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Isle of May seabird studies in 2015

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Summary

The 2015 breeding season on the Isle of May NNR proved to be another good year following the general success of 2014. Breeding in 2015 commenced early for most species, especially European shags and black-legged kittiwakes.

Of the six study species, northern fulmar, European shags and black-legged kittiwakes had one of their most successful seasons on record. Common guillemot and Atlantic puffin had above average breeding seasons, while razorbill returned to typical levels after four poor years. Return rates were above the long term average in all five study species. Sandeels (*Ammodytes sp.*) remained the main food of young razorbill, Atlantic puffins, shags and kittiwakes. The diet of common guillemots was dominated by clupeids. The main results are as follows:

- Northern fulmar breeding success (0.52 chicks per incubating pair) was well above average.

- European shags had an above average breeding season (1.91 chicks per pair). Return rate was above average at 87.9%. Diet was dominated by sandeel which occurred in 94% of samples.

- Black-legged kittiwakes had an excellent season with productivity (1.07 chicks per completed nest) being well above average. Adult return rate (84%) was also well above the long term average. The proportion of sandeel in the diet (66% by biomass) was below average whereas the proportion of clupeid (22% by biomass) was typical.

- Guillemots had an average breeding season (0.78 chicks leaving per pair). Return rate of adults (93.1%) was above average. Adults fed their chicks mainly on medium-sized sprats (91% by number).

- Razorbill breeding success (0.60 chicks leaving per pair) was typical and adult return rate (86.2%) was typical. Chick diet contained more sandeel (59% of loads) than clupeids (40%).

- Atlantic puffins had an average season with 0.75 chicks fledging per pair laying. The return rate for adults (89.8%) was above average. Chicks were fed mainly sandeels (87% by number) with Clupeidae (mainly sprats) and Gadiformes (mainly rockling) contributing 7% and 6% respectively.

Contents

1 Background

The Joint Nature Conservation Committee (JNCC) has a responsibility to advise on certain aspects of the condition of the natural marine environment. Seabirds are one of the more important components of this environment, and Britain has internationally important populations of several species. JNCC has designed a programme that will allow the numbers and breeding success of selected species of seabirds to be monitored at a range of colonies throughout the UK. In addition, selected colonies have been targeted for more detailed monitoring of reproductive performance and annual survival rates. These selected colonies are geographically spread in order to give as full a coverage as possible of British waters; the Isle of May NNR is the chosen site in eastern Britain.

The Centre for Ecology and Hydrology (CEH, formerly known as ITE) has had a long-term interest in seabirds on the Isle of May. Since 1986, CEH has received NCC-CSD/JNCC support for a more formalised seabird monitoring programme. Long-term studies on numbers, breeding success, adult survival, and chick food are carried out on up to eight species. Due to the long period of immaturity and high annual survival rates of seabirds, it is essential that continuity of these long-term studies is maintained. As part of its Seabird Monitoring Programme, JNCC has a contract with CEH to:

a) ensure that the breeding success of northern fulmars *Fulmarus glacialis*, European shags *Phalacrocorax aristotelis*, black-legged kittiwakes *Rissa tridactyla*, common guillemots *Uria aalge*, razorbills *Alca torda* and Atlantic puffins *Fratercula arctica* is monitored;

b) monitor adult survival of black-legged kittiwakes, common guillemots, razorbills and Atlantic puffins. Monitoring of European shag adult survival was also included up to March 1994, was then excluded for the 1994 season, but was reinstated in May 1995;

c) assess food of young European shags, black-legged kittiwakes, common guillemots, razorbills and Atlantic puffins; and

d) undertake special studies on species agreed between the nominated officer and the contractor.

Soon after the Seabird Monitoring Programme (SMP) on the Isle of May was initiated, the Danish industrial sandeel fishery started to use the fishing grounds on the Wee Bankie, Marr Bank and Scalp Bank. These lay 30-50km east of the island and are known to be important feeding areas for many seabirds during the breeding season. Considerable concern has been expressed about the potential impact of this fishery on the top predators in the area. In December 1999, EU Fishery Ministers agreed a ban on fishing for sandeels, effective for 2000 and still in place in 2016, in 20,000 square kilometres of sea off eastern Scotland (including the Wee Bankie grounds) and northeast England.

The breeding success of kittiwakes and shags, which had declined whilst the fishery was in operation, increased during the period 2000-2003, suggesting that the industrial fishery on the Wee Bankie had adversely affected this species (Daunt *et al* 2008). However, from 2004, breeding success and adult return rate declined in several species, including kittiwakes, despite the fishing ban still being in operation. The common guillemot was particularly hard hit, with the period 2004-2008 representing the five worst breeding seasons on record. Particularly poor breeding seasons were recorded in several species in 2004, 2007 and 2008 (Ashbrook *et al* 2008). Over the same period, there

were changes in seabird diet with the sudden appearance of snake pipefish *Entelurus aequoreus* the most dramatic. Although numerous, this prey is difficult to digest and of poor nutritional value (Harris *et al* 2008). Pipefish have now disappeared from the diet of seabirds on the Isle of May.

Whilst not universal across all species in all years, a marked improvement in breeding success and adult survival was observed in the following seven years up to 2015. Continued monitoring of the Isle of May seabirds is vital to assess whether the period 2009-2015 is a recovery after the setback of the previous few years, or a temporary departure from a sustained period during which poor environmental conditions override any benefit of fishery closure, and catastrophic years such as 2004, 2007 and 2008 become commonplace.

