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**Isle of May
seabird studies in 2003**

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1. Summary

During 2003, weather conditions on the Isle of May, like much of the UK, were considerably warmer and drier than in recent years. Most seabird species experienced a reasonably productive breeding season, with breeding success for all species except common guillemot and razorbill being close to, or above, the long term average. European shag productivity saw its highest value on record and continued the trend of very high breeding success seen during the previous three seasons. Black-legged kittiwakes had their second most productive season since 1990. Breeding success of both northern fulmars and Atlantic puffins was close to the long term average, and similar to 2002. Common guillemot productivity was no higher than in 2002, and was still below the long term average. Razorbill breeding success was well below the long term average and lower than that of 2002. Timing of breeding was earlier for European shags and common guillemots, but normal for northern fulmar, black-legged kittiwake, Atlantic puffin and razorbill. Return rates of colour-ringed European shags, black-legged kittiwake and Atlantic puffins were close to, or above, the long term average, while those for common guillemots and razorbills were slightly lower. As in previous years, lesser sandeels were the predominant prey species for all species, except for guillemots, which mainly brought back clupeids for their chicks.

- Northern fulmar breeding success (0.44 chicks per pair) was similar to that of 2002, and close to the long term average.
- European shags had another productive season, with timing of breeding (the first eggs were laid on 23 March) being much earlier than in 2001 and 2002. Breeding success was 1.83 chicks per pair, the highest ever recorded here. As in 2002, return rate was high at 92.7%.
- Timing of breeding for black-legged kittiwakes was normal, but 15% of birds occupying a site did not start nest building. Those pairs that did complete a nest, however, produced an average of 0.77 chicks per pair. This value is much higher than that for 2002 and the long term average. Black-legged kittiwake return rate (84.2%) was the highest since 1990.
- Common guillemots began egg laying slightly earlier than in 2002, with the first egg on the island being seen on 17 April and in the study plots, on 20 April. Breeding success (0.68 chicks per pair) was below the long term average, but similar to 2002. Common guillemot return rate (87%) was the same as in 2002.
- Razorbill breeding success (0.59 chicks per pair) was below that for 2002, and slightly below the long term average. The return rate of razorbills (77.8%) was slightly lower than in 2002.
- Atlantic puffin breeding success for 2003 (0.77 chicks per pair) was similar to the long term mean. Return rate (85.2%) was similar to that in 2002 and close to the long term average.

There has been no commercial sandeel fishery on the Wee Bankie since 2000. Studies on the Isle of May in 2000-2002 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 has been at record levels and black-legged kittiwake breeding success returned to something approaching the higher levels (0.82-1.38) typical of the pre-fishery period.

In 2003, 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, which also rely heavily on sandeels but which target the 0-group sandeels during chick-rearing and forage offshore, experienced increased breeding success from the previous two seasons, although not quite reaching levels of 2000, immediately after the fishery closure. Breeding success for Atlantic puffins was similar to the previous three years. 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. Northern fulmars, for which sandeels appear not to be an important prey item, experienced breeding success close to 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. An EU-funded interdisciplinary project was started in 2001 to try to investigate this further and its last field season was completed in 2003.

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 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 northeast 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 2003, 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 during 2000-2002 was maintained.

3. Methods

3.1 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 was marked on photographs on 2, 5 and 9 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 6 August to determine sites which had hatched eggs. A final check was made on 23 August, when chicks present were assumed to have fledged successfully.

European shag

The position of nests in 12 areas was marked on photographs and the state and contents of these nests were checked weekly from 26 March until 23 July. All medium size or large young present on the 23 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 was marked on photographs and the presence or absence of an incubating bird, or the number of young present at each, was noted. Checks of nests were made on 1, 4 and 7 June. The first young was seen flying on 13 July, but this was known to be an exceptionally early nest. The first check of chicks was therefore postponed until 23 July, four days after the first fledged young on the island was recorded. Within the four days, very few other fledged young were recorded. A further two checks were made on 28 July and 4 August, 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 29 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.

3.2 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 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. As in 2002, the area included birds nesting at North Horn.

3.3 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. 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 2003 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 of common guillemots' diet. 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

4.1 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 the first egg was seen on 19 May. Breeding success was 0.44 young per incubating pair (Table 1). This is within the 95% Confidence Intervals for the long-term average of 1986-2002 (0.42, CI=0.37-0.46), although slightly lower than breeding success in 2002. The methodology used is not designed to determine when breeding attempts fail, but most losses apparently occurred during incubation. However, three medium-sized young (1 at Cornerstone and 2 at Greengates) were seen dead on the nest on 6 August, during a period of exceptionally hot, dry weather.

