



JNCC Report No. 475c

Isle of May seabird studies in 2007

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January 2013

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ISSN 0963-8901

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This report should be cited as:

Newell, M., Harris, M.P., Daunt, F., Watts, E., Quinn, L. & Wanless, S. (2013)

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Acknowledgements:

We are grateful to Therese Alampo and Tabby Lamont of Scottish Natural Heritage for logistical support on the Isle of May. Kate Ashbrook, Sue Lewis, Morten Frederiksen, Chris Thaxter, Tom Reed, and Ellie Owen made major contributions to the fieldwork. Sheila and Debbie Russell, Toby Reynolds, Fiona Leckie, Elaine Tooth, David Kortan, Tom Staton and Neil Dawson also helped with fieldwork. We are grateful to Andy Easton for providing transport to and from the Isle of May throughout the season.

Summary

The 2007 season was an exceptionally poor one for most species on the Isle of May. Of the six species studied intensively, European shag and razorbill had an average season but common guillemot, Atlantic puffin and Northern fulmar all had the worst season on record, while black-legged kittiwakes had the worst season for nine years. Severe weather conditions played a part in the poor breeding season but difficult feeding conditions were still likely to be the main reason for such low productivity. Return rates were also at all-time lows for common guillemot, Atlantic puffin and black-legged kittiwake and well below average for shag. Although lesser sandeels remained the main food of young Atlantic puffins, razorbills and black-legged kittiwakes, common guillemots fed their young mainly on clupeids, while European shags brought in a wide variety of bottom-living fish. Very few 1+ group sandeels were present in food samples during the chick-rearing period. 2007 continued the recent trend for an increasing proportion of snake pipefish in the diet of several of the seabirds.

- Northern fulmar breeding success (0.21 chicks per incubating pair), which, with 2004, was the joint worst season on record.
- European shags began breeding earlier than in 2006 and had a productive season. Shag was the only species for which productivity (1.07 chicks per pair) was above the long-term mean. Following high mortality during the winter, return rate at 60.8% took a drop from 2006 and was well below the long-term mean. As in the previous two years, the prey eaten was unusually varied with sandeels making up only 28.3% by mass of the diet, the lowest proportion on record. All sandeels that were recorded during chick-rearing were from older (1+ group) fish.
- Black-legged kittiwakes had a very poor breeding season with productivity (0.24 chicks per completed nest) the lowest since 1999 and well below the long term average. Adult return rate (62.9%) was the lowest on record. The proportion of sandeel in the diet (48% by biomass) was also the lowest recorded.
- Common guillemots had their poorest breeding season on record with 0.28 chicks leaving per pair laying. The last four seasons have seen the three lowest breeding successes on record. As in the previous three years, many chicks were left unattended. Surprisingly, fewer were taken by gulls than killed by other guillemots and razorbills. Return rate of adults (75.2%) was also the lowest on record. Adults fed their chicks mainly on sprats with small gadoids the main alternative. Sandeels made up only 1% of the diet by mass. Chicks grew slowly and all the evidence suggested that feeding conditions were poor.
- Razorbill breeding was earlier than last year and, in contrast to most other species, breeding success (0.63 chicks leaving per pair) was close to the long-term average. Adult return rate (80.0%) was also close to the long-term average. Chicks were fed mainly 0 group sandeels.
- Atlantic puffins had their worst ever breeding season at 0.29 chicks per pair, which is a huge drop on the previous lowest figure. Unprecedented rainfall washed out numerous burrows and those chicks which managed to survive the wet conditions showed slow growth rates and high mortality. Return rate for adults (56.9%) was also the lowest on record. Chicks were mainly fed 0 group sandeels (82% by number, 76% by biomass).

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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 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 lie 30-50 km 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 seabirds in the area. In December 1999, EU Fishery Ministers agreed a ban on fishing for sandeels, effective for 2000, in 20,000 square kilometres of sea off eastern Scotland (including the Wee Bankie grounds) and northeast England. 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. In 2004, seabirds on the Isle of May did particularly poorly, despite the ban still being in operation. Continued monitoring of the Isle of May seabirds is vital to assess their performance, and in particular to determine whether 2004 was a one-off event or a temporary setback in the recovery recorded in some species since the fishery closure.

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).

Northern fulmar

The positions of apparently incubating birds in nine areas were marked on photographs on 2, 5, 8 and 11 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 17 and 31 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 April until 17 August. Medium-sized and large young still present on 17 August were assumed to have fledged successfully. Success was estimated both by averaging across the plots and summing over plots.

Black-legged kittiwake

The positions of nests in 16 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 2007. The plot at Horse Hole (that held 11 nests in 2006) was not checked in 2007. Checks of nests were made on 3 and 12 June when regular checks of sample areas showed that most pairs had constructed nests. The first young were seen flying on 22 July and a complete check of nests was made on 23 July. Further checks of nests with small chicks on 22 July were made on 30 July and 17 August. Chicks alive on 17 August were assumed to have fledged. 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 was present were staked in each of four areas on 1-4 May (by when most pairs had laid). The staked burrows were re-checked on 3-4 July at the start of fledging. Normally any young present at this time are assumed to fledge successfully and empty burrows where there are many droppings, moulted down and feather sheaths are also assumed to have been successful. However, from intensive work involving frequent checks of burrows being carried on in 2007, we were aware that there was considerable mortality of puffin chicks after the date the monitoring check was made and thus that our figure over-estimated success. We therefore applied a correction factor to the monitored

burrows, based on the percentage of chicks in the burrows used for the study of growth rates that died after 3-4 July.

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 most 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, Little Hole, Cornerstone and its nearby cliffs.

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). Fish otoliths were extracted from regurgitates, identified and measured. The lengths of the fish from which they came were calculated using regressions derived from the otoliths of fish of known length where possible collected from birds on the island in 2007, otherwise from previously published relationships. 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 throughout the chick-rearing period. 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 directly from this species.

3 Results

3.1 Breeding success

Appendix 1 provides species summaries in Tables 1- 4 and a comparison with recent years' in Table 5. Long-term averages presented do not include the current year.

