.5 chicks per pair per year is needed for colony stability in fulmars.

Common tern productivity

Following a maximum count of 210 breeding pairs in 1983, the number of common terns breeding in Scilly has been in rapid decline (Heaney & St. Pierre 2017). The total number of pairs attempting to breed across the archipelago during this study as well as the outcomes of these attempts is presented in Table 10 and Figure 8. Alongside this steep decline in numbers of terns returning to breed each year, the birds have suffered repeated low success or total breeding failure (see Figure 9). In a number of cases this has been due to their repeated choice of the low-lying Green Island, where high tides often swamp the colony resulting in egg and chick loss.

In recent years the terns have been very late to return to the islands and show any interest in breeding, with hatching observed well into July in both 2016 and 2017. Although in both these years a few chicks fledged, numbers were low and the lateness likely to affect post-fledging survival adversely. Research has shown that sandeels are taking progressively longer to reach threshold 0-group size and this may be related to climate driven changes in the zooplankton community. As sea temperatures increase the cold water adapted copepod species *C. finmarchicus* shift north and *C. heligolandicus* become more abundant. Whilst providing alternative food for developing sandeels this species has a lower lipid content and a later spring burst which does not coincide with the hatching of sandeel eggs (Green *et al. in prep.*) Across the UK the population of common terns decreased by roughly 10% between 2000 and 2015, with the current population index 19% below the 1986 baseline. Productivity fluctuates between 0.75 and 0.35 chicks per pair (JNCC 2015).

Table 10. Common tern productivity estimates

Year	Productivity	Notes
2003	0.43 (*n* = 86)	(Productivity not recorded)
2004	0.59 (*n* = 76)	Majority of nests on North Hill, Samson
2006	0 (*n* = 78)	Young inundated by storm tide, Green Island
2007	0 (*n* = 1)	Only one breeding attempt recorded, Annet
2008	0.26 (*n* = 51)	Green Is. 41 nests; Peasehopper 10 nests
2009	0.39 (*n* = 52)	Green Is. 51 nests; Annet 1 nest

2010	0 (*n* = 0)	Birds settling on Green Is. But site abandoned before laying
2011	0 (*n* = 10+)	Late settlement, then Green Is. Site inundated by storm tide
2012	0 (*n* ≤ 10)	Late settlement, some eggs lost to storm tide Green Island
2013	0	No breeding attempts recorded
2014	0.42 (n = 31)	3 chicks from 12 nests Green Is.; 10 from 19 North Hill Samson
2015	0 (n = 12)	2 Annet; 10 Samson (failed early egg stage)
2016	0.41 (n = 17)	South end Annet very late settling; also 3 newly fledged chicks seen Merrick Island
2017	0.11 (n = 27)	South end Annet extremely late settling again