European shag

The timing of breeding was earlier than in 2002 with the first egg laid on 23 March. Productivity was extremely high: 2003 saw the highest value since monitoring began in 1986 ($1.83 \pm \text{S.E. } 0.19$ young per incubated nest averaged across the plots, 1.57 when results from all areas are pooled; Table 2). This was well above the 95% Confidence Interval for the 1986-2002 average (0.90, CI=0.69-1.11). Of 183 nests built in the study plots, 156 pairs laid and incubated eggs and a total of 238 chicks fledged. Of 112 successful pairs 41 (37%) each raised three young.

Black-legged kittiwake

Breeding started around the same time as in 2002, with nest building first recorded on 26 April and the first egg noted on 9 May. The first chick was seen on 6 June and the first young fledged on 9 July. These were both seen at the North Horn plot, which is a particularly early plot. In the remaining study plots, the first chick was seen on 10 June and the first chick fledged on 13 July. Eighty-nine percent of pairs initiating nest building completed a nest; however, 15% of pairs occupying a site did not start a nest. The mean clutch size of 1.49 was one of the lowest ever recorded (Table 13).

During the first half of the chick rearing period, chick growth appeared slow. However, few unattended broods were seen (8% of broods of one chick; 24% of broods of two; Table 11, see notes section). Within the study plots, 5 pairs (0.02% of successful pairs) reared three young each and a few broods of three large young were seen elsewhere on the island. Breeding success in 2003 was 0.77 ± 0.11 chicks per completed nest, averaged across the plots (Table 3). This value is much higher than that for 2002, and higher than the long-term average (0.55, CI=0.35-0.75) (Table 5). However the total pairs breeding in the study plots (423) was lower than during 2002 (477), continuing the long term decline in numbers.

Common guillemot

The first egg on the island (Greengates) was seen on 17 April and, in the study plots, on 20 April, 3 days earlier than in 2002. The median laying dates in the earliest and latest areas monitored were 1 and 7 May, respectively. The first young left on the night of 13/14 June. Productivity in 2003 (0.68 young per pair laying; Table 4) was the same as in 2002 and was below the 95% Confidence Interval for the long-term average (0.77, CI=0.73-0.81). Chick losses (12%) were much higher than the 8% average (1982-2002) for the Isle of May. Egg losses (20%) were also slightly higher than the long-term average (16%) but these seemed to be mainly caused by eggs being accidentally knocked from the site rather than by predation. Weights of chicks near fledging (average 243g) were close to the long-term mean. Unlike 2002, and in particular 2001, very few chicks were left unattended.

Razorbill

Timing of breeding of razorbills was normal for the Isle of May, with the first egg being laid on 24 April. Breeding success (0.59 young per pair laying; Table 4) was much lower than the long term mean (0.68, CI=0.64-0.72). Seventy percent of losses occurred at the egg-stage, while survival of hatched chicks to fledging was high at 82%.

Atlantic puffin

The first adult Atlantic puffins carrying fish were seen on 24 May and the first young was known to have fledged on the night of 28/29 June. Back-calculation from these figures indicated that laying commenced around 8 April. The overall success rate (0.77 chicks fledged per egg laid; Table 4) was close to the long term mean (0.76, 95% CI=0.70-0.82).

4.2 Adult survival 2002-2003

Not every adult alive is seen each year and thus the return rates in 2003 of birds seen in 2002 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 2003 an additional 10 European shags, 26 black-legged kittiwakes, 42 Atlantic puffins, seven razorbills and 49 common guillemots were colour-ringed.

European shag

Of 164 colour-ringed European shags alive in 2002, 152 (92.7%) were resighted in 2003. This was the highest resighting rate since 1998 and well above the long term average (79.4, 95% CI = 69.2-89.6). In addition, one European shag that had not been seen in 2002 was seen in 2003 .

Black-legged kittiwake

The return rate of black-legged kittiwakes (84.2%) was the highest since 1990 and above the long-term average (79.4, 95% CI =75.5-83.4).

Common guillemot

The return rate of adult common guillemots (87.0%) was the same as in 2002 and is slightly lower than the long-term average (92.5, 95% CI = 91.0-93.9).

Razorbill

The return rate of razorbills (77.8%) was slightly lower than in 2002 and the long-term average (81.7, 95% CI = 76.1-87.4) 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 (85.2%) was close to the long-term average (84.1, 95% CI = 79.8-88.4).