Marine Scotland granted consent for the construction of four wind farms in the Forth/Tay region in October 2014. A judicial review was lodged by RSPB in January 2015 and the ruling is expected in 2016. Offshore wind farms have the potential to impact on seabird populations, notably from collisions with turbine blades and through displacement from important habitat. However, the population consequences of wind farm effects are poorly understood. The long-term study of seabirds on the Isle of May will be essential in assessing the effects of these wind farms on protected seabird populations, should they be constructed, by providing high quality baseline data on demography and behaviour enabling changes associated with wind farms to be partitioned from variation associated with other factors such as climate change and fisheries effects.

2 Methods

2.1 Breeding success

The standardised methods used involved minimal disturbance of birds and are described in detail in Walsh *et al* (1995). Average breeding success of each species was estimated in two ways, as the average across all nests (the pooled average) and as the average of plot averages (the plot average).

Northern fulmar

The positions of apparently incubating birds in ten areas were marked on photographs on 3, 5 and 7 June. At sites where birds appeared to be incubating on three consecutive visits, or where an egg was seen, breeding was assumed to have occurred. These sites were checked again on 6 July to determine those that had hatched eggs. A final check was made on 17 August, when chicks present were assumed to have fledged successfully.

European shag

The positions of nests constructed in nine areas were marked on photographs and the state and contents of these nests were checked weekly from 21 March until 29 July. Young (medium-sized or larger) that remained on 29 July were assumed to have fledged successfully.

Black-legged kittiwake

The positions of nests in 15 areas were marked on photographs and the presence or absence of an incubating bird, or the number of young present at each, was noted. Because of the long-term decline in kittiwake numbers on the Isle of May, the extent of the plots at Greengates and Cornerstone were increased in 2005 with new plots also put in place at South Horn and Hide Face and these were continued in 2015. Checks of nests were made on 3 June when regular checks of sample areas showed that most pairs had constructed nests. The first fledged young was seen on 11 July and a complete check of nests was made on this date. Further checks of the nests with small chicks on 11 July were made on 17, 19 and 27 July. Chicks alive on 27 July were assumed to have fledged.

Common guillemot and razorbill

Daily checks of the state of breeding of numbered nest-sites were made from permanent hides at five study plots for common guillemots and four study plots for razorbills.

Atlantic puffin

Samples of 50 burrows where an egg was present were staked in each of four areas on 27-28 April by when checks suggested that most pairs had laid. The staked burrows were re-checked on 28-29 June at the start of fledging.

2.2 Adult survival rates

Estimates of adult survival rates were based on sightings of individually colour-ringed birds and are therefore, strictly speaking, return rates. The areas in which birds were originally marked were checked regularly throughout the season and adjacent areas were searched from time to time in an attempt to locate any individuals that had moved. Searches were periodically made of the whole island for birds that had moved out of the study areas. These latter searches are very time-consuming, and superficially unrewarding, but are essential if accurate estimates of survival are to be obtained. Observations on the survival of adult Atlantic puffins were concentrated at Little Hole (where many burrows are individually numbered). As in recent years, the area used for monitoring survival of adult black-legged kittiwakes included East Tarbet, Rona (North Horn Gully), Low Light Gully, Cornerstone and its nearby cliffs. The Little Hole plot no longer has any kittiwakes while a new plot was added at Kittiwake Gully in 2013.

2.3 Food of chicks

Food regurgitated by young European shags, young black-legged kittiwakes and adults of both species feeding young, and loads of fish dropped by adult Atlantic puffins caught in mist-nets were collected. Regurgitates and food loads were weighed, fish identified and, where possible, measured (total length, snout to tip of tail), and for shag and kittiwake regurgitates an initial estimate of diet composition made. Fish otoliths were extracted from regurgitates, identified and measured. The weights of the fish from which they came were calculated from otolith length/fish length and fish length/mass regression relationships from fish collected from birds on the island in 2015, otherwise from published relationships. Biomass proportions were derived from initial estimates of diet composition, with species confirmed from identification of bones, or from fish mass estimates from otoliths where initial assessments were unavailable. Observations were made of fish brought to young common guillemots and razorbills during two all-day watches, as well as opportunistically on most other days throughout the chick-rearing period. Uneaten fish were collected from breeding ledges to confirm identifications and size assessments of common guillemot diet, from which biomass proportions were estimated using fish length/mass regressions as outlined above. Fish sizes for razorbills were broadly assessed against the bird's bill but since it was not possible to collect samples directly from this species, fish were placed into size classes. Thus, biomass estimates are available for shags, kittiwakes, guillemots and puffins only.

3 Results

3.1 Breeding success

Appendix 1 contains species summaries in Table 1 and a comparison with recent years' results is shown in Table 2. Long-term averages presented do not include the current year.

Northern fulmar

Breeding success at 0.52 chicks fledged per incubating pair (Table 1) was well above the 1986-2014 average (0.39, Table 1, CI=0.34-0.43).

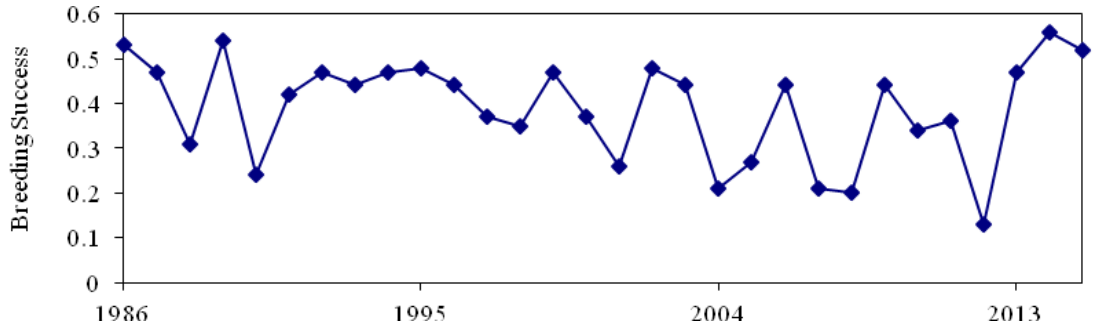

Figure 1. Breeding success (young reared per pair breeding) of northern fulmar on the Isle of May 1986 – 2015.