Figure 8. Common tern breeding numbers in Scilly

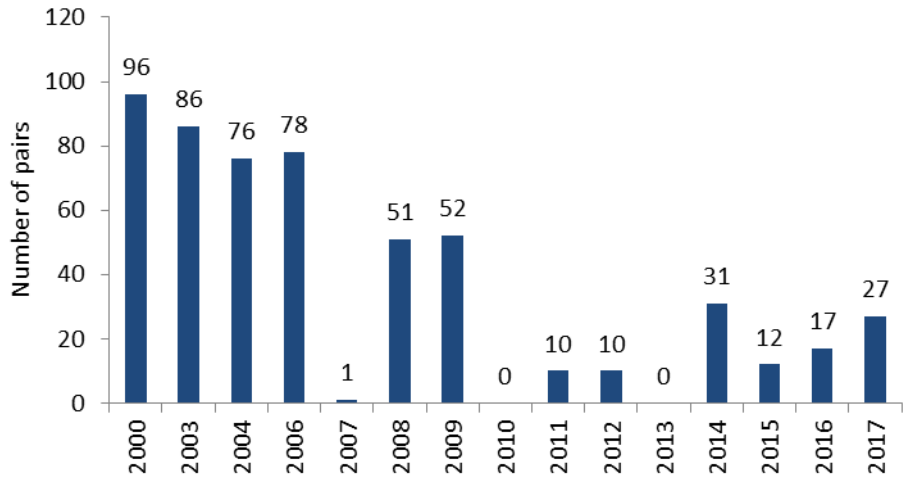
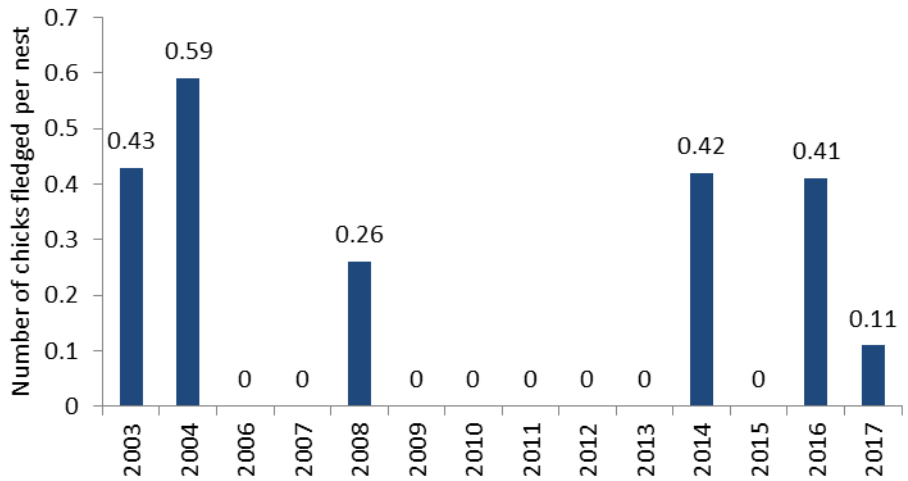


Figure 9. Common tern productivity in Scilly



Shag productivity

In 2016 productivity data was collected for shags for the first time. The shags nesting in Scilly tend to be very 'flighty' with the majority of birds flushing from the beach back nests on disturbance. This apparently differs from a number of other colony sites where these birds are studied and found to remain on their nests, which are often on more cliff ledge locations (e.g. on the Isle of May). This posed an issue for collecting productivity data which required a number of site visits through the season to

account for less synchronised nesting. Limiting the number of visits to just three, one early and two later in the season, hopefully reduced any negative disturbance impact from observations whilst allowing a reasonable estimate of breeding success. Due to the high proportion of birds flushing from nests even at the relatively more visited site of Samson no further productivity data were collected in 2017. The estimated breeding success recorded of 1.30 chicks per pair is slightly higher than the mean breeding success of 1.21 chicks per nest per year between 1986 and 2008 (JNCC 2015), and lends weight to the suggestion that poor survival of either juveniles and/or adult birds in stormier weather is implicated in the shag population declines seen across Scilly and elsewhere in the UK.

Annual count of breeding seabirds on Annet

A count of the seabirds breeding on Annet has been made in most years since 2000 (see Table 5 - no counts were made in 2001 & 2005). This annual count concentrates mainly on the numbers of gulls and shags. Oystercatchers and ringed plovers are included, however due to logistics, an annual count of the burrow nesting puffin, Manx shearwater and storm petrel is not done.

These regular counts document a steep decline in the number of shags nesting on Annet which is mirrored although not so steeply across the rest of the islands (Heaney & St. Pierre 2017). As elsewhere the number of small gulls has also declined. In particular, the sub-colony of lesser black-backed gulls which numbered 517 in 2000 is now deserted. Common terns have returned to breed on the South end of the island in recent years and the number of Great black-backed gulls has increased. Although a significant sub-colony of these large gulls now, the numbers across the islands are still only 62% of the peak for this species before they were controlled by JNCC in the late 1970s (Heaney & St. Pierre 2017).

The reduction in the number of puffins recorded breeding on Annet in 2015 compared to the last count in 2006 (down 38% from 50 to 31) is covered in the 2015/16 SPA Report and is most likely linked to the increase in the number of these birds nesting on Mincarlo (up 34% from 38 to 51) over this same time period. Although the number of fulmars nesting on Annet has increased somewhat in this time and there has been concern over competition for cliff edge nest spaces, there is in reality no shortage of suitable nesting habitat for puffins on Annet. The postcards below dated between 1890 and 1920 show 'Puffin Town' when the north end of Annet was riddled with puffin burrows and supported a much larger breeding population than today. It is also worth noting the significant increase in the number of puffins breeding on Lundy since rat removal – up from just 5 birds in 2004 to 375 in 2017 (Booker *et al.* 2017).

