

**JNCC Report**

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**Isle of May  
seabird studies in 2002**

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# 1. Summary

During the 2002 season, weather conditions on the Isle of May were poor, with much more rain than usual, and strong westerly and easterly winds. Common guillemots, razorbills, Atlantic puffins and black-legged kittiwakes experienced lower breeding success relative to the long-term average, although common guillemots and razorbills did better than in 2001. In contrast, northern fulmars had their best season since 1995, and European shags had their best season ever. Timing of breeding for all species was normal, although European shags and black-legged kittiwakes started breeding earlier than in 2001. Return rates for razorbills and Atlantic puffins were close to the long-term average, whereas those for common guillemots and black-legged kittiwakes were around 6% lower. European shag return rates, in contrast, were much higher than the long-term average. Lesser sandeels *Ammodytes marinus* were the predominant prey items for all species except common guillemots, which mainly brought back clupeids for their chicks.

- Northern fulmars had a relatively productive season, with breeding success estimated at 0.48 chicks per incubating pair. This is above the long-term average and the highest success since 1995.
- European shags had an extremely productive breeding season. Breeding started earlier than in 2001 and overall breeding success (1.66 chicks per incubated nest) was the highest recorded since intensive monitoring began in 1986.
- Black-legged kittiwakes started breeding earlier than in 2001, but conditions appeared less than favourable at the start of the season and losses were high during incubation. Breeding success (0.47 chicks per pair laying) was much lower than in 2001, and below the long-term average.
- Common guillemot productivity in 2002 (0.68 young per pair laying) was the third lowest value recorded since monitoring began in 1986 and continued the trend of declining breeding success noted in recent years. Some chicks were temporarily neglected, but fledging weights were close to the long-term average.
- Razorbill breeding success (0.65 chicks per pair laying) was slightly lower than the long-term average, but higher than that in 2001. Most losses occurred during incubation, while survival of hatched chicks to fledging was very high.
- Breeding success of Atlantic puffins (0.72 chicks per pair laying) was lower than in 2001 and was slightly below the long-term average.
- The return rate of adult colour-ringed European shags in 2002 (92.2%) was the highest since 1998. Black-legged kittiwake return rates (73.5%) were much lower than in 2001, and lower than the long-term average. The return rate of common guillemots (87.0%) was slightly below the long-term average whereas razorbill return rates (83.8%) were slightly higher than the long-term average. The return rate of Atlantic puffins (83.5%), although much lower than in 2001, was similar to the long-term average.

- Lesser sandeels predominated in the diet of European shags, black-legged kittiwakes, razorbills and Atlantic puffins in 2002. As in 2001, well over half of common guillemot chick diet was made up of clupeids.

As in 2000 and 2001, there was no commercial sandeel fishery on the Wee Bankie during 2002. Studies on the Isle of May in 2000 and 2001 provided circumstantial evidence that the closure of the fishery could potentially have an immediate and positive effect on seabird productivity. In particular, breeding success of European shags bounced back to record levels and black-legged kittiwake breeding success returned to the higher levels typical of the pre-fishery period.

In 2002, breeding success of the European shag, an inshore forager which relies almost completely on older sandeels, was the highest on record and continues the upward trend, post-fishery closure. Black-legged kittiwakes however, which also heavily rely on sandeels, but which target the youngest age-class and forage offshore, experienced relatively low breeding success and did not maintain the improved performance shown in 2000, immediately after the fishery closure. For Atlantic puffins, the trend of increasing breeding success over the previous four years was not maintained, although it was similar to the 2000 value. Common guillemots and razorbills, which are less reliant on sandeels, continued the recent trend of having low breeding success relative to the long-term average, although both species were more productive than in 2001. Northern fulmars, for which sandeels appear not to be an important prey item, experienced breeding success above the long-term average, continuing the apparent year to year fluctuations.

It was uncertain in 2000 whether environmental factors, e.g. hydrographic conditions, that potentially affect the growth and life history strategy of sandeels, were involved in the recovery of the breeding success of European shags and black-legged kittiwakes. A new EU-funded interdisciplinary project was started in 2001 and continued during 2002 to try to investigate this further.

## 2. 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 and the Isle of May NNR is the designated 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 under way 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 that lie 30-50 km east of the island which 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 seabirds in the area. In December 1999, EU Fishery Ministers agreed a ban on fishing for sandeels in 20,000 square kilometres of sea off eastern Scotland (including the Wee Bankie grounds) and north-east England in 2000. Results from the 2000 season provided circumstantial evidence that the presence of an industrial fishery on the Wee Bankie might be having an adverse effect on some components of the Isle of May seabird community. The ban was still in operation during 2002, and therefore monitoring was of vital importance to assess the performance of seabirds, and in

particular to determine whether the recovery recorded in some species in 2000 and 2001 was maintained.

## 3. Methods

### Breeding success

The standardised methods used involved minimal disturbance of birds and are described in detail in Walsh *et al.* (1995).

#### Northern fulmar

The position of apparently incubating birds in nine areas were marked on photographs on 30 May and 4 and 11 June. At sites where birds appeared to be incubating on all three visits, or where an egg was seen, breeding was assumed to have occurred. These sites were checked again on 25 July to determine sites which had hatched eggs. A final check was made on 14 August, when chicks present were assumed to have fledged successfully.

#### European shag

The position of nests in 12 areas were marked on photographs and the state and contents of these nests were checked weekly from 12 April until 19 July. All medium size or large young present on the 19 July were assumed to have fledged successfully. Successes are given averaged across the plots and summed over the plots.