Northern fulmar

The first egg was seen on 18 May. This year saw a large drop in productivity from an average year in 2006 (0.40) to the joint lowest figure since monitoring began with breeding success at 0.21 (Figure 1). This is much lower than the 95% Confidence Intervals for the long-term average between 1986-2006 (0.40, CI=0.36-0.44). The methodology used is not designed to determine when breeding attempts fail, but losses appeared to have been slightly higher during incubation than during chick-rearing.

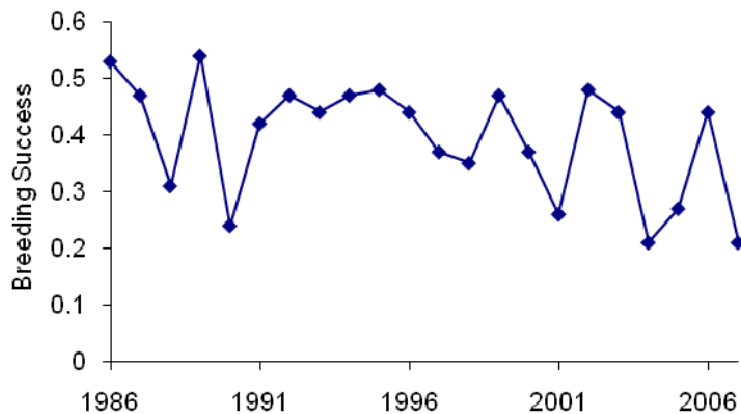


Figure 1. Breeding success (young reared per pair breeding) of Northern fulmar on the Isle of May 1986 – 2007

European shag

In 2007, 57 pairs bred in the study plots, a drop from 81 in 2006. Compared to the last two years, breeding was early with the first egg laid on 20 April (compared with 25 April in 2006 and 6 May in 2005) but still later than the 1986-2006 average of 11 April. Of 64 nests built, 57 pairs laid and raised a total of 61 chicks to fledging. Productivity was high (1.07 chicks per pair laying or 0.95 per nest built) (Figure 2). The former estimate was well above the 1986-2006 average (0.91, CI=0.68-1.14).

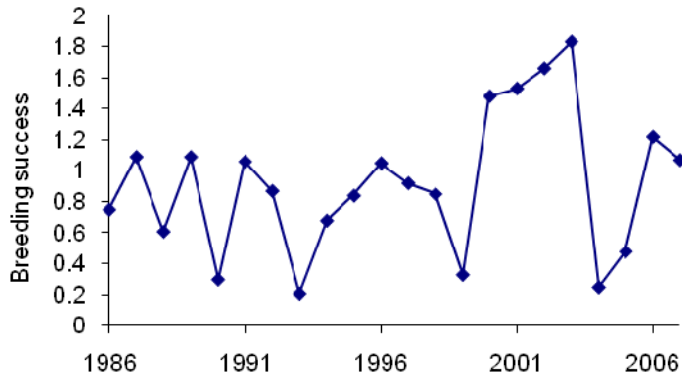


Figure 2. Breeding success (young reared per pair breeding) of European shag on the Isle of May 1986 – 2007

Black-legged kittiwake

Timing of breeding of black-legged kittiwakes in 2007 was noticeably earlier than in the previous few seasons although still somewhat later than the long term mean. The first courtship feed was observed on 26 April, nearly three weeks ahead of 2006 and the first egg was found on 19 May, eight days ahead of last year. The first chick was recorded on 15 June and the first young fledged on 22 July. The mean clutch size, including complete nests where no eggs were laid, was 1.80 eggs, an improvement on recent years (Table 13). There were 21 clutches of three eggs recorded in the 320 nests checked for clutch-size which is a large rise on the single nests with three eggs recorded in each of the previous two years. Mean breeding success in 2007 was 0.23 (\pm se 0.06) chicks per completed nest, averaged across the plots, 0.24 after pooling areas (Figure 3). This value was well below the 95% Confidence Interval for the 1986-2006 average (0.56, CI=0.41-0.71) and the lowest breeding success since 1999. The total number of pairs breeding in the study plots (609) was down on the previous two years.

The first broods without an adult present were noted on 30 June. The frequency of neglected broods of one chick increased from 0% up to 62% by the time of the first fledging while that of broods of two increased steadily from 2% to 100%, the average daily rates of unattended chicks were 36.6% and 49.9% for broods of one and two chicks, respectively. No brood of three young fledged on the island and no brood of two fledged in the plots.

The 2007 season for kittiwakes began positively with early signs of nesting activity, feeding flocks around the island and a return towards normal laying times. With much higher clutch-sizes than have been observed for a number of years the omens looked good, but as with several species on the isle in 2007 kittiwakes then experienced a slow but steady decline. Some clutches were abandoned late in incubation followed by early chick neglect and losses of at least one chick from virtually all broods of two.

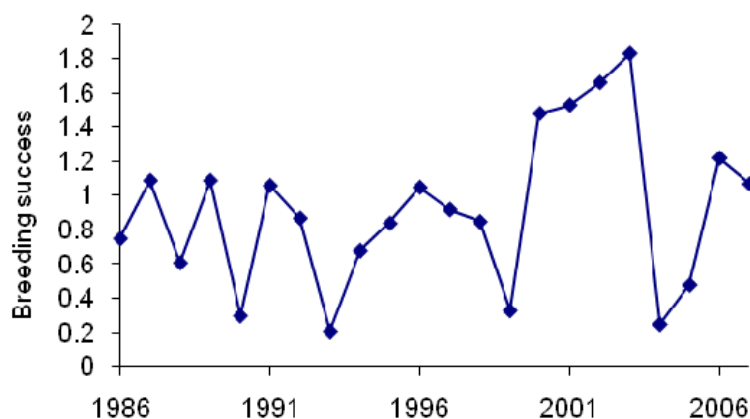


Figure 3. Breeding success (young reared per pair breeding) of black-legged kittiwake on the Isle of May 1986 – 2007

Common guillemot

Breeding numbers were depressed with a total of 850 pairs laying in the study plots compared with 932 in 2006. This was due, at least in part, to many pairs not laying since an additional 100 sites were occupied (compared to 59 in 2006).

The first guillemot egg was seen on 25 April, a return to normal after a few late breeding

years – in 2006 the first egg recorded was not until 2 May. The first young left on the night of 22-23 June, with a minor fledge night on 25-26 June. Breeding success (0.26 and 0.28 young per pair laying for the plot average and summed total, respectively; Figure 4) was by far the lowest ever recorded on the Isle of May. The previous lowest successes were 0.51 and 0.39 in 2004 and 2006, respectively. Although the total hatching success (75%) was lower than the long-term average (84%), chick success was much more dramatically reduced to 37%, contrasting with the norm of 89%.