Postcards circa 1920 by CJ King *courtesy of the Isles of Scilly Museum*

Table 5. Breeding seabirds on Annet (a dash indicates that no count was made)

Year	SH	GBBG	LBBG	HG	RAZ	FUL	COT	TOTAL	SP	MX	PUF	OYC	RPL
2000	209	137	517	42	4	21	1	**931**	938	123	47	-	-
2001	-	-	-	-	-	-	-		-	-	-	-	-
2002	-	171	215	7	4	-	**-**		-	-	-	-	-
2003	150	164	18	17	0	45	0	**394**	-	-	-	-	-
2004	159	197	7	32	2	44	0	**441**	-	-	-	5	0
2005	-	-	-	-	-	-	-		-	-	-	-	-
2006	177	187	281	24	4	37	0	**710**	788	89	50	-	-
2007	140	88	0	5	1	37	0	**272**	-	-	-	5	0
2008	164	47	(5)	4	3	48	0	**271**	-	-	-	6	0
2009	154	168	54	7	7	43	0	**433**	-	-	-	6	0
2010	198	213	76	11	2	40	0	**540**	-	-	-	7	1
2011	115	180	27	5	4	37	0	**368**	-	-	-	4	2
2012	107	177	32	8	2	49	0	**375**	-	-	-	-	-
2013	99	208	6	4	1	36	0	**354**	-	-	-	5	0
2014	96	205	10	5	1	38	0	**355**	-	-	-	9	1
2015	85	235	1	20	5	57	2	**405**	778	229	31	6	0
2016	86	215	1	16	6	41	14	**379**	-	-	-	4	1
2017	74	222	7	12	5	41	27	**388**	-	-	-	7	1

Storm petrel study beach on Annet

Between 2010 and 2014 the number of Apparently Occupied Sites at a study beach between Smith's Carn and Minmow on the south end of Annet was recorded annually using diurnal tape-playback. Unfortunately, this boulder beach was totally destroyed by storms in February 2014. A new study beach running between South Carn and Carn Windlass was identified in 2016 and results from this are presented below along with the previous SPA counts from 2000, 2006 and 2015. Although confidence intervals on playback survey results are relatively large due to low response rates, these counts suggest relative stability or possible increase in storm petrel numbers on Annet.

Table 6. Storm petrel numbers at Annet study beach

Year	Number AOSs	Notes
2000	109 (±)	38 responses x 2.86
2006	87	31 responses x 2.86
2015	92	32 responses x 2.86
2016	106	37 responses x 2.86
2017	132	46 responses x 2.86

Discussion

As an evolutionary adaptation to the unpredictable marine environment, seabirds are strongly 'k' selected compared with many other birds. They tend toward high longevity, delayed reproduction and a relatively large number of reproductively active years in which to raise young. As a result they generally have small clutch sizes and may take the option to forgo breeding altogether in years when the likelihood of successfully raising young is low. Due to this life history strategy, seabird populations are to some extent able to buffer the effect of a few years of poor breeding success, with individual birds living long enough to hopefully make up the productivity shortfall in subsequent better years. However, if productivity levels continue to be depressed over successive years, whole cohorts of young will fail to be raised, creating a gap. Unfortunately, the longevity and delayed maturity of the seabirds will initially mask this problem, and it may not become apparent until the older breeding birds start to senesce and are not replaced by new recruitment of young birds to the breeding population.

The big picture factors likely to be driving change in seabird numbers in Scilly are discussed in detail in the 2015/6 SPA report and are summarised in Table 7 below. It is intended that Table 7 will be used at the Seabird Technical Group Annual Meeting in September 2017 to help inform discussion of the wider issues affecting seabirds in Scilly and possible management measures which can be employed to help reverse the declines recorded.