#### Black-legged kittiwake

The position of nests in fifteen areas were marked on photographs and the presence or absence of an incubating bird, or the number of young present at each, were noted. Checks of nests were made on 27 May and 4 and 11 June. The first check of chicks was on 16 July, the day that the first fledged young on the island was recorded. Further checks were then made, the last being on 25 July when all remaining chicks were large and were assumed to have fledged successfully. Successes are given averaged across the plots and summed over the plots.

#### Common guillemot and razorbill

Daily checks of the state of breeding of numbered nest-sites in five study plots were made from permanent hides.

#### Atlantic puffin

Samples of 50 burrows where an egg could be felt were staked in each of four areas on 27 and 30 April and 1 May (other checks indicated that most pairs had laid by this date). The staked burrows were re-checked on 2 and 3 July (when chicks were near fledging). All large young present at this time were assumed to have fledged successfully. Empty burrows where there were many droppings, moulted down and feather sheaths were also assumed to have been successful.

## 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 pick up those which had moved. Searches were also made of the whole island for birds which 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 most burrows are individually numbered). As in recent years, the area used for monitoring survival of adult black-legged kittiwakes included Tarbert, Rona (kittiwake gully), Low Light gully, Little hole, Cornerstone and its nearby cliffs. In 2002, the area was expanded to include birds nesting at North Horn.

## 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. The regurgitates and food loads were weighed, fish identified and, where possible, measured (total length, snout to tip of tail). Fish otoliths were extracted from regurgitates and identified and the lengths of the fish from which they came were calculated using regressions derived from the otoliths of fish of known length collected from birds on the island in 2002 or published works. Observations were made of fish brought to young common guillemots and razorbills during three all-day watches, as well as opportunistically on most other days. Uneaten fish were collected from breeding ledges to confirm identifications and size assessments for common guillemots. Fish sizes for razorbills were assessed against the bird's bill but were essentially orders of size as it was not possible to collect samples from this species.

## 4. Results

### Breeding success

Species accounts are given in Tables 1- 4 and a comparison with recent years' results is shown in Table 5 and Figure 1.

#### Northern fulmar

The first incubating northern fulmars were noted on 15 May, and their first egg was seen on 22 May. Breeding success was 0.48 young per incubating pair (Table 1). This is above the 95% Confidence Intervals for the long-term average between 1986-2001 (0.41, CI=0.37-0.45) and the most productive season since 1995. The methodology used is not designed to determine when breeding attempts fail, but most losses apparently occurred during incubation.

#### European shag

The timing of breeding was earlier than in 2001 with the first egg laid on 16 April. Productivity was extremely high and 2002 saw the highest value since monitoring began in 1986 ( $1.66 \pm \text{S.E. } 0.17$  young per incubated nest averaged across the plots, 1.76 when results from all areas are pooled; Table 2). This was well above the 95% Confidence Interval for the 1986-2001 average (0.85, CI=0.65-1.05). Of 134 nests built in the study plots, 130 pairs laid and incubated eggs and a total of 229 chicks fledged. Of 103 successful pairs 43 (42%) raised three young.

#### Black-legged kittiwake

Breeding started earlier than in 2001, but conditions appeared less than favourable for black-legged kittiwakes at the beginning of the season than in recent years, since losses during incubation were high (Table 3). Nest building started on 24 April and the first egg was noted on 10 May. The first chick was seen on 6 June and the first young fledged on 16 July. Ninety-five percent of pairs initiating nest building completed a nest; however, 7% of pairs occupying a site did not start a nest. The mean clutch size of 1.87 was slightly lower than that in 2001 (Table 13).

Early in the chick rearing period, chick growth appeared slow and losses were high. However, brood neglect was fairly low (6% of broods of one chick; 19% of broods of two; Table 11). Within the study plots, only one pair (0.002% of successful pairs) reared three young and elsewhere on the island very few broods of three large young were seen. Breeding success in 2002 was  $0.47 \pm 0.04$  chicks per completed nest, averaged across the plots (Table 3). This value is lower than that for 2001, and lower than the long-term average (0.55, CI=0.35-0.75) (Table 5). Although the total number of pairs breeding in the study plots (477) was higher than during 2001 (410), this is still much lower than number of breeding pairs in 1999 (616) and 2000 (545).

#### Common guillemot

The first egg was laid on 23 April. The median laying dates in the earliest and latest areas monitored were 5 and 9 May respectively. The first young left on the night of 19/20 June. Productivity in 2002 (0.68 young per pair laying; Table 4) was the third lowest value recorded since monitoring began in 1986 and was well below the 95% Confidence Interval for the long-term average (0.78, CI=0.74 - 0.82). Chick losses (13%) were much higher than the 8% average (1981-2001) for the Isle of May. Egg losses (20%) were also slightly higher than the long-term average (17%) but these seemed to be mainly caused by eggs being accidentally knocked from the site rather than predation. Weights of chicks near fledging (average 250g) were close to the long-term mean. As in 2001, some chicks were occasionally left unattended, but this did not occur as frequently as in 2001.

### **Razorbill**

Timing of breeding of razorbills was normal for the Isle of May, with the first egg being laid on 23 April. Breeding success (0.65 young per pair laying; Table 4) was slightly lower than the long term mean (0.68, CI=0.64-0.72). Ninety-one percent of losses occurred at the egg-stage, while survival of hatched chicks to fledging was very high at 94%.

### **Atlantic puffin**

The first adult Atlantic puffins carrying fish were seen on 22 May. Back-calculation from this figure indicated that laying commenced in the second week of April. The overall success rate (0.72 chicks fledged per egg laid; Table 4) was slightly below the long term mean (0.77, 95% CI=0.71-0.83).