Normally, one member of the pair is always present in the colony to guard the chick. However, in recent years some chicks have been left unattended, suggesting that adults were finding it hard to find food; this was very obvious in both 2006 and 2007. Surprisingly, such neglected chicks were rarely eaten by gulls, even though gulls came on to the ledges to pick up deserted/addled eggs and fish that had been dropped. Rather, it was clear that chicks were more likely to be killed by other guillemots (or occasionally razorbills), particularly if they wandered into neighbouring territories, or die on the site, apparently of starvation. Measurements of chicks during ringing indicated that fledging weights were markedly lower than normal. As in 2004 and 2006 (the other very poor breeding seasons), many chicks fledged during the day rather than in the evening, but unlike in these years, many chicks were eaten by gulls, especially great black-backed gulls. True breeding success will have been substantially lower than that described above. Some male parents returned soon after they had gone to sea with the chick, suggesting that initial post-fledging survival may have been poor. Females spent little time at the nest-sites once their mates had taken the chick to sea and the colonies emptied of birds several weeks earlier than the case even a few years ago.

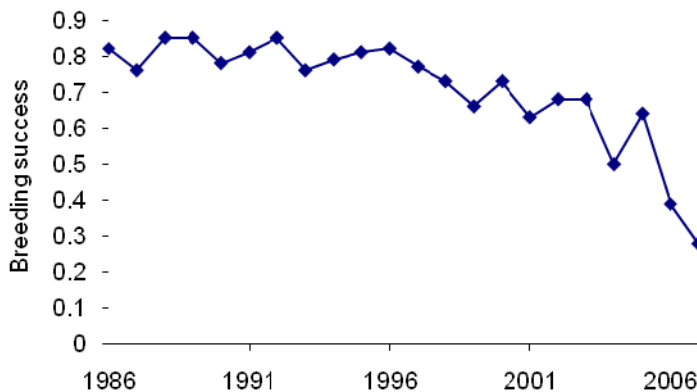


Figure 4. Breeding success (young reared per pair breeding) of common guillemot on the Isle of May 1986 – 2007

Razorbill

Breeding of razorbills was 10 days earlier than in 2006 with the first eggs (3) being seen on 24 April – a day earlier than the first guillemot egg. Mean breeding success (0.62 and 0.63 young per pair laying for the plot average and total pairs laying; Figure 5), was close to the 1986-2006 mean (0.66, CI=0.63-0.70). No unattended razorbill chicks were recorded. The high success (0.86) of chicks that hatched was in marked contrast with the dramatically low success of guillemot chicks.

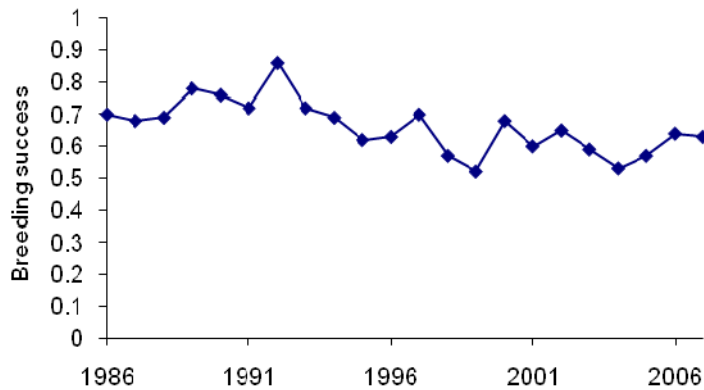


Figure 5. Breeding success (young reared per pair breeding) of razorbill on the Isle of May 1986 – 2007

Atlantic puffin

The first puffin carrying fish was seen on 26 May and the first young fledged on the night of 5-6 July. Back-calculation from these figures indicates that laying commenced around 15 April. There was also a suggestion that fewer pairs than normal laid eggs. Despite this slightly earlier start of laying than in 2005 and 2006, the mean fledging date for chicks that were weighed regularly was several weeks later. It is unclear whether this was due to the population laying later or, and more likely, the fledging period was prolonged.

The mean breeding success based on the assumption that all chicks alive on 3-4 July fledged successfully was 0.35 chicks fledged per egg laid (Figure 6), a figure much lower than the 1977-2006 mean (0.76, 95% CI=0.71-0.81). In most years very few puffin chicks die after the young are more than about a week old, but the pattern in 2006 and 2007 was very different. Intensive studies in both years showed that chicks grew very slowly, reached very low weights and had prolonged fledging periods. Of 35 chicks alive in the intensively studied area when the final productivity monitoring check was made in 2007, six subsequently died i.e. 0.83 rather than 1.0 survived to fledging. Assuming that the same was also true for the productivity burrows (and all the evidence suggested that this was the case), then a more accurate estimate of breeding success was 0.29 chicks fledged per egg laid i.e. 0.83×0.35 . This, far the lowest breeding success recorded since records started in 1977, appeared to be due to a combination of an extremely wet summer, with several torrential downpours that resulted in burrows becoming flooded, and food shortage, as shown by small loads of fish and a low feeding frequency.

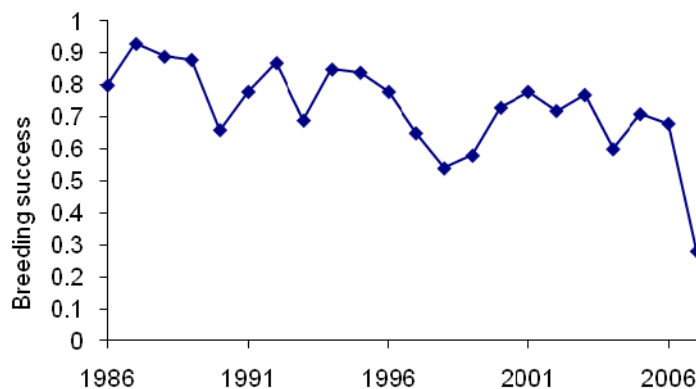


Figure 6. Breeding success (young reared per pair breeding) of Atlantic puffin on the Isle of May 1986 – 2007

3.2 Adult survival 2006-2007

Not every adult alive is seen each year and thus return rates for 2007 presented here need to be treated as minimum estimates of survival of birds seen in 2006. The results are compared with those of previous years in Table 6 in Appendix 2. After the improvement shown in 2006, return rates hit a new low for all species except razorbill in 2007. During 2007 an additional 46 European shags, 12 black-legged kittiwakes, 16 Atlantic puffins and 14 common guillemot were colour-ringed. The long-term averages presented in this section do not include the current year.