European shag

A total of 109 chicks were raised to fledging from the 57 completed nests. The number of completed nests was a small increase on the previous two seasons (55) but half of the 2012 total (108) due primarily to poor over winter survival of adults in the winter of 2012/2013. Productivity at 1.91 chicks per nest built was well above average (Table 1, 1986-2014 average = 1.09; CI=0.90-1.28) and has only been exceeded in two other years.

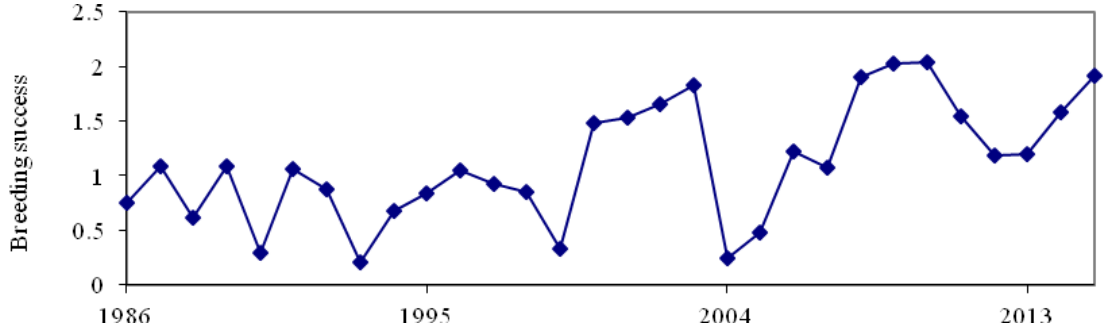

Figure 2. Breeding success (young reared per pair breeding) of European shag on the Isle of May 1986 – 2015.

Black-legged kittiwake

Mean breeding success was 0.98 chicks per completed nest averaged across the plots and 1.07 after pooling plots (Table 1). This value was well above the 1986-2014 average (0.58, CI=0.44-0.71), having only been exceeded in four previous years. As in previous years, breeding success was very variable between plots which may have been a result of predation by gulls in some areas.

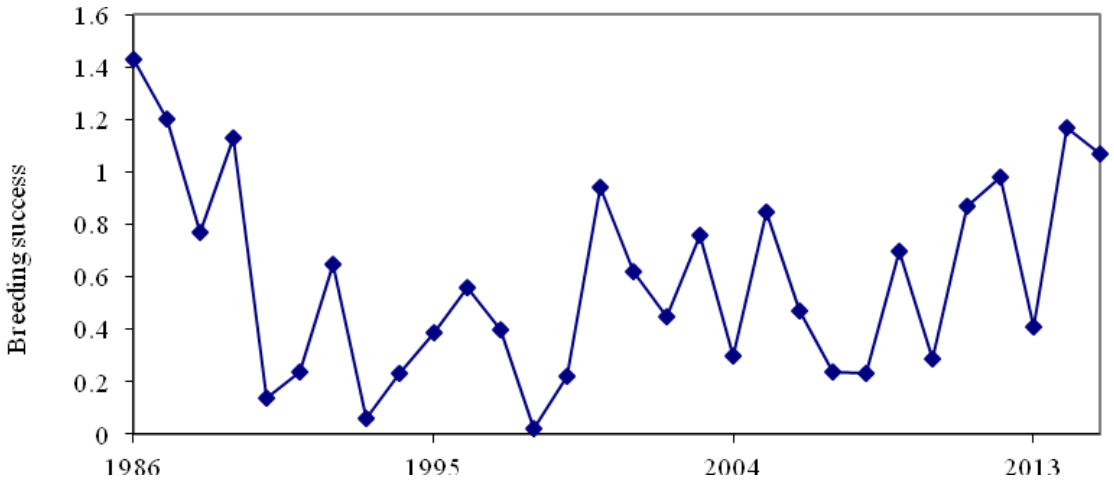

Figure 3. Breeding success (young reared per pair breeding) of black-legged kittiwake on the Isle of May 1986 – 2015.

Common guillemot

Breeding success (0.79 young leaving per pair laying for the plot average and 0.78 for the summed total; Table 1) was similar to that in recent years.

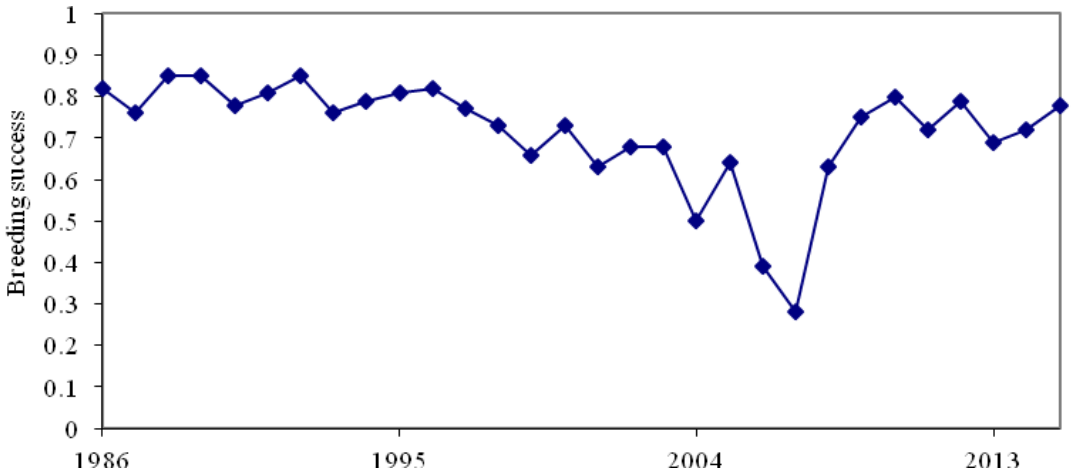

Figure 4. Breeding success (young reared per pair breeding) of common guillemot on the Isle of May 1986 – 2015.