Regarding the specific productivity monitoring and numbers data presented in this report it is clear that a number of often complex and in many cases inter-related factors are likely to be contributing to the breeding successes and failures recorded. However, the principal drivers appear to be;

Rat predation

On the 13th February 2016 the islands of St. Agnes and Gugh were declared officially rat free. Comparing the numbers of Manx shearwater present in 2013 before baiting began and four years later in 2017, it is clear that rat removal has had a very positive impact on the numbers and distribution of apparently occupied burrows and on fledging success. With young shearwaters taking at least four or five years to recruit to the breeding population, the increase in breeding pairs must be attributed to recruitment of surplus young birds from nearby rat-free colonies such as Lundy and Ramsay. This bounce back due to recruitment has been recorded elsewhere after rat removal, with immigrants attracted to new and growing colonies with improved breeding success (Bonnaud *et al*. 2010, Szostek *et al.* 2014). Although Gugh and St. Agnes have extensive suitable habitat for storm petrels, the presence of rats stopped them using it in the past. That storm petrels returned to breed successfully on St. Agnes and Gugh in 2015 is a phenomenal result for the project and the first time in living memory that they have done so. As expected from the literature it does not appear that the removal of rats has had significant impact on productivity in lesser black-backed gulls.

Food availability (mainly driven by Climate change)

Kittiwakes in Scilly have suffered repeated breeding failures, a steep decline in numbers and a loss of sub-colonies. They are small bodied surface feeders with a relatively restricted foraging range and are therefore strongly affected by local changes in prey abundance. Low settlement rates, reduced clutch sizes, later laying and failure during early chick rearing found across this study all suggest the underlying problem is likely to be food supply (Suryan *et al*. 2002). Changes in food supply can mean that adult birds are unable to find sufficient food to meet both their own requirements and the requirements of their offspring. As well as the direct effects on chick growth, low food availability can affect nest survival rates through food-stressed parents spending longer foraging away from the colony, so exposing their nests to adverse weather and predators for longer (Bukacinska *et al*. 1996, 1998, Perrins & Smith 2000, Pons & Migot 1995). As numbers reduce, the capacity for collective colony defence is weakened and secondary factors such as predation by gulls and corvids come into play.

Like kittiwakes, terns in Scilly have suffered repeated breeding failures and a steep decline in numbers in recent years. As with kittiwakes, terns feed at or near the surface and with a short foraging range and inflexible time budgets, so that food supply can be a major driver of population change. They are

strongly affected by local changes in prey abundance as they don't have access to alternative food deeper in water column like the diving auks.

Fulmar productivity has fluctuated from 0.16 to 0.64 chicks per pair at the fulmar sub-colonies studied, but in recent years has been consistently lower than the 0.5 chpp needed for colony stability. Adverse weather has been observed to play a part in some years, however it is likely that food supply is a major driver of change in this population both locally and nationally with initial population expansions then more recent declines associated with changing fisheries discard levels (Reeves & Furness 2002).

The lesser black-backed gulls on Scilly are one of the few large populations left in England that have kept their traditional marine diet and winter migration patterns. On Gugh they have consistently fledged young in the years of this study 2012-17, albeit relatively low numbers in 2013 and 2017. The influence of fluctuations in food supply cannot be overlooked.

Productivity at the rooftop colony in Hugh Town has been consistently higher than at the more 'natural' beach sub-colonies on Samson. Although birds at both colonies have fledged some chicks each year, the sub-colony on Gimble Porth beach on Tresco has now failed. Again food supply appears to be a major driver of change in this population, with the availability of anthropomorphic food waste likely fuelling the high success on St. Marys. The productivity recorded here is sufficient to effect an increase in population, but lack of additional roof nesting locations is probably limiting further growth at this site.

Weather (increased storminess – climate change)

In Scilly in addition to presumed food supply issues resulting in late settlement and low numbers attempting to breed, common terns have also suffered tidal inundation in a number of years due to their choice of the low-lying Green Island site. Particularly wet weather around chick hatching has also been seen to reduce productivity in gulls and fulmar.

Suitable habitat availability

Vegetation cover can be significant in the settlement and success of gull colonies. Some cover is good (sheltered micro-climate and reduced conspecific aggression) but there is a trade-off as it becomes denser, influencing visibility of predators and ease of access and escape. This is particularly true for areas on a number of islands in Scilly where dense honeysuckle and woody bramble shoots appear to restrict nests to incidental rocks and old boundary walls. However it should also be noted that the settlement and trampling of vegetation by gulls tends to keep it down in their nesting colony areas rather than the other way round.