Figure 1. Breeding success (young reared per pair breeding) of seabirds on the Isle of May 1986 - 2003

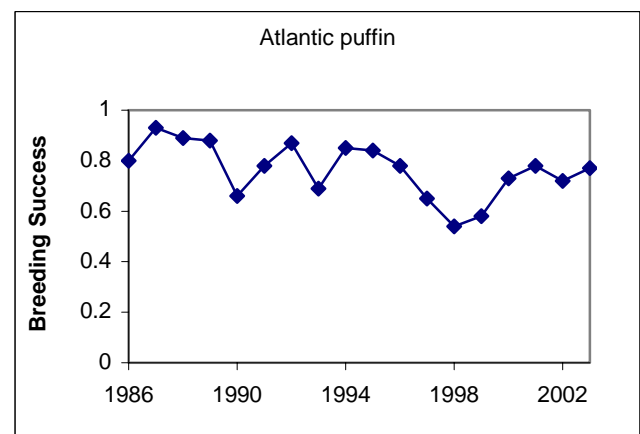
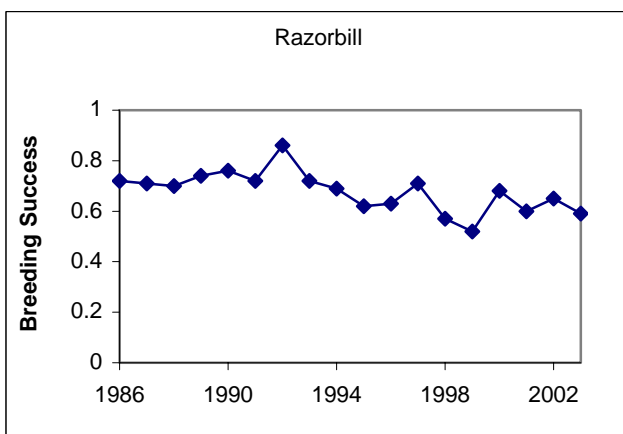
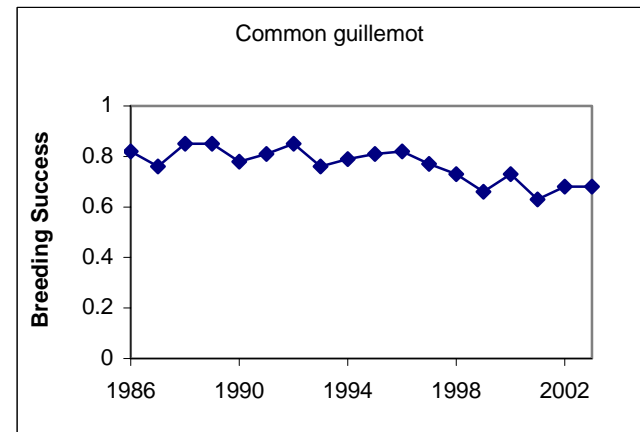
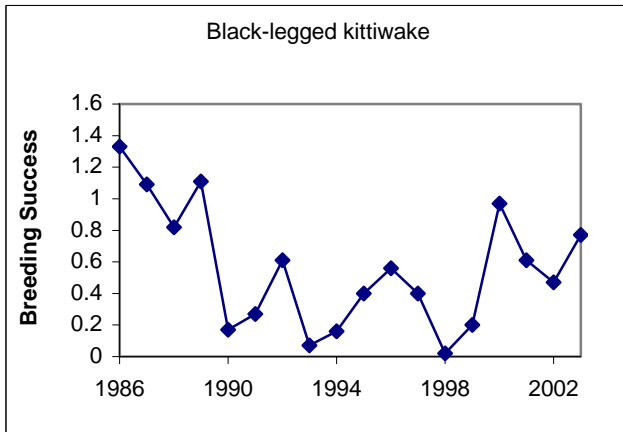