## **Adult survival 2001-2002**

Not every adult alive is seen each year and thus the return rates in 2002 of birds seen in 2001 must be treated as minimum estimates of survival. The results are compared with similar figures from earlier years in Table 6 and Figure 2. During 2002 an additional 21 European shags, 25 black-legged kittiwakes, 25 Atlantic puffins, eight razorbills and three common guillemots were colour-ringed.

### **European shag**

Of 154 colour-ringed European shags seen in 2001, 142 (92.2%) were seen in 2002. This was the highest re-sighting rate since 1998. In addition, one colour-ringed European shag was seen in 2002 that had not been seen in 2001.

### **Black-legged kittiwake**

The return rate of black-legged kittiwakes (73.5%) was lower than that in 2002 (81.2%) and also below the long-term average (79.8, 95% CI = 76.0-83.7).

### **Common guillemot**

The return rate of adult common guillemots (87.0%) represented a slight decrease from 2001 and is slightly lower than the long-term average (92.9, 95% CI = 91.6 - 94.1).

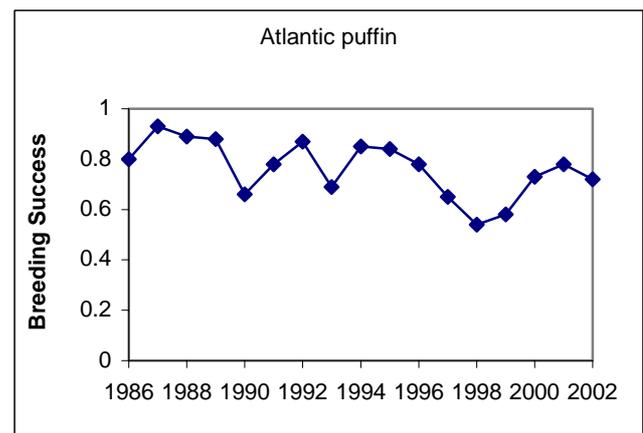
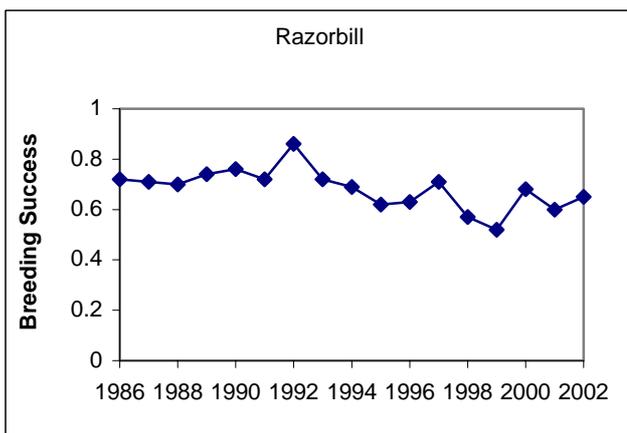
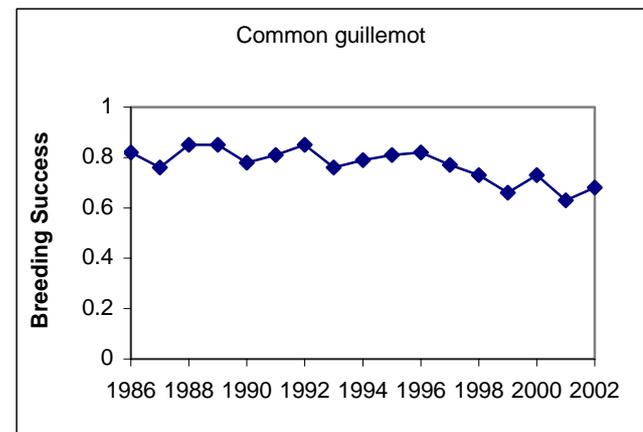
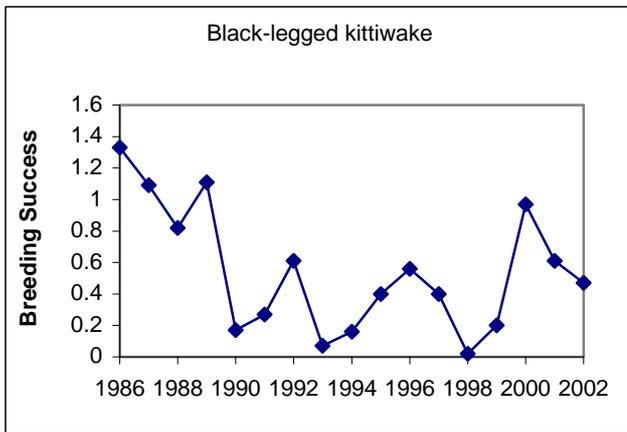
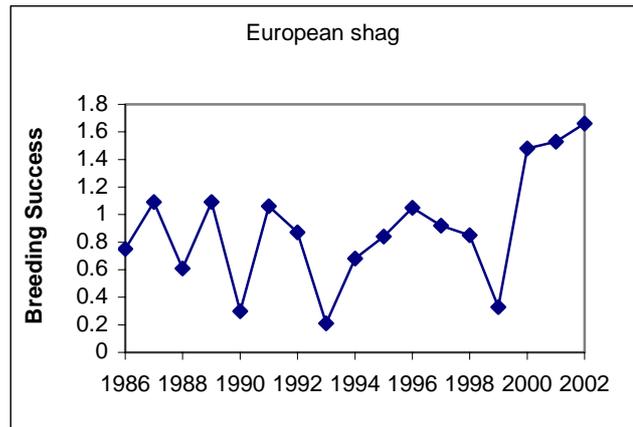
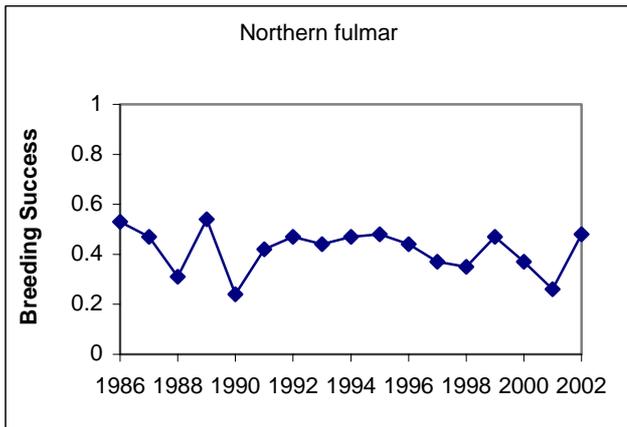
**Razorbill**