Although herring gulls in the Hugh Town colony may be limited by the availability of roof top nesting sites, in general habitat availability does not appear to be a major driver of productivity failure.

Disturbance

Across the islands as a whole the loss of gull colonies from the inhabited off-islands in recent years may well also be influenced by human disturbance. Although some disturbance has been noted anecdotally at tern and gull breeding sites, no direct influence on productivity has been measured.

The digging up of Manx shearwater burrows by dogs has also been recorded on occasion as has cat predation.

Table 7. Summary of factors driving change in seabird numbers in Scilly.

Factor driving change	Mechanism of effect	Species impacted	Possible management measures
	Rats – lowering productivity, clear driver of population change	Particularly burrow-nesters	**Clearance of rats from Agnes & Gugh achieved – support community in maintaining vigilance and biosecurity, part-time Biosecurity Officer?** **Work towards future clearance across St. Martins, Tresco and Bryher (flavour monitoring, DNA resistance)** **Control of rats at key sites e.g. St. Helens** **Trial new technology e.g. Good Nature traps**
	Hedgehogs – lowering productivity	Ground-nesters – particularly waders	Only present on St. Mary's – raise awareness so not spread
	Rabbits – destroy habitat and compete for burrows, but also alternative food source for large gulls on Annet	Particularly burrow nesters	Present on Annet, Great Ganilly and all inhabited islands – possible study?
	Domestic and feral cat predation	Affected gulls on Gugh in 2007	Awareness raising, study/ monitor and deal with specific cases
	Increased storminess particularly in Spring reducing productivity and survival of juveniles and adults – food supply issues clear driver of population change	Wrecks - shags and auks Reduction in foraging success hard to attain breeding condition and later feed chicks – all species, particularly terns and kittiwakes Wet weather chilling eggs and young chicks Collapse of unstable waterlogged cliff nesting sites - kittiwake Inundation of nests when rough weather	

		combined with high tides - terns Destruction of nesting beaches – storm petrel Flooding - burrow-nesters	
	Reduction of food supply by disrupting ocean fronts in early spring	All but particularly small-bodied inshore surface feeders – kittiwakes and terns	
	Higher sea temperatures reduce the abundance of small fish at the surface and cause reductions/ changes in zooplankton that sandeels feed on; though sprats may increase	Small-bodied inshore surface feeders – can't access food deeper in water column like auks can Delay in sandeel availability can cause delay in breeding also – kittiwakes, terns	
Avian predators	Gulls, ravens and crows – reducing productivity (limited direct evidence and mostly secondary cause of failure after poor food supply – reduced colony size and lower nest attendance)	All but particularly - shags, terns, kittiwakes, storm petrel	Natural part of seabird assemblage and of conservation importance in their own right. Provision of wooden chick boxes to reduce gull predation pressure on terns. Laser deterrent?
		Possible reduction in habitat suitability – Lesser black-backed gull	Gulls settle and keep vegetation down v. clearance of study plots? Analyse records of vegetation/ habitat change e.g. ERCIS GIS data, fixed point photography
		Dense brambles round burrow entrances - Manx shearwater	Clearance of woody bramble round densest burrow areas Gugh and St. Helens – but may result in more vigorous re-growth if not maintained, also possible predation cover
		Terns need bare/ sparsely vegetated areas	Could look at spreading sand/ shells – ultimately not limited by habitat availability

Human disturbance	Disturbance of nests (dog-walkers, picnickers, kite-surfers, kayakers etc.)	Gulls, terns and waders on beaches in particular	**Important to manage for people and wildlife – awareness raising, closed areas, maintain paths, promote sustainable development, recreation and safe maritime practices (WISE)** Review location of gull declines and monitor disturbance e.g. at Gugh, colony by path Analysis of economic factors around seabird assemblage – value to tourism economy
	Dogs not on leads digging and entering breeding colonies	Manx shearwater burrows dug up (Gugh, St. Marys and Bryher) and occasionally adults killed (Giants Castle 2007, Shipman Head 2008) Terns on Samson disturbed by dog walkers	Islands currently being heavily marketed as 'Dog Friendly' destination. Signage and awareness raising of sensitive and closed nesting areas Samson signage on north hill path by tern colony 2014 (keep dogs on a lead, don't linger)
	Reduction in fisheries discards	Particularly gulls and fulmars	Scillonian fishery small and mainly shellfish, but birds have access to fleet from Newlyn
	Reduction in domestic refuse	Gulls	Waste now shipped to mainland
Disease	Killing adults and/ or chicks – suspected to be a major driver in gull population declines through adult mortality	Botulism in gulls from refuse (reduced discards feed more on waste); red tide toxins in shags and kittiwakes; Puffinosis in Manx chicks	**Investigate cases of mortality in gulls**
Pollution	Marine plastics ingested	Surface feeders - fulmars particularly	Raise awareness of marine plastics, beach cleans, Reduce Reuse Recycle
Fisheries by-catch	Drowning in inshore fixed gill nets, hooked on long-lines	Mainly pursuit diving auks, shag and fulmars	Scilly fishery currently small, but may be an issue in wintering ranges