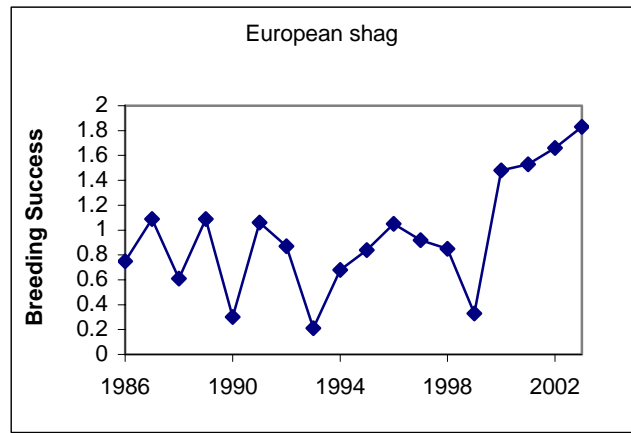
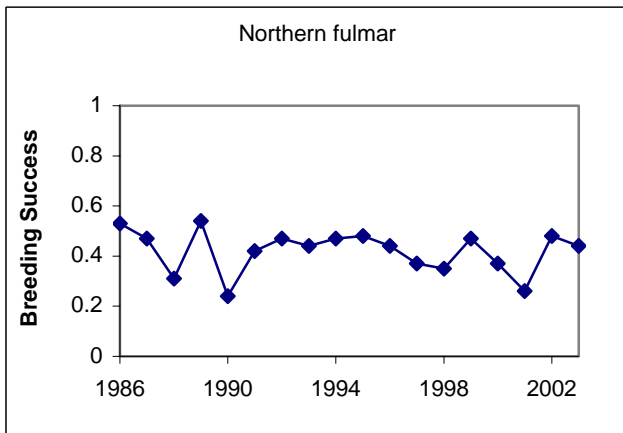
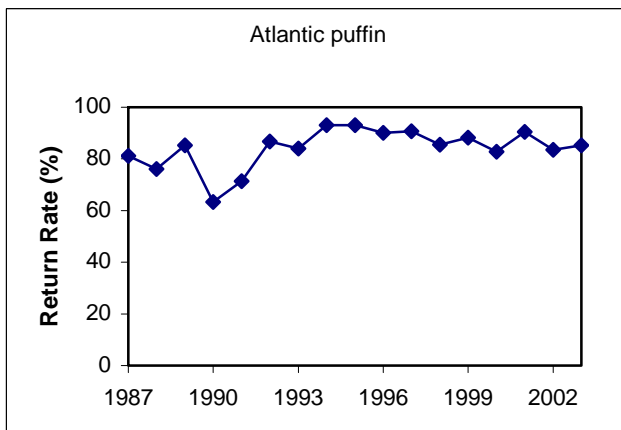
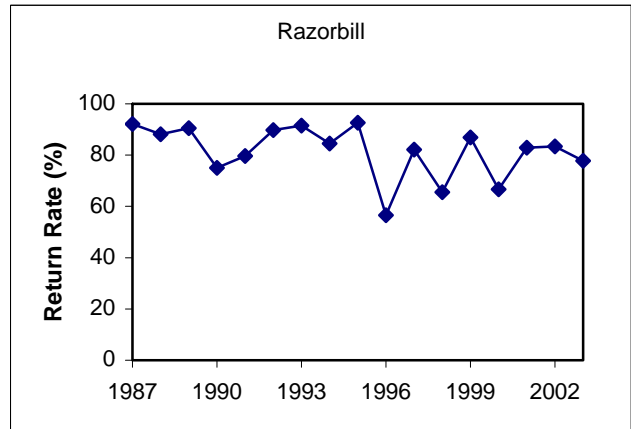
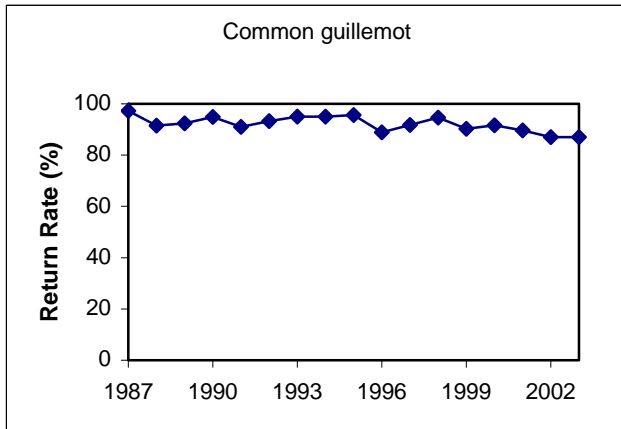
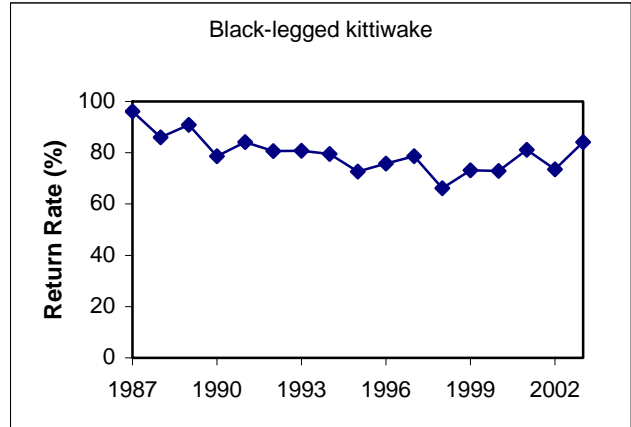
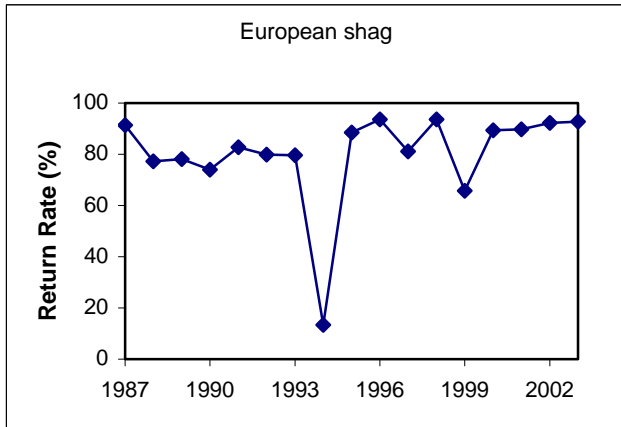