The return rate of razorbills (83.8%) was slightly higher than in 2001 and the long-term average (81.6, 95% CI = 81.1-82.2) and continues the picture of year-to-year fluctuations which has been apparent through the study period.

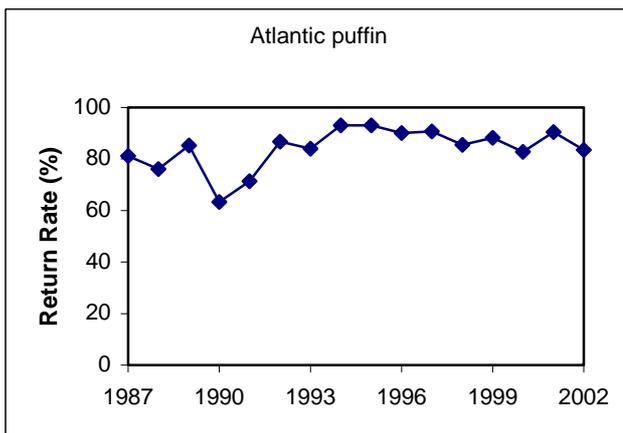
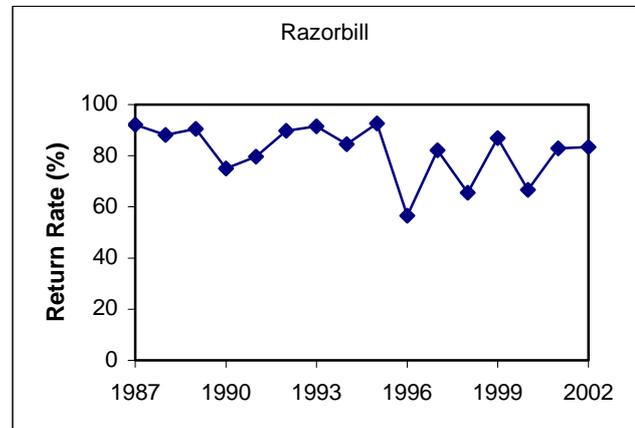
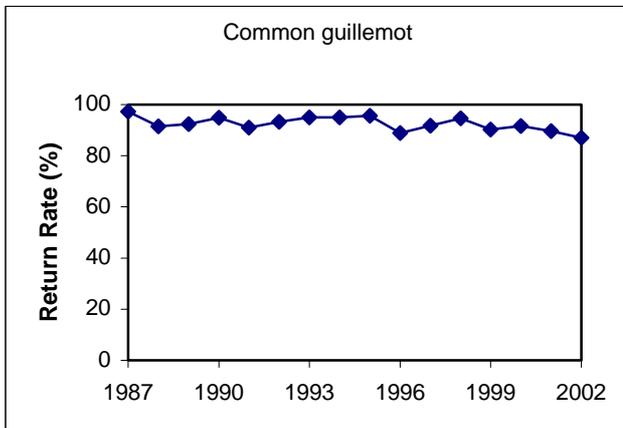
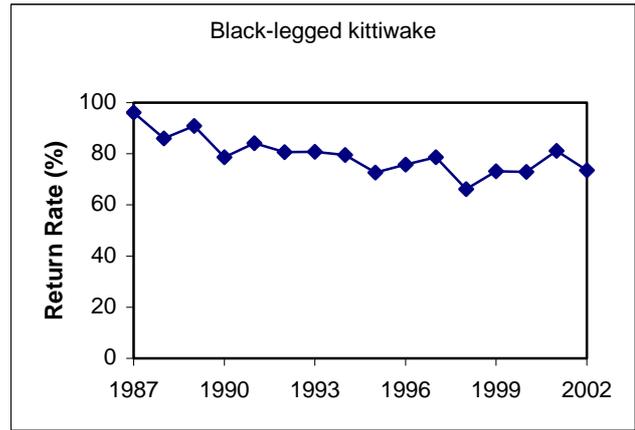
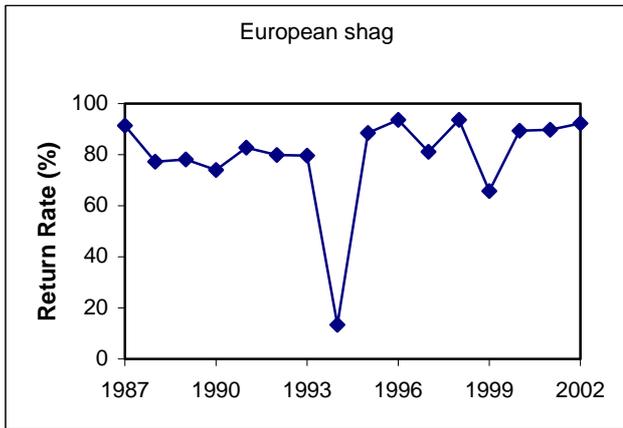
**Atlantic puffin**

The return rate of Atlantic puffins (83.5%) was slightly lower than in 2001 but was close to the long-term average (84.1, 95% CI = 79.9 – 88.4).