Razorbill

Mean breeding success (0.62 per pair laying for the plot average and 0.60 for the summed total; Table 1), was the highest since 2010.

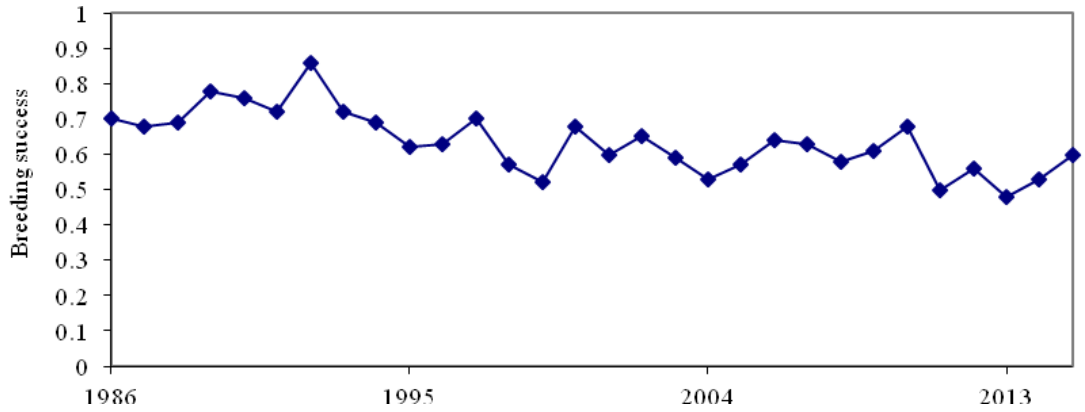

Figure 5. Breeding success (young reared per pair breeding) of razorbill on the Isle of May 1986 – 2015.

Atlantic puffin

The mean breeding success of 0.75 chicks per egg laid based on chicks alive on 28-29 June, immediately prior to the first chick fledging overnight 30 June/ 1 July, was the highest since 2010 (Table 1).

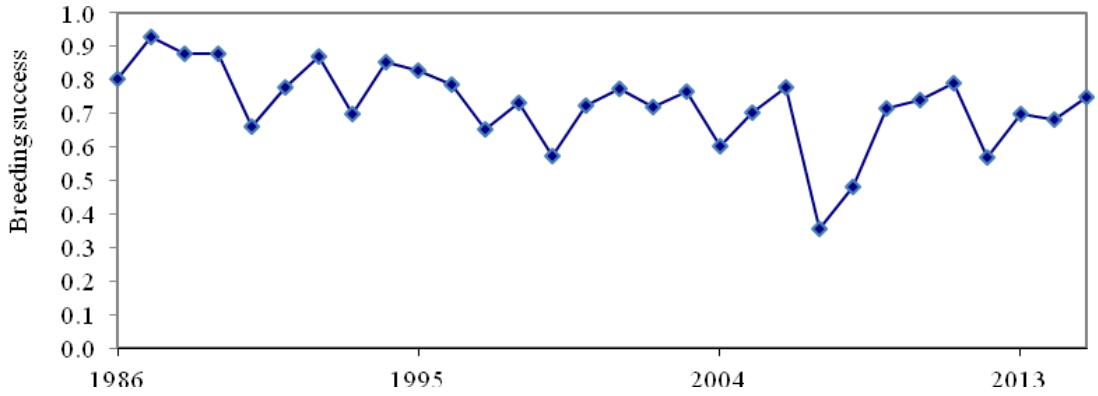

Figure 6. Breeding success (young reared per pair breeding) of Atlantic puffin on the Isle of May 1986 – 2015.

3.2 Adult survival 2014-2015

Not every adult alive is seen each year and thus return rates for 2015 presented here need to be treated as minimum estimates of survival of birds seen in 2014. The results are compared with those of previous years in Table 3 in Appendix 2. During 2015, 33 European shags, 11 black-legged kittiwakes, 8 common guillemots, 14 razorbill and 7 Atlantic puffins were newly colour-ringed. The long-term averages presented in this section do not include the current year.

European shag

The return rate for 2015 (87.9%) was above average (long-term average 78.1%, 95% CI = 71.2-85.6).