Figure 2. Annual return rates of adult seabirds on the Isle of May 1987 – 2003



4.3 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 consisted mainly of sandeels. Of 38 regurgitates obtained between 29 May and 5 July, 37 contained sandeels and in terms of biomass sandeels accounted for 96% of the total (Tables 7 and 12). Based on otolith counts, 8% of sandeels were 0-group and 92% were older age classes. Eelpout *Zoarces viviparus* accounted for 3% of biomass.

Black-legged kittiwake

Ninety-eight percent of black-legged kittiwake food samples collected during the chick-rearing period contained sandeels (Table 7). Of 6,937 otoliths examined, 96% was sandeel, of which 99.5% was 0-group fish with estimated lengths of 2.3-10.1 cm (n=6621 otoliths examined). In terms of biomass, sandeels contributed 95% by weight of the diet and clupeids (mainly sprat *Sprattus sprattus*) contributed 4%.

Common guillemot

As in recent years, the majority (82%) of 1,301 fish delivered to young common guillemots was clupeids (probably mainly sprat *Sprattus sprattus*), with most assigned to the small (c.10 cm) size category (Table 8). The remaining food items were sandeels, predominantly in the small-medium (9-12 cm) size category. The average weight of a prey item (estimated from individual lengths) was 3.1 g, around half that of the long term (19 year) average of 7.4 g. Despite this the fledging weight of chicks was close to the long-term average. In biomass terms, sandeels comprised only 15% of the diet.

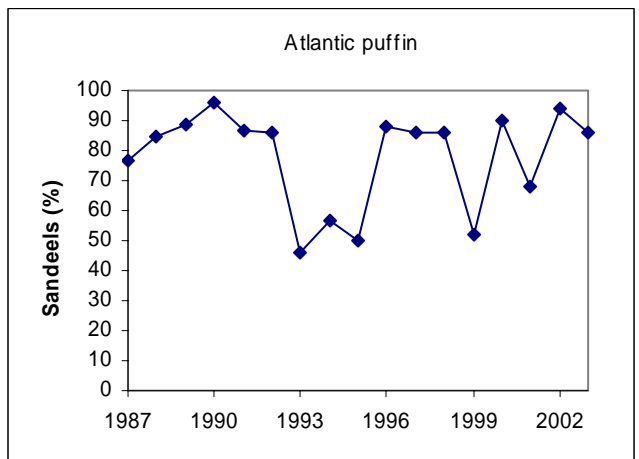
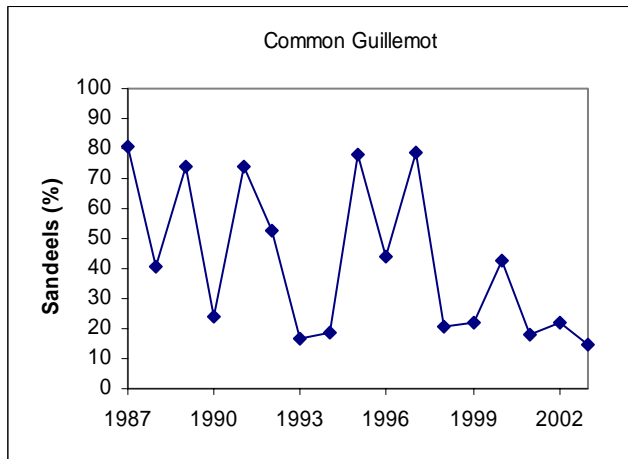
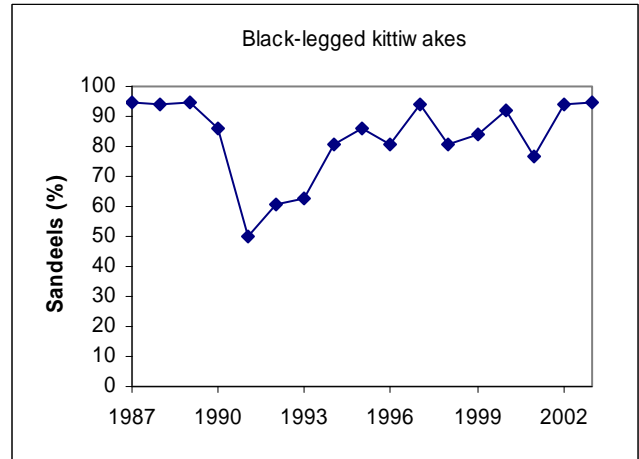
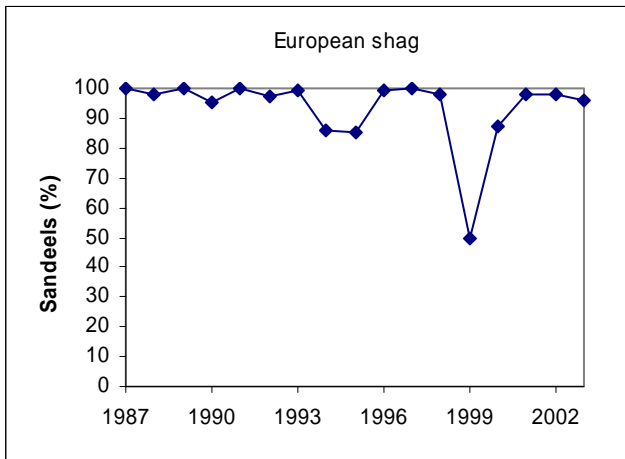
Razorbill