Table 8a. Future monitoring recommendations

Species/ Location	**Population trends**	**Rationale for study**	**Monitoring recommendation – Prioritisation (HIGH, MEDIUM, LOW)**
All islands SPA Survey	8266 pairs of breeding seabirds 9.8% decline*	Internationally important numbers of seabirds Assemblage SPA notified feature SSSI condition analysis	6 yearly full SPA counts – next due 2022/ to fit in with next National Census **H**
Annet	1443 breeding pairs 12% decrease* (mainly LBBG)	Main seabird island, annual counts since 2006 'heartbeat' but no kittiwakes here and hardly any smaller gulls now SSSI (notified seabird features MX, GBBG, SP, PUF, COT, LBBG)	Annual counts of all species except burrow nesters **H** Annual count of storm petrels in study beach **H**
St. Agnes & Gugh	463 breeding pairs (2017) 59% decrease* (mainly LBBG)	Annual counts since 2012 LIFE requirements, SRP legacy, Community support for continued survey (engagement & motivation)	Annual count of AOBs Manx shearwater and storm petrel AOSs (study area only) – LIFE requirement **H** Annual count of chicks fledging (easy boating but camping cost and repeated checks) **H/ M** Annual count of other seabird species **M** [Ringing of chicks to investigate recruitment]
Black-legged kittiwake	30 pairs on 1 island 72% decrease*	Red/Amber listed notified feature Chapel Down SSSI St Martins	Annual monitoring of all settlement and fledging **H** [Monitoring of provisioning/ attendance/ predation] [Colour-ringing adult return/ survival]
Common tern	27 pairs on 1 island 85% decrease*	Amber listed regional importance notified feature Annet, Samson & Pentle Bay SSSIs Linked to Roseate tern return (last bred 1995)	Annual monitoring of all settlement and fledging **H** [Monitoring of provisioning/ attendance/ predation] [Colour-ringing adult return/ survival]

Manx shearwater	523 pairs on 10 islands 206% increase*	Amber listed regional importance – only two sites in England notified feature Annet SSSI 6% breeding assemblage	Annual counts on St. Agnes & Gugh see above Monitoring of settlement on St. Helen's linked to rat control **M** Monitoring of settlement and fledging on St. Mary's, Tresco, Bryher (easy boating but, many visits, baseline for future removal impact monitoring) – **M/ L**
Storm petrel	1335 pairs on 14 islands 5% decrease*	Amber listed international importance – only two sites in England SPA notified feature notified feature Annet & Round Island SSSI 16% breeding assemblage	Annual monitoring of breeding numbers on Annet study beach and sample areas on St. Agnes & Gugh see above Annual monitoring nesting boxes (6 on St. Agnes) and productivity if occupied **H**
Lesser black-backed gull	2485 pairs on 30 islands 26% decrease*	Amber listed; international importance SPA notified feature notified feature Annet SSSI 30% breeding assemblage NE focus species	Annual monitoring of productivity on Gugh **H** Colour-ringing adult return/ survival [Monitoring of provisioning/ attendance/ predation] [Diet study – pellet analysis]
Herring gull	556 pairs on 47 islands 22% decrease*	Red/Amber listed 7% breeding assemblage NE focus species	Annual monitoring of productivity on Samson & Hugh Town **H/ M** [Colour-ringing adult return/ survival] [Monitoring of provisioning/ attendance/ predation] [Diet study – pellet analysis]
European shag	1025 pairs on 31 islands 21% decrease*	Red/Amber listed national importance – possibly largest UK colony now	Productivity monitoring priority **H** but problems with disturbance – investigate use of nest cameras? [Colour-ringing adult return/ survival]