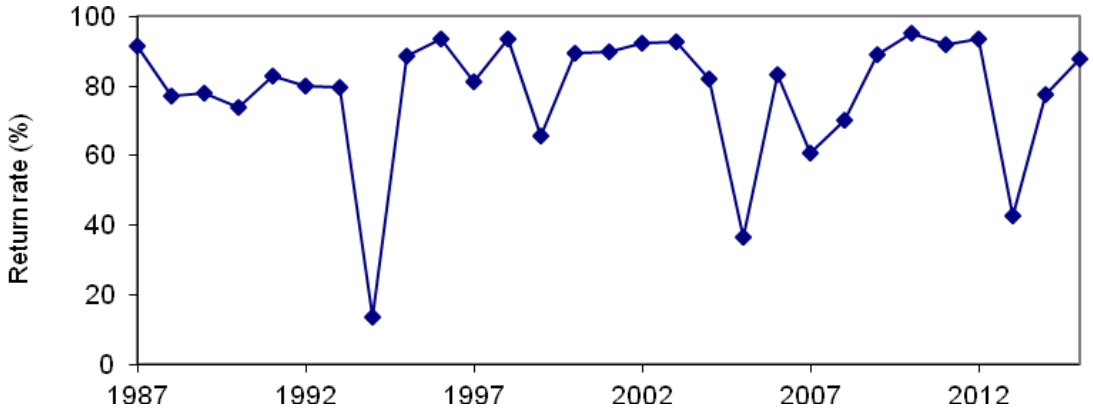

Figure 7: Annual return rates of adult European shag on the Isle of May 1987 – 2015.

Black-legged kittiwake

The return rate of black-legged kittiwakes (84.1%) was above average (1986-2014 average 78.4%, 95% CI =75.6-81.2) and the highest since 1989.

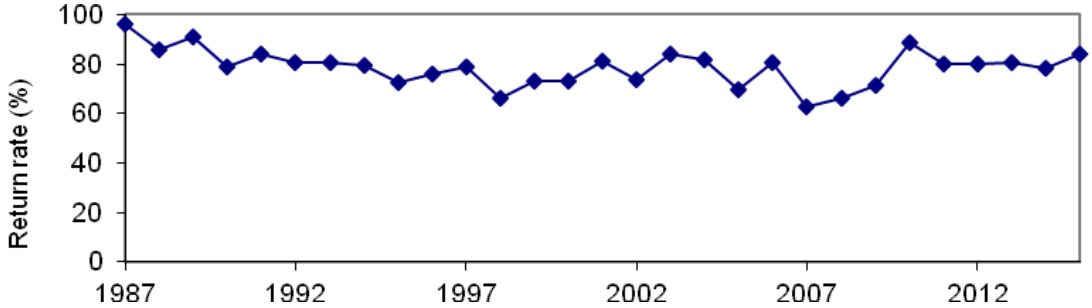

Figure 8: Annual return rates of adult black-legged kittiwake on the Isle of May 1987 – 2015.

Common guillemot

The return rate for common guillemot at 93.1% (201/216) was typical.

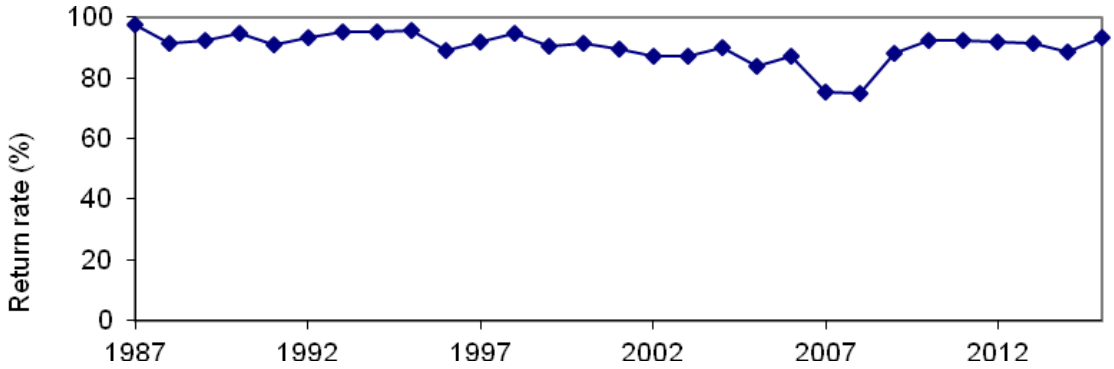

Figure 9. Annual return rates of adult common guillemot on the Isle of May 1987 – 2015.

Razorbill

The return rate of razorbills (25/29 or 86.2%) was typical.

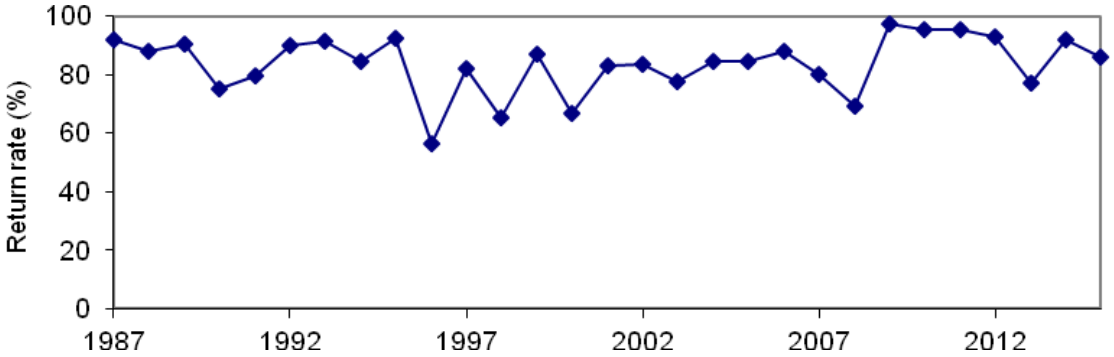

Figure 10. Annual return rates of adult razorbill on the Isle of May 1987 – 2015.

Atlantic puffin

The return rate of Atlantic puffins at 89.8% (132/147) was above average (1986-2014 average 82.6%, 95% CI =79.1-86.1).