Most loads of fish brought to razorbill chicks were made up of several small sandeels (probably 0-group). Single fish loads were mostly made up of 1+ group sandeels (Table 9).

Atlantic puffin

Sandeels made up 93% by number of the diet of young Atlantic puffins with the proportion in biomass terms being 86% (Table 12). Most sandeels were 0-group with a mean length of 6.3 cm; only 20 (<1%) were longer than 10 cm (Table 10). Many of the clupeids were small, and were mostly sprat. The mean load size of 8.1 g was slightly below 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, 1987-2003



5. Conclusions

During the first year of the closure of the Wee Bankie sandeel fishery in 2000, all the species monitored, except 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 more successful season than in 1999, prior to the fishery closure. The 2003 season contrasted markedly with that of 2002, with all species except common guillemots and razorbills experiencing breeding success close to, or above, the long term average. In 2003 all species were more successful than in 1999, pre-fishery closure.

Clearly, there is still uncertainty about the relative importance of climate, hydrography and fishing pressure and their effects upon feeding conditions for seabirds. The IMPRESS project, (Interactions between the marine environment, predators and prey: implications for sustainable sandeel fisheries) started in 2001 and completed its final field season in 2003. Given the contrasting weather conditions and breeding success experienced in 2002 and 2003, it will be interesting to see if results from this project can go some way in explaining the fluctuating breeding performance that the Isle of May seabirds have experienced in recent years.

6. Acknowledgements

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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 2002 report.

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Table 1. Breeding success of northern fulmars on the Isle of May in 2003

<i>Area</i>	<i>Incubating Birds</i>	<i>No. probably hatched</i>	<i>Young fledged</i>
Cleaver	8	3	3
Pilgrim's Haven	3	2	2
Cornerstone	4	4	3
Loch (S)	20	9	9
Greengates	45	23	21
Horse Hole	7	3	3
Tarbet	16	5	5
Low Light	3	1	1
Colm	2	1	1
Rona	1	0	0
Total	109	51	48
Overall mean			0.44 fledged/ pair

Notes:

Incubating birds were those sitting tight on three checks or where an egg was seen. Chicks present on 23 August were assumed to have fledged.

Table 2. Breeding success of European shags on the Isle of May in 2003

<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	19	4	3	6	4	27	1.42
Chatterstones	5	1	0	1	2	8	1.60
Pilgrim's Haven	17	2	1	2	7	26	1.53
North Pilgrims	1	0	0	0	1	3	3.00
South Face	2	0	0	0	2	6	3.00
Mill Door (N)	15	5	2	6	3	23	1.53
Mill Door (S)	18	4	2	8	4	30	1.67
Horse Hole	21	5	5	8	4	33	1.57
North Horn	32	3	4	10	9	51	1.59
Tarbet	5	0	0	2	3	13	2.60
Low Light	13	1	1	4	1	12	0.92
Colms Hole	9	2	2	3	2	14	1.56
							1.83 ± 0.19
Total	157	27	20	50	42	246	1.57

No nests were built in the plots at South Ness, Lady's Bed Stack, South Horn or Bishop's Cove in 2003.