		notified feature Western Rocks SSSI 12% breeding assemblage NE focus species	[Study of winter activity, food availability] [Monitoring of provisioning/ attendance/ predation]
Puffin	167 pairs on 10 islands 4% decrease*	Red/Amber listed regional importance notified feature Annet SSSI NE focus species	Annual monitoring of numbers across islands (boating charter needed) Productivity monitoring medium/ high priority but not possible at boulder sites – nest cams?
Great black-backed gull	984 pairs on 45 islands 9% increase*	Amber listed national importance notified feature Annet SSSI 12% breeding assemblage	Productivity monitoring would need mark/ ring recapture – two visits with a ringing team Annet?
Northern fulmar	287 pairs on 18 islands 3% increase*	Amber listed regional importance notified feature Men-a-vaur SSSI	Annual monitoring at Menawethan & Daymark (continuous data-set since 2006, but boat charter needed, could reduce sample size to sites can monitor from St Martins without charter @30) **M/L**
Razorbill	473 pairs on 16 islands 38% increase*	Amber listed regional importance notified feature Men-a-vaur SSSI	
Guillemot	291 pairs on 5 islands 88% increase*	Amber listed notified feature Men-a-vaur SSSI	
Great cormorant	53 pairs on 3 islands 6% increase*	Green listed notified feature Norrard Rocks SSSI	

* % change in population between 2006 and 2015/16; LBBG – lesser black-backed gull

Table 8b. Future monitoring recommendations – staffing and boating ballpark estimates

Species/ Location	**Monitoring recommendation – Prioritisation (HIGH, MEDIUM, LOW)**	**Staff days**	**Boating**
All islands SPA Survey	6 yearly full SPA counts – next due 2022/ to fit in with next National Census **H**	4 full time staff	Expensive!
Annet	Annual counts of all species except burrow nesters **H**	2.5 (plus volunteer help)	1 or 2 charter returns
Annet	Annual count of storm petrels in study beach **H**	1.5 (plus volunteer help)	1 charter return
St. Agnes & Gugh	Annual count of AOBs Manx shearwater and storm petrel AOSs (study area only) – LIFE requirement **H**	5 (plus volunteer help)	8 returns
Black-legged kittiwake	Annual monitoring of all settlement and fledging **H**	5 (plus volunteer help)	6 returns
Common tern	Annual monitoring of all settlement and fledging **H**	4 (plus volunteer help)	5 returns, possible charter
Storm petrel	Annual monitoring nesting boxes (6 on St. Agnes) and productivity if occupied **H**	2	2 returns
Lesser black-backed gull	Annual monitoring of productivity on Gugh **H**	5 (plus volunteer help)	8 returns
Herring gull	Annual monitoring of productivity on Samson & Hugh Town **H/ M**	5 (plus volunteer help)	5 returns
St. Agnes & Gugh	Annual count of chicks fledging (easy boating but camping cost and repeated checks) **H/ M**	7 (plus volunteer help)	10 returns (plus camping)
St. Agnes & Gugh	Annual count of other seabird species **M**	Can be done at same time as Manx counts	n/a
Manx shearwater	Monitoring of settlement on St. Helen's linked to rat control **M**	1.5 (plus volunteer help)	Charter return
Manx shearwater	Monitoring of settlement and fledging on St. Mary's, Tresco, Bryher (easy boating but, many visits, baseline for future removal impact monitoring) – **M/ L**	4 (plus volunteer help)	8 returns
Northern fulmar	Annual monitoring at Menawethan & Daymark (continuous data-set since 2006, but boat charter needed, could reduce sample size to sites can monitor from St Martins without charter @30) **M/L**	4	3 x charter 1.5 hours

References

Bonnaud E, Zarzoso-Lacoste D & Bourgeois K Top predator control on islands boosts endemic prey but not mesopredator. Animal Conservation 13 (6): 556-567.

Booker H & Price D (2014) Manx shearwater recovery on Lundy: Population and distribution change from 2001 to 2013. Journal of the Lundy Field Society, 4: 105-116.