European shag

After the high mortality in early 2005, followed by a return to normal levels in 2006, the Isle of May breeding shag population experienced another over-winter mortality event. The return rate for 2007 (60.8%) was well below the long-term average on the Isle of May (78.7%, 95% CI = 69.8-87.6) with only 1994 and 2005 having lower values (Figure 7).

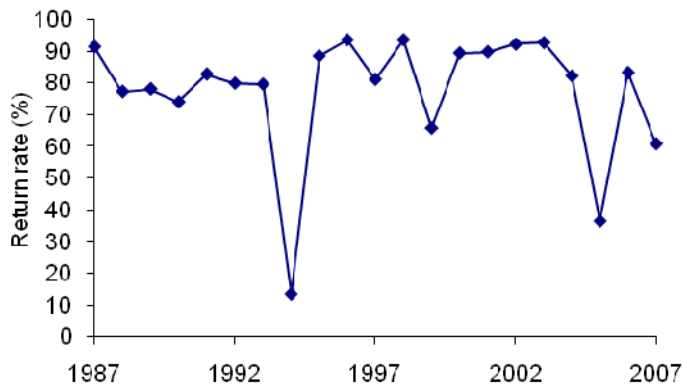


Figure 7. Annual return rates of adult European shag on the Isle of May 1987 – 2007

Black-legged kittiwake

The return rate of black-legged kittiwakes (62.9%) was the lowest recorded, being substantially below than the 1986-2006 average (79.4, 95% CI =76.3-82.5) (Figure 8).

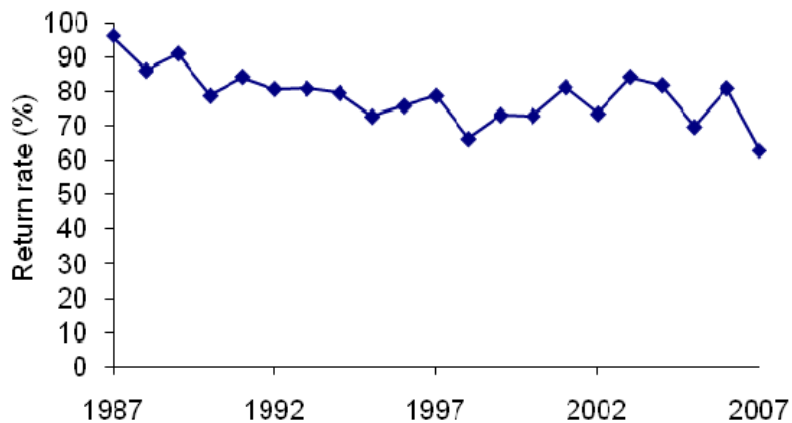


Figure 8. Annual return rates of adult black-legged kittiwake on the Isle of May 1987 – 2007

Common guillemot

The return rate of common guillemots (75.2%) was the lowest recorded on the Isle of May. As is usual, observer effort was high with the study plots checked carefully every day making it highly unlikely that any birds were overlooked. The value for 2007 therefore continues the recent decline and falls well outside the 95% Confidence Interval for the 1986-2006 average (91.4, 95% CI = 89.9-92.9) (Figure 9). This species is usually very consistent in terms of the percentage that return each year, so this large drop is a very worrying development.

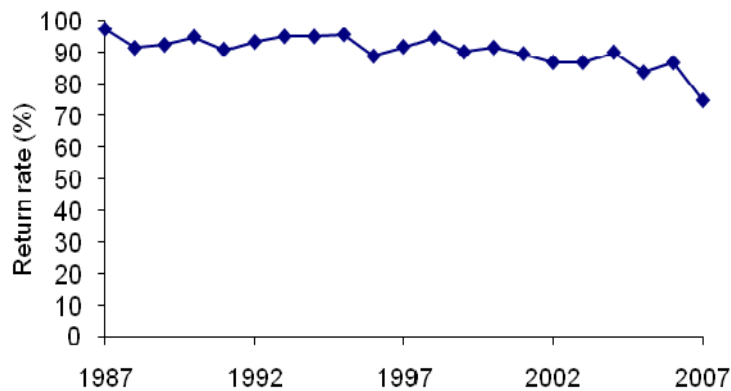


Figure 9. Annual return rates of adult common guillemot on the Isle of May 1987 – 2007

Razorbill

The return rate of razorbills (80.0%) was only slightly lower than the 1986-2006 average (82.1, 95% CI = 77.9-86.3) (Figure 10).

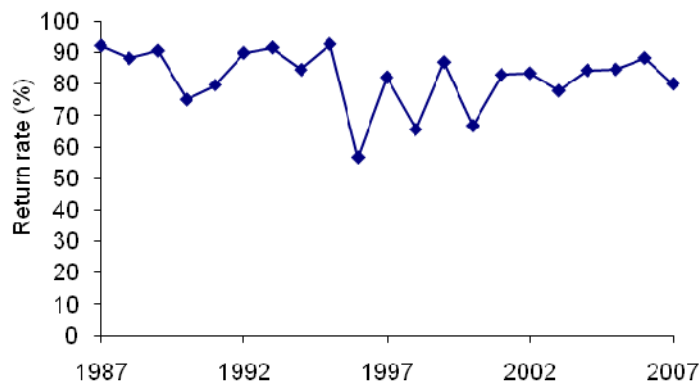


Figure 10. Annual return rates of adult razorbill on the Isle of May 1987 – 2007

Atlantic puffin

The return rate of Atlantic puffins (56.9%) was by far the lowest on record and well below the 1986-2006 average (83.9, 95% CI = 80.6-87.2) (Figure 11).