Table 3. Breeding success of black-legged kittiwakes on the Isle of May in 2003

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	27	1	3	11	12	4	0	20	0.74
Pilgrim's Haven	19	1	3	2	10	7	0	24	1.26
South Face	15	4	3	4	5	6	0	17	1.13
Colony 4	48	6	11	14	13	17	4	59	1.23
Cornerstone	54	6	7	17	18	19	0	56	1.04
Loch (S)	11	1	2	7	3	1	0	5	0.45
Loch (N)	67	4	9	53	12	2	0	16	0.24
Greengates	11	3	0	6	3	2	0	7	0.64
Bishop's Cove	28	0	14	12	11	5	0	21	0.75
Horse Hole	3	2	0	1	1	1	0	3	1.00
Iron Bridge	32	4	4	8	5	19	0	43	1.34
Rona	28	6	6	7	13	7	1	30	1.07
Tarbert	55	9	19	42	10	3	0	16	0.29
Low Light	12	2	0	12	0	0	0	0	0
Colm's Hole	13	3	4	10	1	2	0	5	0.39
									0.77 ± 0.11
Total	423	52	85	206	117	95	5	322	0.76

Table 4. Breeding success of auks on the Isle of May in 2003

Species	Area	Pairs laying	Young hatched	Young "fledged"	Young leaving / pair
Guillemot	Dense	316	253	228	0.72
	Hide / White Ledge	113	93	77	0.68
	Colony 4	283	223	185	0.65
	South	51	39	29	0.57
	Cornerstone	251	206	193	0.77
	Mean ± se				0.68 ± 0.04
Razorbill	Hide / White Ledge	28	21	17	0.61
	Colony 4	56	37	30	0.54
	South	22	14	13	0.59
	Cornerstone	71	53	43	0.61
	Mean ± se				0.59 ± 0.02
Puffin	Lady's Bed	48	?	37	0.77
	Kirkhaven	48	?	38	0.79
	Burrian	49	?	38	0.78
	Rona	50	?	36	0.72
	Mean ± se				0.77 ± 0.02

Notes:

For the puffin, the number of young that hatched was unknown.

Table 5. Breeding success (mean number of young reared per breeding pair) of seabirds on the Isle of May, 1989-2003

<i>Species</i>	<i>1990</i>	<i>1991</i>	<i>1992</i>	<i>1993</i>	<i>1994</i>	<i>1995</i>	<i>1996</i>
Fulmar	0.24 (66)	0.42 (100)	0.47 (129)	0.44 (121)	0.47 (122)	0.48 (126)	0.44 (135)
Shag	0.30 (154)	1.06 (187)	0.87 (181)	0.21 (80)	0.68 (74)	0.84 (131)	1.05 (105)
Kittiwake	0.17(1095)	0.27 (1172)	0.61(1062)	0.07(1034)	0.16 (861)	0.40 (874)	0.56 (825)
Guillemot	0.78 (748)	0.81 (754)	0.85 (745)	0.76 (797)	0.79 (775)	0.81 (805)	0.82 (786)
Razorbill	0.76 (100)	0.72 (104)	0.86 (105)	0.72 (119)	0.69 (134)	0.62 (143)	0.63 (140)
Puffin	0.66 (176)	0.78 (153)	0.87 (184)	0.69 (182)	0.85 (189)	0.84 (180)	0.78 (173)
	<i>1997</i>	<i>1998</i>	<i>1999</i>	<i>2000</i>	<i>2001</i>	<i>2002</i>	<i>2003</i>
Fulmar	0.37 (136)	0.35 (120)	0.47 (115)	0.37 (143)	0.26 (134)	0.48 (131)	0.44 (109)
Shag	0.92 (109)	0.85 (125)	0.33 (58)	1.48 (127)	1.53 (135)	1.66 (130)	1.83 (156)
Kittiwake	0.40 (822)	0.02 (683)	0.20 (616)	0.97 (545)	0.61 (459)	0.47 (477)	0.77 (423)
Guillemot	0.77 (842)	0.73 (852)	0.66 (870)	0.73 (942)	0.63 (975)	0.68 (955)	0.68 (1014)
Razorbill	0.71 (132)	0.57 (134)	0.52 (142)	0.68 (149)	0.60 (167)	0.65 (167)	0.59 (177)
Puffin	0.65 (166)	0.54 (179)	0.58 (181)	0.73 (132)	0.78 (185)	0.72 (174)	0.77 (195)