**Figure 1** Breeding success (young reared per pair breeding) of seabirds on the Isle of May 1986 - 2002



**Figure 2** Annual return rates of adult seabirds on the Isle of May 1987 – 2002



## Food of young

Species accounts are given in Tables 7-10, and a comparison of sandeel biomass data with recent years' results is given in Table 12 and Figure 3.

### European shag

Food samples were readily obtained in 2002 and consisted mainly of sandeels. Of 48 regurgitates obtained between 4 June and 21 July, 100% contained sandeels (by numbers) and in terms of biomass sandeels accounted for 98% of the total (Tables 7 and 12). Sixteen percent of sandeels were 0-group and 84% were older age classes. Dragonet *Callionymus lyra* (4-13 cm long) accounted for 1% of biomass.

### Black-legged kittiwake

Ninety-seven percent of black-legged kittiwake food samples collected during the chick-rearing period contained sandeels (Table 7). Of 3,448 otoliths examined, 99% was sandeel. Of that, 99.8% was 0-group fish with estimated lengths of 3.5 - 8.5 cm (n = 3,423 otoliths examined). In terms of biomass, sandeels contributed 94% by weight of the diet and gadoids (mainly whiting *Merlangius merlangus*) contributed 5%.

### Common guillemot

As in 2001, well over half (61%) of 1,093 fish delivered to young common guillemots was clupeids (probably mainly sprat *Sprattus sprattus*), with the majority assigned to the small size category, corresponding to fish about 10 cm long (Table 8). The remainder of food items was sandeels, predominantly in the small-medium size category, corresponding to fish around 9-12 cm long. The average weight of a prey item (calculated from lengths) was 6.5 g. This was lower than the long term (19 year) average of 7.4 g, although fledging weights of the chicks were the same as the long-term average. In biomass terms, sandeels comprised only 22% of the diet.

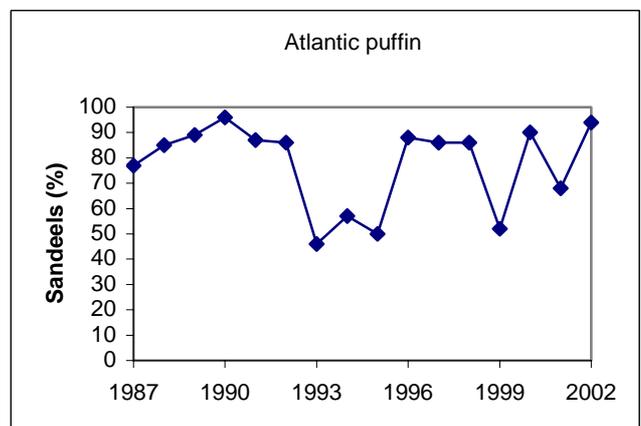
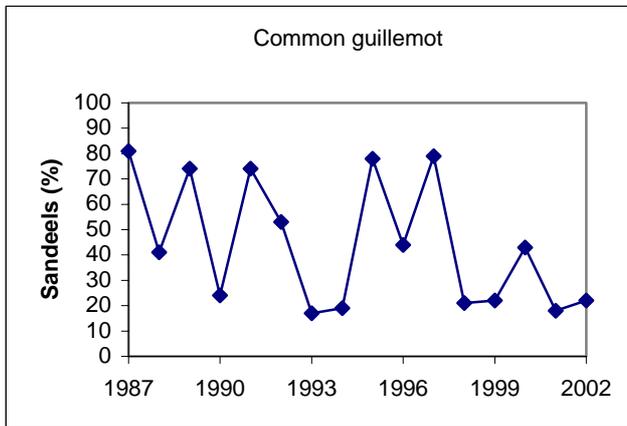
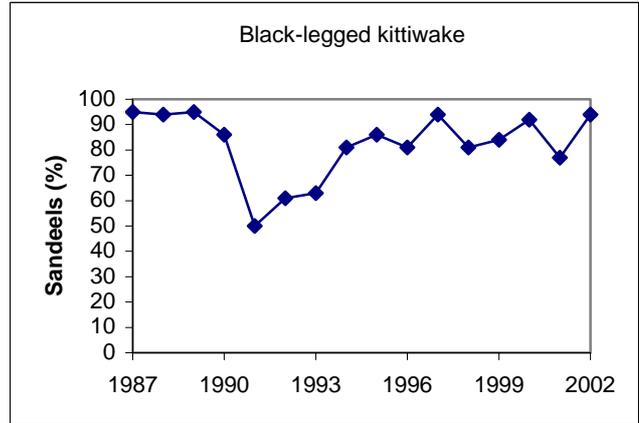
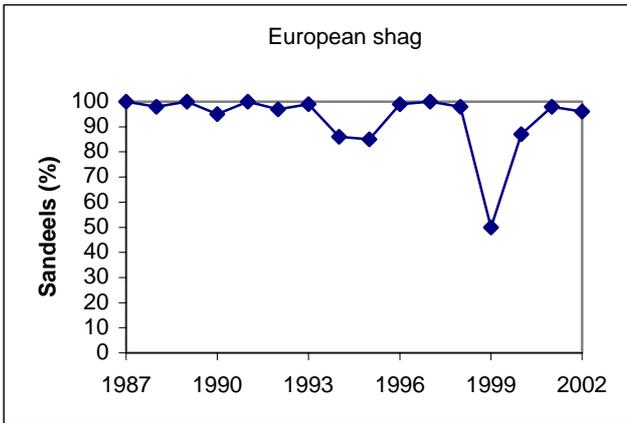
### Razorbill

Most loads of fish brought to razorbill chicks comprised of several small sandeels, which were often of the 0-group age class. The loads with a single sandeel were mostly made up of large fish (Table 9).