Booker H, Appleton D, Bullock D, MacDonald R, Bell E, Price D, Slader P, Frayling T and Taylor T (2017) Seabird recovery on Lundy following eradication of brown and black rats. Island Invasives 2017 Dundee Conference Poster.

Brooke M de L (1990) The Manx shearwater. T & AD Poyser, Calton.

Bukacinska M, Bukacinski D & Spaans AL (1998) *Experimental evidence for the relationship between food supply, parental effort and chick survival in the Lesser Black-backed Gull* Larus fuscus*.* Ibis 140: 422-30.

Cook A S C P & Robinson R A (2010) How representative is the current monitoring of breeding success in the UK? BTO Research Report No.53, BTO, Thetford.

Dawson RJG 2012. Survey of Breeding Land birds of the Isles of Scilly. Isles of Scilly Wildlife Trust.

De Leon A, Minguez E, Harvey P, Meek E, Crane J E & Furness R W (2006) Factors affecting breeding distribution of storm petrels Hydrobates pelagicus in Orkney & Shetland. Bird Study 53: 64-72.

Heaney V., N. Ratcliffe, A. Brown, P.J. Robinson & L. Lock (2002). The status and distribution of European storm petrels *Hydrobates pelagicus* and Manx shearwaters *Puffinus puffinus* on the Isles of Scilly. Atlantic Seabirds 4(1): 1-16

Heaney V, Lock L, St Pierre P & Brown A (2008) *Important Bird Areas: Breeding seabirds on the Isles of Scilly.* British Birds 101: 418-438.

Heaney, V. & St. Pierre, P. (2017) The status of seabirds breeding in the Isles of Scilly in 2015/16. Upubl. RSPB Report.

JNCC (2015) Seabird population trends and causes if change: 1986-2014 Report [http://www.jncc.defra.gov.uk/page3201] Joint Nature Conservation Committee Updated September 2016. Accessed September 2017.

Green E, Bolton M, Piec D & Lock L (in prep) The diet of terns around the British Isles. RSPB Report

Moors PJ & Atkinson IAE (1984) Predation of seabirds by introduced animals and factors affecting its severity. In: Croxall JP, Evans PGH & Schreiber RW (eds) Status and conservation of the world's seabirds. Pp. 667-690. ICBP Technical publication No. 2, Cambridge.

Perrins CM & Smith SB (2000) *The breeding* Larus *gulls on Skomer Island National Nature Reserve, Pembrokeshire.* Atlantic Seabirds 2: 195-210.

Pons JM & Migot P (1995) *Life-history strategy of the Herring Gull, changes in survival and fecundity in a population subjected to various feeding conditions*. J. Anim. Ecol. 64: 592-9.

Porter R, Brown A & Lock L (2010) English seabird monitoring project south west England 2006-2009. Natural England & RSPB Unpubl. Report.

Prieto J, Gonzalez-Solis J, Ruiz X & Prieto J (2003) Can rats prey on gull eggs? An experimental approach. Biodiversity and Conservation 12(12): 2477-2486

Reeves SA & Furness RW (2002) *Net loss – seabirds again? Implications of fisheries management for seabirds scavenging discards in the northern North Sea.* Unpubl. Rep. Royal Society for the Protection of Birds, Sandy.

Riou S & Hamer K 2008. Predation risk and reproductive effort: impacts of moonlight on food provisioning and chick growth in Manx shearwaters. Animal Behaviour 76: 1743-1748.

Szostek KL, Schaub M & Becker PH (2014) Immigrants are attracted by local pre-breeders and recruits ion a seabird colony. J. of Animal Ecology 83(5): 1015-1024.

Thompson KR, Brindley E & Heubeck M (1998) Seabird numbers and breeding success in Britain and Ireland, 1997. Joint Nature Conservation Committee. (UK Nature Conservation No. 22) Peterborough.

Upton A J, Pickerell G and Heubeck M (2000) *Seabird numbers and breeding success in Britain and Ireland 1999.* JNCC, Peterborough.

Walsh PM, Halley DJ, Harris MP, del Nevo A, Sim IMW & Tasker MC (1995) *Seabird monitoring handbook for Britain and Ireland*. JNCC/ RSPB/ ITE/ Seabird Group, Peterborough.