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, 1987-2003

<i>Species</i>	<i>No. seen in 2002</i>	<i>No. seen in 2003</i>	<i>Return rate (%)</i>						
			<i>2002-03</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>
Kittiwake	133	112	84.2	73.5	81.2	72.9	73.1	66.2	78.7
Guillemot	355	309	87.0	87.0	89.6	91.6	90.2	94.6	91.8
Razorbill	45	35	77.8	83.8	82.9	66.7	86.9	65.5	82.1
Puffin	183	156	85.2	83.5	90.5	82.8	88.2	85.5	90.7
Shag	164	152	92.7	92.2	89.8	89.4	65.8	93.6	91.1
	<i>1995-96</i>	<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	75.8	72.7	79.5	80.8	80.7	84.2	78.7	90.9	86.0
Guillemot	88.9	95.6	95.0	95.0	93.3	91.0	94.9	92.4	91.5
Razorbill	56.6	92.6	84.5	91.5	89.8	79.6	75.0	90.5	88.1
Puffin	90.1	93.0	93.1	84.0	86.8	71.4	63.3	85.2	76.1
Shag	93.6	88.5	13.4	79.6	79.9	82.8	74.0	78.1	77.3

Notes:

Only birds which had definitely bred in 2002 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 2003

	<i>Black-legged kittiwake</i>	<i>European shag</i>
No. of regurgitations	134	38
Range of dates	6 June – 4 August	29 May – 5 July
Total weight (g)	2151	1591
% regurgitations with sandeels	98	97
with Gadidae	2	5
with Clupeidae	16	5
with flatfish	0	0
with dragonet	0	3
% (by weight) of sandeels in sample	95	96
% (by numbers) of sandeels in sample	96	99
Modal lengths of sandeels (cm)	7	9
Other remains identified	Euphausiid (3 samples) Nereis (1 sample)	Butterfish (1 sample) Goby (1 sample) Eelpout (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 2003

	<i>Number of sandeels</i>				<i>Number of Clupeidae</i>					<i>Number of Gadidae small</i>
	<i>minute</i>	<i>small</i>	<i>Medium</i>	<i>large</i>	<i>minute</i>	<i>small</i>	<i>medium</i>	<i>large</i>	<i>very large</i>	
Mean length (cm)	6	9	12	14	8	10	13	15	17	8
All-day watches										
16 June	1	75	20	0	1	372	20	2	0	0
23 June	1	10	3	0	2	124	3	0	0	0
30 June	0	18	9	2	2	65	5	0	0	0
Other records										
30 May - 3 July	8	64	14	0	14	446	13	2	2	3
Total	10	167	46	2	19	1007	41	4	2	3

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 2003

	<i>Single sandeel</i>				<i>Several sandeels</i>				<i>Clupeidae</i>
	<i>minute</i>	<i>small</i>	<i>medium</i>	<i>large</i>	<i>minute</i>	<i>small</i>	<i>medium</i>	<i>large</i>	
All-day watches									
10 June	1	0	0	1	0	26	3	0	7
15 June	0	0	1	0	5	20	5	2	3
22 June	0	0	0	2	2	18	3	0	4
Other records									
6 June - 5 July	2	1	0	2	30	53	8	1	14
Total	3	1	1	5	37	117	19	3	28

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, 31 May to 12 July 2003

	<i>Sample size</i>	<i>Mean</i>	<i>s.e</i>
a) Load weight (g)	223	8.06	0.25
b) Fish/load	223	11.7	0.38
c) Numbers and lengths of fish (mm)			
Sandeels <i>Ammodytes sp.</i>	2,420	61.4	0.23
Unidentified Clupeid (<i>Clupeidae</i>)	53	48.8	1.8
Sprat <i>Sprattus sprattus</i>	68	82.1	2.1
Cod <i>Gadus morhua</i>	2	42.5	2.5
Herring <i>Clupea harengus</i>	1	70.0	-
Saithe <i>Pollachius virens</i>	2	57.0	2.0
Goby (<i>Gobidae</i>)	3	44.0	1.53
Unidentified Gadid (<i>Gadidae</i>)	14	40.7	2.1
Rockling <i>sp.</i> (<i>Gadidae</i>)	51	36.2	0.64
Whiting (<i>Merlangius merlangus</i>)	1	55.0	-

Note:

Most of the Clupeidae category probably comprised small sprat. The gobies were probably crystal gobies *Crystallogobius linearis*. In addition 2 samples contained small squid.

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, 1986-2003

<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
2003	0.2	7

Notes:

Figures are based on 87-196 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). Note that the very small values for 2003 are due to the small sample size, as the first chick seen neglected was not until 9 July, and the first fledged chicks in the area were 13 July. Including checks until 30 July, the percentage of broods of 1 and 2 neglected were 8 and 24 respectively.

Table 12. Percentage of sandeels (by weight) in the diet of young seabirds on the Isle of May, 1987-2003

	<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>	<i>2003</i>
Shag	85	99	100	98	<50	87	95	98	96
Kittiwake	86	81	94	81	84	92	76	94	91
Guillemot	78	44	79	21	22	43	18	22	15
Puffin	50	88	86	86	52	90	68	94	86

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, 1986-2003

<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
2003	9 May	1.49