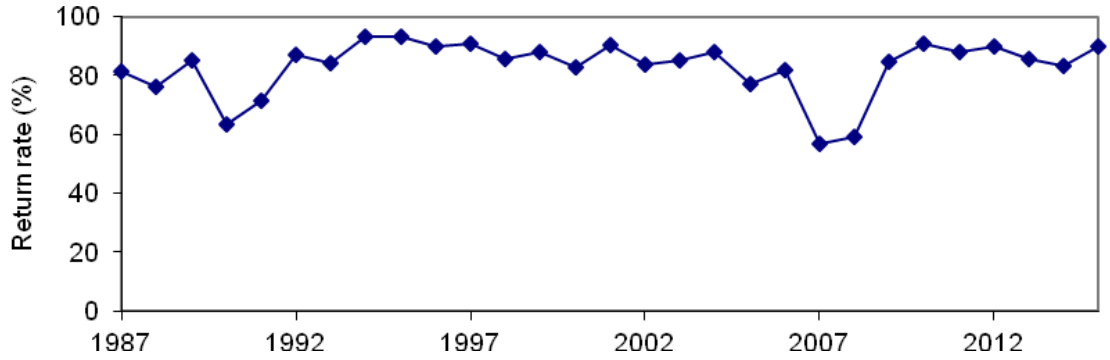

Figure 11. Annual return rates of adult Atlantic puffin on the Isle of May 1987 – 2015.

3.3 Food of young

Species summaries are given in Tables 4-7, and a comparison of sandeel biomass data with recent years' results is given in Table 8 in Appendix 3.

European shag

The most frequent prey (by occurrence in a regurgitate) in the 52 regurgitations was sandeel which occurred in 94.2% of samples (Table 4) and contributed 86.6% of the biomass, a proportion that was above the long term average. The remains of other items found were *Callionymidae* (7 samples), *Gadidae* (4), crustacea (4), *Pholidae* (3), *Cottidae* (3), flatfish (3), *Labridae* (3), mollusc (2) and polychaete worm (1).

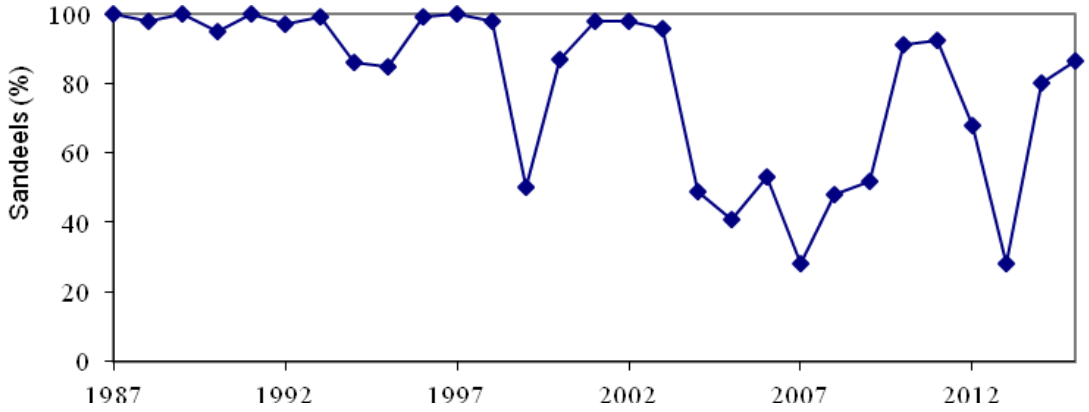

Figure 12. Percentage of sandeels (by weight) in the diet of young European shags on the Isle of May, 1987–2015.

Black-legged kittiwake

Of the 61 food samples obtained, 80% contained sandeels (Table 4). In terms of biomass, sandeels contributed 66.4% to the diet, which is below the long term average (77.2%). Clupeidae (mainly sprat *Sprattus sprattus*) contributed 22.4% of the biomass and occurred in 50.7% of regurgitations. Gadidae contributed 5.9%, Lotidae (rockling sp.) 5.2% and crustacea 0.1% of the biomass.

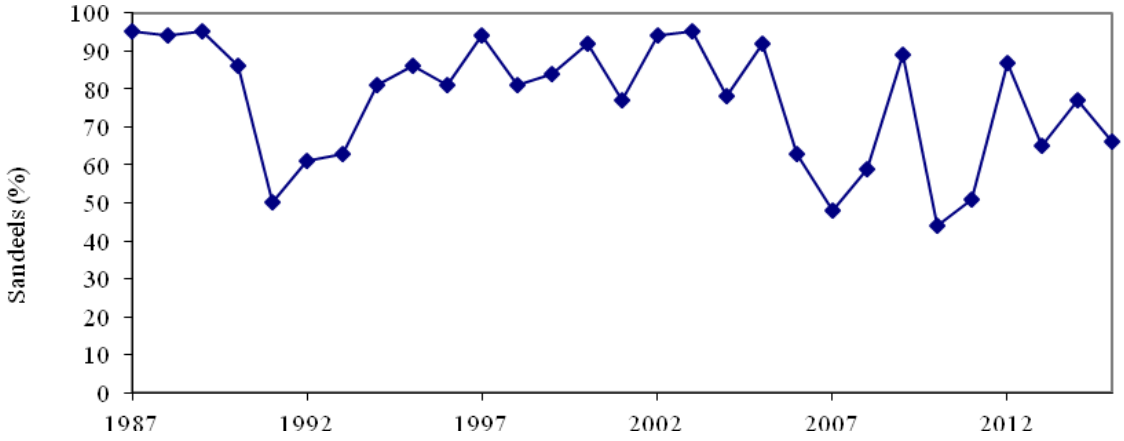

Figure 13. Percentage of sandeels (by weight) in the diet of young black-legged kittiwakes on the Isle of May, 1987–2015.