### Atlantic puffin

Sandeels made up 97% by number of the diet of young Atlantic puffins with the proportion in biomass terms being 94% (Table 12). Most sandeels were 0-group and had a mean length of 6.5 cm; only 20 (2%) were longer than 10 cm (Table 10). Many of the clupeids were small, and thus difficult to identify, but most appeared to be sprat. Four gobies (probably crystal gobies *Crystallogobius linearis*) were identified in the samples. The mean load size of 9.2 g was close to the long-term average (9.1 g) for this species.

**Figure 3** Percentage of sandeels (by weight) in the diet of young seabirds on the Isle of May, 1987-2002



## 5. Conclusions

During the first year of the closure of the Wee Bankie sandeel fishery in 2000, all the species monitored, except the northern fulmar, showed an increase in breeding success over the 1999 figure, with the recovery being particularly marked in European shags and black-legged kittiwakes. This recovery was generally sustained in 2001, with most species again having a more productive season than in 1999. During 2002, the situation did not seem as encouraging, with all species, bar European shag and northern fulmar, experiencing lower breeding success than the long-term average. However, all species did have a better season than in 1999, prior to the fishery closure.

Clearly, there is still uncertainty about the relative importance of climate, hydrography and fishing pressure and their affects upon the availability of prey to seabirds. The IMPRESS project, (Interactions between the marine environment, predators and prey: implications for sustainable sandeel fisheries) started in 2001 and continued during 2002. Given the poor weather conditions experienced during the 2002 season, it will be interesting to see if results from this project can go some way in explaining the fluctuating performance levels that the Isle of May seabirds have experienced in recent years.

## 6. Acknowledgements

We are grateful to Ian Parkinson and Mareike Moeller-Holtkamp of Scottish Natural Heritage, and Francis Daunt, Maggie Hall, Sue Lewis, Jos Milner, Steve Redpath, Sheila Russell, Mark Newell, and Tom and Ann Dewdney for providing help during the 2002 field season. We thank Andy Easton for providing transport to and from the Isle of May throughout the season and Ian Gibb for assistance with analysing food samples.

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## 8. Further reading

The following is a list of additional papers on Isle of May seabirds published or in press since publication of the 2001 report.

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**Table 1** Breeding success of northern fulmars on the Isle of May in 2002

<i>Area</i>	<i>Incubating birds</i>	<i>No. probably hatched</i>	<i>Young fledged</i>
Cleaver	13	3	3
Pilgrim's Haven	2	1	1
Cornerstone	7	3	2
Loch (S)	30	13	13
Greengates	47	28	28
Horse Hole	5	4	4
Tarbet	18	11	10
Low Light	7	2	1
Colm	2	1	1
<b>Total</b>	<b>131</b>	<b>66</b>	<b>63</b>
<b>Overall mean</b>			<b>0.48 fledged/ pair</b>

Notes:

No pairs bred in plot 7 (Rona) in 2002.

Incubating birds were those sitting tight on three checks or where an egg was seen. Chicks present on 14 August were assumed to have fledged.

**Table 2** Breeding success of European shags on the Isle of May in 2002

<i>Area</i>	<i>Total incubated</i>	<i>Other nests</i>	<i>Young fledged</i>			<i>Total young fledged</i>	<i>Mean young fledged per incubated nest</i>
			<i>1</i>	<i>2</i>	<i>3</i>		
Maidens	15	0	5	6	4	29	1.93
Chatterstones	4	1	1	1	2	9	2.25
Pilgrim's Haven	14	0	0	2	7	25	1.79
North Pilgrims	1	0	0	1	0	2	2.00
South Face	1	0	0	0	0	0	0
Mill Door (N)	11	1	1	7	3	24	2.18
Mill Door (S)	15	1	0	5	7	31	2.07
Horse Hole	22	0	3	8	5	34	1.55
North Horn	22	0	7	4	8	39	1.77
Tarbet	8	0	0	1	3	11	1.38
Low Light	8	1	1	1	3	12	1.5
Colms Hole	9	0	2	4	1	13	1.44
							<b>1.66 ± 0.17</b>
<b>Total</b>	<b>130</b>	<b>4</b>	<b>20</b>	<b>40</b>	<b>43</b>	<b>229</b>	<b>1.76</b>

No nests were built in the plots at South Ness, Lady's Bed Stack, South Horn or Bishop's Cove in

**Table 3** Breeding success of black-legged kittiwakes on the Isle of May in 2002

Area	Completed nests	Trace nests	Other pairs with site	Fledged young per completed nest				Total young produced	Fledging success per completed nest
				0	1	2	3		
Cleaver	24	1	3	17	6	1	0	8	0.33
Pilgrim's Haven	18	1	0	7	7	4	0	15	0.83
South Face	24	0	2	16	3	5	0	13	0.54
Colony 4	59	3	7	35	15	9	0	33	0.56
Cornerstone	59	4	4	29	24	5	1	37	0.63
Loch (S)	20	3	4	16	4	0	0	4	0.2
Loch (N)	74	4	0	53	18	3	0	24	0.32
Greengates	21	2	1	16	4	1	0	6	0.29
Bishop's Cove	37	3	6	26	8	3	0	14	0.38
Horse Hole	4	0	4	2	2	0	0	2	0.5
Iron Bridge	30	4	1	20	10	0	0	10	0.33
Rona	24	1	1	8	10	6	0	22	0.92
Tarbert	59	3	2	44	15	0	0	15	0.25
Low Light	11	1	2	8	3	0	0	3	0.27
Colm's Hole	13	0	0	6	6	1	0	8	0.62
									<b>0.47 ± 0.06</b>
<b>Total</b>	<b>477</b>	<b>30</b>	<b>37</b>	<b>303</b>	<b>135</b>	<b>38</b>	<b>1</b>	<b>214</b>	<b>0.45</b>