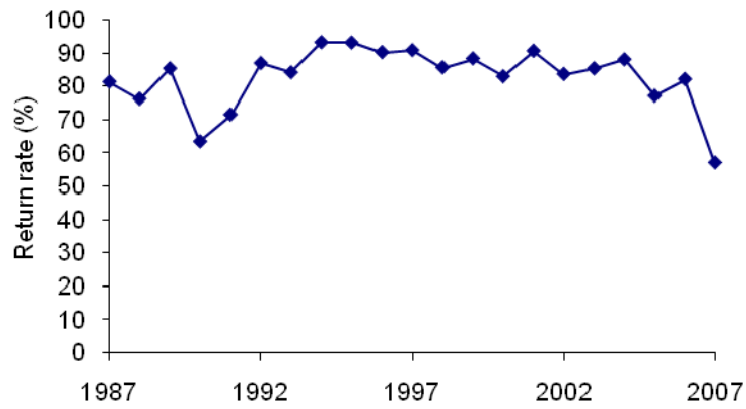


Figure 11. Annual return rates of adult Atlantic puffin on the Isle of May 1987 – 2007

3.3 Food of young

Appendix 3 provides species summaries in Tables 7-10, and a comparison of sandeel biomass data with recent years' results in Table 12.

European shag

During the chick-rearing period, 15 regurgitations were obtained from chicks or adults attending chicks. The most frequent prey (by occurrence in a regurgitate) were butterfish *Pholis gunnellus* which were found in 53.3% of samples, followed by Gadidae (including whiting *Merlangius merlangus* and rockling) in 40%, and sandeel *Ammodytes marinus* in 33.3% (Figure 12). Sandeels constituted 28.3% of the biomass and only 11.3% of the items identified. This sandeel biomass proportion is the lowest on record. The remains of other items found were dragonet *Callionymus lyra* (in 3 regurgitates), Cottidae (3, including 2 Sea Scorpion *Scorpaena porcus*), pipefish, presumably *Entelurus aequoreus* (1) eelpout (1), rockling (1), wrasse (1) and crustacea (1) were also identified. In the previous three years an unusually high proportion of 0 group sandeels occurred in the diet during chick-rearing but in 2007 all sandeels were older (1+).

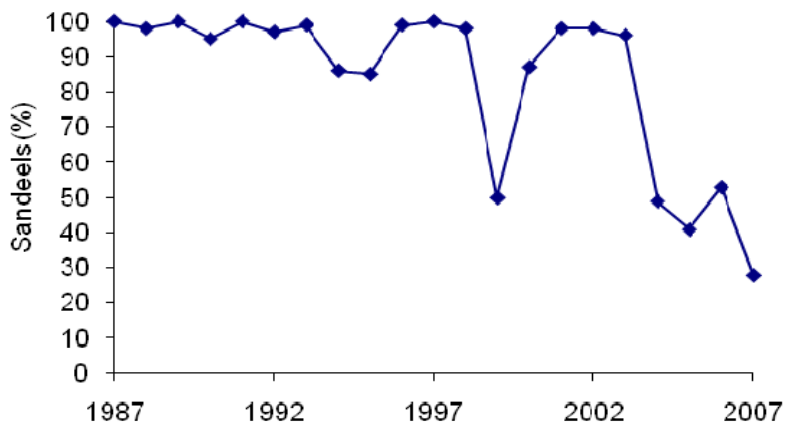


Figure 12. Percentage of sandeels (by weight) in the diet of young European shag on the Isle of May, 1987-2007

Black-legged kittiwake

Of the 61 black-legged kittiwake food samples collected during the chick-rearing period, 70.5% contained sandeels (Figure 13). Of 2,020 otoliths examined, 75.1% were from 0 group sandeels, mostly about 5 cm long, with none from 1+ group sandeels although one sample contained 1+ bones. In terms of biomass, 0 group and older sandeels contributed 47.9% and 0.1% by mass of the diet, respectively. This sandeel biomass proportion is the lowest on record. Clupeids (mainly sprat *Sprattus sprattus*) contributed 26.1% of the biomass and occurred in 39.3% of regurgitations. In 2005, pipefish were found in only two samples, however, the prevalence of this species increased dramatically in 2006 and a similar proportion (39.3%) was found in 2007. In all but three samples, only traces of pipefish were found with just a few vertebrae or scales detected during lab analysis and the species was rarely visible in intact regurgitations. Thus, although pipefish were being taken in significant quantities they were of very little value in terms of biomass. The remains of other items found were Gadidae (in 17 regurgitates, 12 of which contained rockling) and small crustacea (1). The number of samples containing rockling is unprecedented in kittiwake diet on the Isle of May but as they were all small pelagic immatures it was not possible to identify them to species.

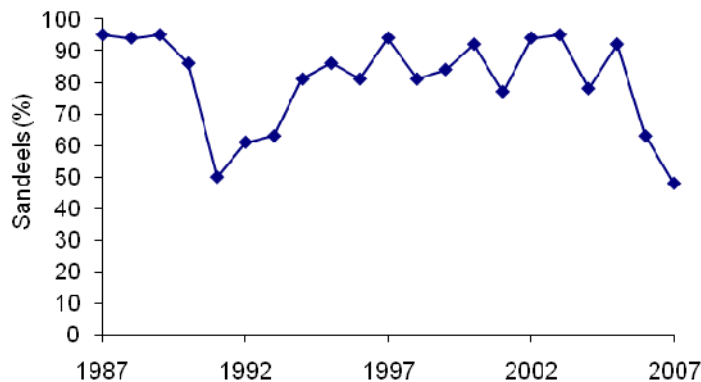


Figure 13. Percentage of sandeels (by weight) in the diet of young black-legged kittiwakes on the Isle of May, 1987-2007

Common guillemot

About 89% of the 755 food items delivered to chicks were clupeids. All those that could be identified to species were sprat. Most were assigned to the medium (10 cm) or small (9 cm) size category (Table 8). Clupeids made up 92% of the diet by weight, sandeels were the next commonest prey making up 6.4% of feeds and 1% of the total mass (Figure 14). Identification of Gadidae in the field is extremely difficult but saithe *Pollarchius virens* and whiting *Merlangius merlangus* were specifically identified among the 24 gadoids seen. In 2007, more 'unusual' prey items were recorded than usual including small squid, butterfish, flatfish and at least three other species that could not be identified. The average weight of a prey item (estimated from body length and mass:length relationships) was 10.5 g, well above the 1986-2006 average of 6.6 g.