Common guillemot

Of the 770 food items delivered to chicks, 700 (90.9%) were Clupeidae (most thought to be sprat) and 68 (8.8%) were sandeels. There were also 2 Gadidae (0.3%).

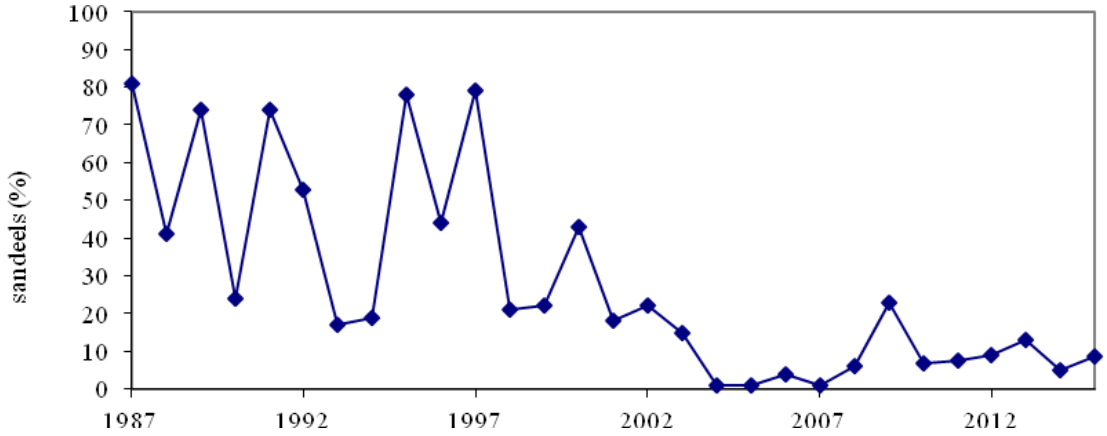

Figure 14. Percentage of sandeels (by weight) in the diet of young common guillemot on the Isle of May, 1987–2015.

Razorbill

Of the 138 loads seen clearly, 82 (59.4%) contained sandeels and 55 (39.6%) clupeids. There was also one load of rockling.

Atlantic puffin

Sandeels predominated the diet of puffins making up 87.0% of the 2333 fish collected. Large sprat and small indeterminate Clupeidae made up 1.4% and 5.9%, respectively. The remainder were rockling (5.3%) and Gadidae (0.4%) (Table 7).

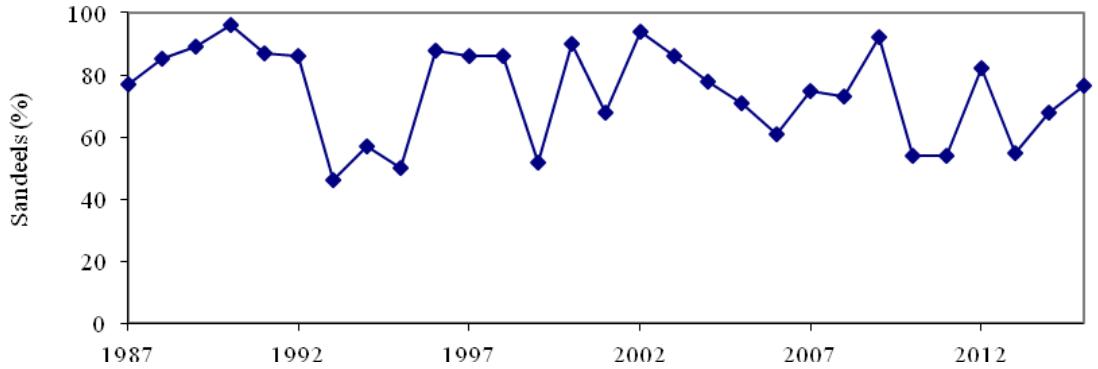

Figure 15. Percentage of sandeels (by weight) in the diet of young Atlantic puffin on the Isle of May, 1987–2015.

4 Acknowledgements

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6 Further reading

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7 Appendices

7.1 Appendix 1: Breeding success

Table 1. Breeding success of seabirds on the Isle of May in 2015.

	Plots	Plot average	Total nests	Total success
Northern fulmar	11	0.57±0.08	121	0.52
European shag	9	2.11±0.21	57	1.91
Black-legged kittiwake	15	0.98±0.11	569	1.07
Common guillemot	5	0.79±0.03	914	0.78
Razorbill	4	0.62±0.05	219	0.60
Atlantic puffin	4	0.75±0.03	193	0.75

Table 2. Breeding success (mean number of young reared per breeding pair; pooled average across nests) of seabirds on the Isle of May, 2004-2015).

Species	2004	2005	2006	2007	2008	2009
Northern fulmar	0.21 (97)	0.27 (135)	0.44 (139)	0.21 (141)	0.20 (121)	0.44 (147)
European shag	0.25 (103)	0.48 (42)	1.22 (81)	1.07 (57)	1.90 (60)	2.02 (61)
Black-legged kittiwake	0.30 (466)	0.85 (675)	0.47 (613)	0.24 (609)	0.23 (485)	0.70 (491)
Common guillemot	0.50 (984)	0.63 (945)	0.41 (932)	0.28 (850)	0.63 (807)	0.75 (824)
Razorbill	0.54 (190)	0.55 (200)	0.62 (190)	0.63 (188)	0.58 (170)	0.61 (180)
Atlantic puffin	0.60 (196)	0.71 (184)	0.68 (166)	0.29 (158)	0.48 (179)	0.72 (176)