**Table 4** Breeding success of auks on the Isle of May in 2002

Species	Area	Pairs laying	Young hatched	Young "fledged"	Young leaving / pair
Guillemot	Dense	308	246	224	0.73
	Hide / White Ledge	104	80	68	0.65
	Colony 4	249	205	162	0.65
	South	54	41	35	0.65
	Cornerstone	240	196	178	0.74
	<b>Mean ± se</b>				<b>0.68 ± 0.02</b>
Razorbill	Hide / White Ledge	25	21	20	0.8
	Colony 4	62	30	27	0.44
	South	18	13	12	0.67
	Cornerstone	62	43	42	0.68
	<b>Mean ± se</b>				<b>0.65 ± 0.08</b>
Puffin	Lady's Bed	40	?	22	0.55
	Kirkhaven	43	?	33	0.77
	Burrian	45	?	32	0.71
	Rona	46	?	38	0.83
	<b>Mean ± se</b>				<b>0.72 ± 0.06</b>

Notes:

For puffins, the number of young that hatched is unknown.

**Table 5** Breeding success (mean number of young reared per breeding pair) of seabirds on the Isle of May, 1989-2002

<i>Species</i>	<i>1989</i>	<i>1990</i>	<i>1991</i>	<i>1992</i>	<i>1993</i>	<i>1994</i>	<i>1995</i>
Northern fulmar	0.54 (93)	0.24 (66)	0.42 (100)	0.47 (129)	0.44 (121)	0.47 (122)	0.48 (126)
European shag	1.09 (234)	0.30 (154)	1.06 (187)	0.87 (181)	0.21 (80)	0.68 (74)	0.84 (131)
Black-legged kittiwake	1.11 (1327)	0.17 (1095)	0.27 (1172)	0.61 (1062)	0.07 (1034)	0.16 (861)	0.40 (874)
Common guillemot	0.85 (757)	0.78 (748)	0.81 (754)	0.85 (745)	0.76 (797)	0.79 (775)	0.81 (805)
Razorbill	0.74 (97)	0.76 (100)	0.72 (104)	0.86 (105)	0.72 (119)	0.69 (134)	0.62 (143)
Atlantic puffin	0.88 (164)	0.66 (176)	0.78 (153)	0.87 (184)	0.69 (182)	0.85 (189)	0.84 (180)
	<i>1996</i>	<i>1997</i>	<i>1998</i>	<i>1999</i>	<i>2000</i>	<i>2001</i>	<i>2002</i>
Northern fulmar	0.44 (135)	0.37 (136)	0.35 (120)	0.47 (115)	0.37 (143)	0.26 (134)	0.48 (131)
European shag	1.05 (105)	0.92 (109)	0.85 (125)	0.33 (58)	1.48 (127)	1.53 (135)	1.66 (130)
Black-legged kittiwake	0.56 (825)	0.40 (822)	0.02 (683)	0.20 (616)	0.97 (545)	0.61 (459)	0.47 (477)
Common guillemot	0.82 (786)	0.77 (842)	0.73 (852)	0.66 (870)	0.73 (942)	0.63 (975)	0.68 (955)
Razorbill	0.63 (140)	0.71 (132)	0.57 (134)	0.52 (142)	0.68 (149)	0.60 (167)	0.65 (167)
Atlantic puffin	0.78 (173)	0.65 (166)	0.54 (179)	0.58 (181)	0.73 (132)	0.78 (185)	0.72 (174)

## 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.

**Table 6** Annual return rates of adult seabirds on the Isle of May, 1987-2002

<i>Species</i>	<i>No. seen in 2001</i>	<i>No. seen in 2002</i>	<i>Return rate (%)</i>						
			<i>2001-02</i>	<i>2000-2001</i>	<i>1999-2000</i>	<i>1998-99</i>	<i>1997-98</i>	<i>1996-97</i>	<i>1995-96</i>
Kittiwake	136	100	73.5	81.2	72.9	73.1	66.2	78.7	75.8
Guillemot	368	320	87.0	89.6	91.6	90.2	94.6	91.8	88.9
Razorbill	37	31	83.8	82.9	66.7	86.9	65.5	82.1	56.6
Puffin	194	162	83.5	90.5	82.8	88.2	85.5	90.7	90.1
Shag	154	142	92.2	89.8	89.4	65.8	93.6	91.1	93.6
	<i>1994-95</i>	<i>1993-94</i>	<i>1992-93</i>	<i>1991-92</i>	<i>1990-91</i>	<i>1989-90</i>	<i>1988-89</i>	<i>1987-88</i>	
Kittiwake	72.7	79.5	80.8	80.7	84.2	78.7	90.9	86.0	
Guillemot	95.6	95.0	95.0	93.3	91.0	94.9	92.4	91.5	
Razorbill	92.6	84.5	91.5	89.8	79.6	75.0	90.5	88.1	
Puffin	93.0	93.1	84.0	86.8	71.4	63.3	85.2	76.1	
Shag	88.5	13.4	79.6	79.9	82.8	74.0	78.1	77.3	

## Notes:

Only birds which had definitely bred in 2001 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 S Wanless.