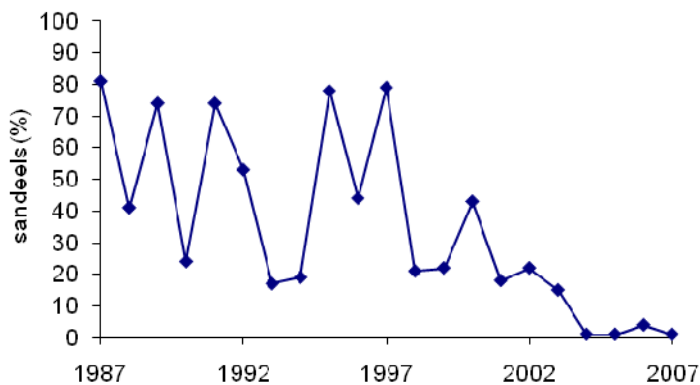


Figure 14. Percentage of sandeels (by weight) in the diet of young common guillemot on the Isle of May, 1987-2007

Razorbill

Sandeels made up the bulk of the fish brought in by razorbills, being the only species recorded in 193 (74.2%) of the 260 feeds where the fish were clearly visible (Table 9). Virtually all the sandeels were 0 group. Clupeids were present in 66 (25.4%) of loads; with most appearing to be sprats 4-6 cm long. Unusually, juvenile rockling (in 6 loads), saithe and squid were also recorded.

Atlantic puffin

Sandeels made up 82% by number and 76% by biomass in the diet of young Atlantic puffins (Figure 15). Most sandeels were 0 group, between 3 and 7 cm long, with only 3 (0.3%) fish longer than 8 cm being recorded (Table 10). Most of the remainder of the diet was made up of small sprats (2% by number but 20% by weight including unidentified clupeids) and rockling (15% by number but due to their small size only 4% by mass). The mean load size of 5.8 g was the lowest recorded (previous lowest 6.3 g, mean 9.1 g over 34 years) for puffins on the Isle of May. In line with the normal inverse relationship between load mass and the number of fish in a load, the number of fish per load (17.5) was the highest recorded over the same period (34 year average 7.4 fish, previous maximum 14.9).

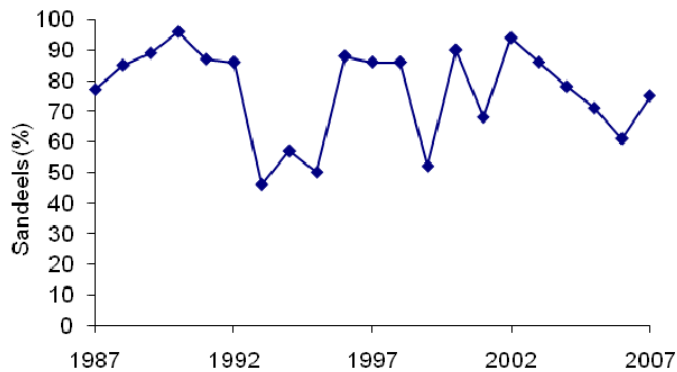


Figure 15. Percentage of sandeels (by weight) in the diet of young Atlantic puffin on the Isle of May, 1987-2007

4 Conclusions

The commercial sandeel fishery on the Wee Bankie has been closed since 2000. Seabird monitoring on the Isle of May initially indicated that breeding success, particularly of kittiwakes and shags, improved following the closure. However, in 2004 all species had a disastrous breeding season raising concerns that climate change effects in the plankton were starting to affect top predators. In line with this, analyses of fish fed to young seabirds revealed that their lipid levels were extremely low indicating that feeding conditions for mid trophic fish such as sandeel and sprat were also poor in 2004 (Wanless et al. 2005). Results from 2005 provided further evidence of deteriorating conditions with the whole of the North Sea sandeel fishery closed due to reduced catches, and some seabird breeding seasons shifting later.

In 2006 the sandeel fishery re-opened, though the area down the east coast, including the Wee Bankie remained closed. The same situation occurred in 2007 but the Total Allowable Catch that had been set for the North Sea was soon reached and the fishery closed by mid-May. The Wee Bankie fishery was closed throughout. After a very mixed season in 2006, fortunes for Isle of May seabirds in 2007 took a significant down turn for most species. Although the timing of breeding was close to the long-term average it soon became apparent that the return rate of adult birds of nearly all species was very low with puffin, guillemot and kittiwake experiencing the lowest returns on record.

Breeding success was also extremely poor for most species with puffin, guillemot and fulmar experiencing their worst ever season. The weather in 2007 was atypical with exceptional rainfall and several gales washing some guillemot eggs and chicks off sites low down on the cliffs and repeatedly flooding puffin burrows. However, even allowing for adverse weather it was clear that feeding conditions were also poor, particularly during the chick-rearing period. As in 2004 and 2006, large numbers of guillemot chicks were left unattended and vulnerable to attack from other guillemots and razorbills. Growth of those chicks that did fledge was extremely slow and chicks fledged at all times of day rather than in the evening.

There appears to be a shift in diet of several species with very few sandeels recorded in samples from shags in particular. Snake pipefish continue to occur in numerous samples closely mirroring the situation in 2006, while rockling appeared in significant quantities in the diet of kittiwakes and puffin. It will be interesting to see how this situation develops over the coming seasons.

5 References

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7 Appendices

Appendix 1: Breeding success

Table 1. Breeding success of northern fulmars on the Isle of May in 2007

<i>Area</i>	<i>Incubating birds</i>	<i>No. probably hatched</i>	<i>Young fledged</i>
Cleaver	8	5	1
Pilgrim's Haven	3	0	0
Cornerstone	3	0	0
Loch (S)	32	20	10
Greengates	57	37	13
Horse Hole	12	5	1
Tarbet	19	12	4
Low Light	4	1	1
Colm's Hole	2	1	0
Rona	1	0	0
Total	141	81	30
Overall mean			0.21 fledged/ pair

Notes:

Incubating birds were those sitting tight on three checks or where an egg was seen. Chicks present on 17 August were assumed to have fledged.