Species	2010	2011	2012	2013	2014	2015
Northern fulmar	0.34 (176)	0.36 (149)	0.13 (157)	0.47 (167)	0.56 (142)	0.52 (121)
European shag	2.04 (77)	1.54 (104)	1.18 (108)	1.20 (55)	1.58 (55)	1.91 (57)
Black-legged kittiwake	0.29 (494)	0.87 (449)	0.98 (470)	0.41 (351)	1.17 (403)	1.07 (569)
Common guillemot	0.80 (846)	0.72 (858)	0.79 (812)	0.69 (797)	0.72 (826)	0.78 (914)
Razorbill	0.68 (177)	0.50 (175)	0.56 (195)	0.48 (191)	0.53 (213)	0.60 (219)
Atlantic puffin	0.74 (169)	0.79 (173)	0.57 (167)	0.70 (163)	0.68 (192)	0.75 (193)

Notes:
The number of pairs followed is given in brackets. Details of the monitoring methods for these species can be found in this and previous reports to JNCC.

7.2 Appendix 2: Annual return rates

Table 3. Annual return rates of adult seabirds on the Isle of May, 2000-2015.

Species			***Return rate (%)***						
	No. seen in 2014	**No. seen in 2015**	**2014-15**	**2013-14**	**2012-13**	**2011-12**	**2010-11**	**2009-10**	**2008-09**
Kittiwake	113	95	**84.1**	78.4	80.6	80.2	80.0	89.0	71.3
Guillemot	216	201	**93.1**	88.7	91.3	93.4	92.1	92.4	88.1
Razorbill	29	25	**86.2**	91.9	76.9	92.9	95.2	95.2	97.3
Puffin	147	132	**89.8**	83.4	85.4	89.7	87.9	90.9	84.7
Shag	124	109	**87.9**	77.7	42.7	93.4	92.1	95.0	89.0
	2007-08	**2006-07**	**2005-06**	**2004-05**	**2003-04**	**2002-03**	**2001-02**	**2000-01**	**1999-00**
Kittiwake	66.4	62.9	80.9	69.7	81.8	84.2	73.5	81.2	72.9
Guillemot	75.0	75.2	86.9	83.9	90.1	87.0	87.0	89.6	91.6
Razorbill	69.4	80.0	88.2	84.6	84.3	77.8	83.8	82.9	66.7
Puffin	59.4	56.9	81.8	77.0	87.9	85.2	83.5	90.5	82.8
Shag	70.3	60.8	83.3	36.4	82.2	92.7	92.2	89.8	89.4

Notes:
Only birds which had definitely bred in 2014 or earlier are included.
Directly comparable figures for earlier seasons are given. These have not been corrected for missing birds seen in later years, and for some species may severely under-estimate actual survival rates. These figures should not be used for population dynamics calculations without consultation with the authors.

7.3 Appendix 3: Chick diet

Table 4. Food of young black-legged kittiwakes and European shags on the Isle of May during chick-rearing in 2015.

	Black-legged kittiwake	European shag
No. of regurgitations	61	52
Range of dates	8 June - 29 July	30 April -16 July
Total weight (g)	1038	1991
% regurgitations with sandeels	80.3	94.1
with Gadidae	23.0	7.7
with Lotidae	23.0	0
with Clupeidae	47.5	0
with flatfish	0	5.8
with butterfish	0	5.8
with Cottidae	0	5.8
% (by number) of sandeels in sample	69.4	90.0
Other remains identified	crustacea (1)	Dragonet (7 samples), Crustacea (4), *Labridae* (3), mollusc (2) and polychaete worm (1).

Notes:
Samples were collected from chicks or adults during the chick-rearing period.
Counts and lengths of fish were based on otoliths retrieved from the regurgitations.

Table 5. Food of young common guillemots on the Isle of May in 2015.

	Sandeels	Clupeidae	Gadidae
All-day watches			
14 June	18	235	0
17 June	12	106	0
Other records			
29 May - 14 July	38	359	2
Total	**68**	**700**	**2**

Table 6. Food of young razorbills on the Isle of May in 2015.

	Sandeels	Clupeidae	Gadidae
All-day watches			
14 June	37	10	7
17 June	30	21	9
Other records			
12 -29 June	15	7	1
Total	**82**	**38**	**17**

Note:
One load of rockling and three of the loads of sandeels included a single clupeid.

Table 7. Food of young Atlantic puffins on the Isle of May, 29 May to 16 July 2015.

Species	**Sample size**	**Mean Length (mm)**	**s.e.**
Sandeel *Ammodytes sp*.	2037	59.8	0.19
Sprat *Sprattus sprattus*	32	107.8	1.56
Other Clupeidae	130	40.0	0.39
Rockling *sp*. (Lotidae)	124	32.7	0.45
Whiting *Merlangius merlangus*	3	56.0	9.54
Cod *Gadus morhua*	5	44.4	3.23
Saithe *Pollachius virens*	2	36.5	2.50

Table 8. Percentage of sandeels (by weight) in the diet of young seabirds on the Isle of May, 1995-2015.

Species	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Shag	85	99	100	98	<50	87	95	98	96	49
Kittiwake	86	81	94	81	84	92	76	94	91	79
Guillemot	78	44	79	21	22	43	18	22	15	2
Puffin	50	88	86	86	52	90	68	94	86	78

Species	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Shag	41	53	28	48	52	91	92	68	28	80	87
Kittiwake	92	63	48	59	89	44	51	87	65	77	66
Guillemot	1	4	1	6	23	7	8	9	8	4	4
Puffin	71	61	75	72	92	54	54	82	55	68	77

Notes:
Dates and sample sizes can be found in the contract reports for the respective years.
Sandeels also made up the bulk of the food of young razorbills in most years but it is extremely difficult to assess proportions in terms of biomass.