Details of earlier estimates are given in previous reports to NCC-CSD/JNCC.

**Table 7** Food of young black-legged kittiwakes and European shags on the Isle of May during chick-rearing in 2002

	<i>Kittiwake</i>	<i>Shag</i>
No. of regurgitations	76	48
Range of dates	6 June -18 July	4 June- 21 July
Total weight (g)	1333	1400
% regurgitations with sandeels	97	100
with Gadidae	9	2
with Clupeidae	4	2
with flatfish	0	6
with dragonet	0	6
% (by weight) of sandeels in sample	94	98
% (by numbers) of sandeels in sample	99	95
Modal lengths of sandeels (cm)	7	13
Other remains identified	Euphausiid (3 samples)	Butterfish (1 sample) Goby (1 sample)

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 8** Food of young common guillemots on the Isle of May during chick-rearing in 2002

	<i>Number of sandeels</i>				<i>Number of Clupeidae</i>		
	<i>minute</i>	<i>small</i>	<i>medium</i>	<i>large</i>	<i>small</i>	<i>medium</i>	<i>large</i>
Mean length (cm)	6	9	12	14	10	13	15
<b>All-day watches</b>							
16 June	4	59	68	3	230	20	4
23 June	0	25	18	0	74	10	2
30 June	5	18	16	2	38	40	1
<b>Other records</b>							
30 May - 3 July	5	100	99	6	223	20	3
<b>Total</b>	14	202	201	11	565	90	10

Notes:

Lengths were based on visual estimates against the bird's bill checked by measurements of dropped fish collected from the breeding ledges.

**Table 9** Food of young razorbills on the Isle of May in 2002

	minute	Single sandeel			Several sandeels			Clupeidae
		small	medium	large	minute	small	medium	
<b>All-day watches</b>								
16 June	1	2	4	2	5	4	3	7
23 June	0	2	0	3	5	8	2	0
30 June		3	0	1	8	6	0	0
<b>Other records</b>								
3 June - 1 July	1	1	8	19	55	26	9	19
<b>Total</b>	<b>2</b>	<b>8</b>	<b>12</b>	<b>25</b>	<b>73</b>	<b>44</b>	<b>14</b>	<b>26</b>

Notes:

Figures are numbers of loads of various types of food

Sizes are qualitative as it was not possible to collect food samples from razorbills

**Table 10** Food of young Atlantic puffins on the Isle of May, 4 June to 16 July 2002

	Sample size	Mean	s.e
a) Load weight (g)	105	9.2	0.32
b) Fish/load	105	12.2	0.62
c) Numbers and lengths of fish (mm)			
Sandeels <i>Ammodytes</i> sp.	1,120	65.1	0.64
Clupeid ( <i>Clupeidae</i> )	7	65.0	3.06
Sprat <i>Sprattus sprattus</i>	6	74.2	3.42
Cod <i>Gadus morhua</i>	12	46.1	2.8
Herring <i>Clupea harengus</i>	4	73.3	1.55
Saithe <i>Pollachius virens</i>	1	54.0	-
Goby ( <i>Gobidae</i> )	4	45.6	1.93

Notes:

Most of the Clupeidae category were probably small sprat. The gobies were probably crystal gobies *Crystallogobius linearis*.

**Table 11** Percentage of black-legged kittiwake broods of one and two chicks that had no adults present during daily checks in the middle of the day on the Isle of May, 1986-2002

<i>Year</i>	<i>One young</i>	<i>Two young</i>
1986	1	7
1988	31	66
1989	13	32
1990	21	45
1991	2	13
1992	13	28
1993	12	31
1994	1	19
1995	3	14
1996	7	27
1997	14	42
1998	23	63
1999	5	25
2000	2	8
2001	6	19
2002	6	19

Notes:

Figures are based on 56-170 broods in the same areas each year and are the means of daily checks made from the date that the first neglected chick was noted, to the start of fledging in the areas. (Details of methods are given in Wanless & Harris, *Scottish Birds* 15 (1989):156-161).

**Table 12** Percentage of sandeels (by weight) in the diet of young seabirds on the Isle of May, 1987-2002

	<i>1987</i>	<i>1988</i>	<i>1989</i>	<i>1990</i>	<i>1991</i>	<i>1992</i>	<i>1993</i>	<i>1994</i>
Shag	100	98	100	95	100	97	99	86
Kittiwake	95	94	95	86	50	61	63	81
Guillemot	81	41	74	24	74	53	17	19
Puffin	77	85	89	96	87	86	46	57
	<i>1995</i>	<i>1996</i>	<i>1997</i>	<i>1998</i>	<i>1999</i>	<i>2000</i>	<i>2001</i>	<i>2002</i>
Shag	85	99	100	98	<50	87	95	98
Kittiwake	86	81	94	81	84	92	76	94
Guillemot	78	44	79	21	22	43	18	22
Puffin	50	88	86	86	52	90	68	94

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.

**Table 13** Black-legged kittiwake first-egg dates and clutch-sizes on the Isle of May, 1986-2002

<i>Year</i>	<i>First date egg seen</i>	<i>Mean clutch-size (eggs)</i>
1986	9 May	no data
1987	4 May	no data
1988	6 May	no data
1989	27 April	2.04
1990	2 May	1.82
1991	6 May	1.86
1992	30 April	1.83
1993	4 May	1.78
1994	17 May	0.86
1995	16 May	1.61
1996	24 May	1.13
1997	10 May	2.03
1998	13 May	1.46
1999	16 May	1.99
2000	5 May	1.89
2001	17 May	1.93
2002	10 May	1.87