Table 2. Breeding success of European shags on the Isle of May in 2007

	<i>Total incubated</i>	<i>Other nests</i>	<i>Young fledged</i>			<i>Total</i>	<i>Fledging success per completed nest</i>
			<i>1</i>	<i>2</i>	<i>3</i>		
Maidens	5	0	1	4	0	9	1.80
South Horn	1	0	0	1	0	2	2.00
Pilgrim's Haven	4	0	3	1	0	5	1.25
Mill Door (N)	4	1	1	2	0	5	1.25
Mill Door (S)	5	2	2	2	0	6	1.20
Horse Hole	11	2	3	4	0	11	1.00
North Horn	14	2	1	3	2	13	0.93
Tarbet	9	0	2	2	0	6	0.67
Low Light	4	0	0	2	0	4	1.00
Mean ± se							1.23±0.14
Total	57	7	13	21	2	61	1.07

Notes:

No nests were built in the plots at South Ness, Lady's Bed Stack, Chatterstones, North of Pilgrim's Haven, South Face, Bishop's Cove or Colm's Hole in 2007. The plot at Horse Hole (11 nests in 2006) was not checked in 2007.

Table 3. Breeding success of black-legged kittiwakes on the Isle of May in 2007

<i>Area</i>	<i>Completed nests</i>	<i>Trace nests</i>	<i>Other pairs with site</i>	<i>Fledged young per completed nest</i>				<i>Total young produced</i>	<i>Fledging success per completed nest</i>
				0	1	2	3		
Cleaver	19	1	8	14	5	0	0	5	0.26
South Horn	52	5	9	31	21	0	0	21	0.40
Pilgrim's Haven	28	1	3	16	12	0	0	12	0.43
South Face	16	2	1	9	7	0	0	7	0.44
Colony 4	53	3	7	30	23	0	0	23	0.43
Hide Face	33	2	11	24	9	0	0	9	0.27
Cornerstone	79	4	11	47	32	0	0	32	0.41
Lock (S)	15	2	1	15	0	0	0	0	0.00
Loch (N)	58	4	6	58	0	0	0	0	0.00
Greengates	57	2	2	38	19	0	0	19	0.33
Bishop's Cove	40	1	3	40	0	0	0	0	0.00
Iron Bridge	46	0	4	44	2	0	0	2	0.04
Rona	49	0	3	38	11	0	0	11	0.22
Tarbet	43	4	7	39	4	0	0	4	0.09
Low Light	11	0	1	7	4	0	0	4	0.36
Colm's Hole	10	0	0	10	0	0	0	0	0.00
Mean ± se									0.23± 0.06
Total	609	31	77	460	149	0	0	149	0.24

Table 4. Breeding success of auks on the Isle of May in 2007

<i>Species</i>	<i>Area</i>	<i>Pairs laying</i>	<i>Young hatched</i>	<i>Young "fledged"</i>	<i>Young leaving / pair</i>
Guillemot	Dense	270	200	68	0.25
	Hide / White Ledge	89	62	20	0.22
	Colony 4	222	168	54	0.24
	South	42	32	9	0.21
	Cornerstone	227	178	88	0.39
	Mean ± se				
	Total	850	640	239	0.28
Razorbill	Hide / White Ledge	27	20	16	0.59
	Colony 4	57	40	37	0.65
	South	26	18	15	0.58
	Cornerstone	78	61	51	0.65
	Mean ± se				
	Total	188	139	119	0.63
Puffin	Lady's Bed	43		11	0.26
	Kirkhaven	41		22	0.54
	Burrian	31		7	0.23
	Rona	43		16	0.37
	Mean ± se				
	Total	158		56	0.35

Notes:

The estimates for guillemot and puffin are maxima (see text).

Table 5. Breeding success (mean number of young reared per breeding pair) of seabirds on the Isle of May, 1994-2007

<i>Species</i>	<i>1994</i>	<i>1995</i>	<i>1996</i>	<i>1997</i>	<i>1998</i>	<i>1999</i>	<i>2000</i>
Northern fulmar	0.47 (122)	0.48 (126)	0.44 (135)	0.37 (136)	0.35 (120)	0.47 (115)	0.37 (143)
European shag	0.68 (74)	0.84 (131)	1.05 (105)	0.92 (109)	0.85 (125)	0.33 (58)	1.48 (127)
Black-legged kittiwake	0.16 (861)	0.40 (874)	0.56 (825)	0.40 (822)	0.02 (683)	0.20 (616)	0.97 (545)
Common guillemot	0.79 (775)	0.81 (805)	0.82 (786)	0.77 (842)	0.73 (852)	0.66 (870)	0.73 (942)
Razorbill	0.69 (134)	0.62 (143)	0.63 (140)	0.71 (132)	0.57 (134)	0.52 (142)	0.68 (149)
Atlantic puffin	0.85 (189)	0.84 (180)	0.78 (173)	0.65 (166)	0.54 (179)	0.58 (181)	0.73 (132)
	<i>2001</i>	<i>2002</i>	<i>2003</i>	<i>2004</i>	<i>2005</i>	<i>2006</i>	<i>2007</i>
Northern fulmar	0.26 (134)	0.48 (131)	0.44 (109)	0.21 (97)	0.27 (135)	0.44 (139)	0.21 (141)
European shag	1.53 (135)	1.66 (130)	1.83 (156)	0.25 (103)	0.48 (42)	1.22 (81)	1.07 (57)
Black-legged kittiwake	0.61 (459)	0.47 (477)	0.77 (423)	0.29 (476)	0.85 (675)	0.47 (613)	0.24 (609)
Common guillemot	0.63 (975)	0.68 (955)	0.68 (1014)	0.50 (984)	0.63 (945)	0.41 (932)	0.28 (850)
Razorbill	0.60 (167)	0.65 (167)	0.59 (177)	0.54 (190)	0.55 (200)	0.62 (190)	0.63 (188)
Atlantic puffin	0.78 (185)	0.72 (174)	0.77 (195)	0.60 (196)	0.71 (184)	0.68 (166)	0.29 (158)

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.

The figures for puffin in recent years allow for losses after the final check (see text).

Appendix 2: Annual return rates

Table 6. Annual return rates of adult seabirds on the Isle of May, 1991-2007

<i>Species</i>	<i>No. seen in 2006</i>	<i>No. seen in 2007</i>	<i>Return rate (%)</i>						
			<i>2006-07</i>	<i>2005-06</i>	<i>2004-05</i>	<i>2003-04</i>	<i>2002-03</i>	<i>2001-02</i>	<i>2000-01</i>
Kittiwake	143	90	62.9	80.9	69.7	81.8	84.2	73.5	81.2
Guillemot	306	230	75.2	86.9	83.9	90.1	87.0	87.0	89.6
Razorbill	45	36	80.0	88.2	84.6	84.3	77.8	83.8	82.9
Puffin	204	116	56.9	81.8	77.0	87.9	85.2	83.5	90.5
Shag	153	93	60.8	83.3	36.4	82.2	92.7	92.2	89.8
	<i>1999-00</i>	<i>1998-99</i>	<i>1997-98</i>	<i>1996-97</i>	<i>1995-96</i>	<i>1994-95</i>	<i>1993-94</i>	<i>1992-93</i>	<i>1991-92</i>
Kittiwake	72.9	73.1	66.2	78.7	75.8	72.7	79.5	80.8	80.7
Guillemot	91.6	90.2	94.6	91.8	88.9	95.6	95.0	95.0	93.3
Razorbill	66.7	86.9	65.5	82.1	56.6	92.6	84.5	91.5	89.8
Puffin	82.8	88.2	85.5	90.7	90.1	93.0	93.1	84.0	86.8
Shag	89.4	65.8	93.6	91.1	93.6	88.5	13.4	79.6	79.9

Notes:

Only birds which had definitely bred in 2006 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.

Appendix 3: Chick diet

Table 7. Food of young black-legged kittiwakes and European shags on the Isle of May during chick-rearing in 2007

	<i>Black-legged kittiwake</i>	<i>European shag</i>
No. of regurgitations	61	15
Range of dates	19 June-24 July	12 June-27 July
Total weight (g)	1224	750
% regurgitations with sandeels	70.5	33.3
with Gadidae	27.9	40.0
with Clupeidae	39.3	0
with flatfish	1.6	0
with butterfish	0	53.3
with Cottidae	0	20.0
with pipefish	39.3	6.7
% (by weight) of sandeels in sample	48.0	28.3
	75.1	11.3
% (by number) of sandeels in sample		
Lengths of most sandeels (cm)	5	14
Other remains identified	Small crustacea (1 sample).	Dragonet (3), wrasse (1), crustacea (1), eelpout (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 8. Food of young common guillemots on the Isle of May in 2007

	<i>No. of sandeels</i>				<i>No. of Clupeidae</i>				<i>No. of Gadidae</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>minute</i>	<i>small</i>	<i>medium</i>
Length (cm)	5	7	11	14	9	10	13	4	5	7	5
All-day watches											
17 June	1	9	2	1	39	127	16	0	3	2	1
24 June	0	2	1	0	13	23	2	0	0	0	0
27 June	0	0	0	0	18	26	2	0	0	0	0
Other records											
6 June - 5 July	8	16	8	0	66	328	13	8	11	0	8
Total	9	27	11	1	136	504	33	8	14	2	9

Notes:

In addition, there were small squid (3), butterfish *Pholis gunnellus* (1), flatfish (1) and other unknown species (5).

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

Table 9. Food of young razorbills on the Isle of May in 2007

	<i>Sandeels</i>			<i>Single Clupeidae</i>			<i>Several Clupeidae</i>		
	<i>small</i>	<i>medium</i>	<i>large</i>	<i>small</i>	<i>medium</i>	<i>large</i>	<i>Small</i>	<i>medium</i>	<i>large</i>
All-day watches									
17 June	60	7	0	2	1	0	5	4	0
24 June	13	3	3	0	3	2	3	1	0
27 June	21	3	0	0	2	0	6	0	0
Other records									
5 June – 4									
July	62	15	5	7	3	2	16	3	0
Total	156	28	8	9	9	4	30	8	0

Notes:

There were also 6 loads of rockling, one of a single saithe and one of a single squid

All the small sandeels appeared to be 0 group.

5 of the loads of small sandeels also included small clupeids.

1 load of small sandeels also had a single rockling.

1 load of small sandeels also had small clupeids.

1 load of small clupeids also had a single sandeel.

1 load of medium sandeels also included 1 0 sandeel.

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, 27 May to 23 July 2007

	<i>Sample size</i>	<i>Mean</i>	<i>s.e</i>
a) Load weight (g)	132	5.79	0.3
b) Fish/load	132	17.5	0.7
c) Numbers and lengths of fish (mm)			
Sandeels <i>Ammodytes sp.</i>	1547	49.5	0.26
Unidentified Clupeid (<i>Clupeidae</i>)	10	31.0	2.3
Sprat <i>Sprattus sprattus</i>	25	92.0	3.7
Cod <i>Gadus morhua</i>	1	49	
Saithe <i>Pollachius virens</i>	5	51.0	6.4
Goby (<i>Gobiidae</i>)	1	49	
Rockling <i>sp.</i> (<i>Gadidae</i>)	282	29.1	0.3
Whiting (<i>Merlangius merlangus</i>)	8	38.4	2.6

Note:

Most of the Clupeidae category were probably small sprat. The goby was probably crystal goby *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, 1986-2007

<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
2004	31	48
2005	4.5	21
2006	19.5	38.7
2007	36.6	49.9

Notes:

Figures are based on 87-269 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.) In 2007 observations were made on 167-269 broods between 6 and 23 July.

Table 12. Percentage of sandeels (by weight) in the diet of young seabirds on the Isle of May, 1988-2007

	1988	1989	1990	1991	1992	1993	1994	1995	1996
Shag	98	100	95	100	97	99	86	85	99
Kittiwake	94	95	86	50	61	63	81	86	81
Guillemot	41	74	24	74	53	17	19	78	44
Puffin	85	89	96	87	86	46	57	50	88

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Shag	100	98	<50	87	95	98	96	49	41	53	28
Kittiwake	94	81	84	92	76	94	91	79	92	63	48
Guillemot	79	21	22	43	18	22	15	2	1	4	1
Puffin	86	86	52	90	68	94	86	78	71	61	75

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 all years except 2004, 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, 1986-2007

<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
2004	22 May	1.65
2005	30 May	1.73
2006	27 May	1.54
2007	19 May	1.80