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Fair Isle seabird studies 1998

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of thirteenth season's work (1998)

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Contents

1 Summary

The results of seabird monitoring on Fair Isle in 1998 are presented.

1.1 Whole-island census

Population changes from 1997 were as follows:

gannet	+4.5%	(to 1,166 Apparently Occupied Territories (AOTs))
Arctic skua	-31.6%	(to 67 AOTs)
great skua	-48.0%	(to 79 AOTs)
common gull	0.0%	(still five nests)
common tern	-57.1%	(to three pairs)
Arctic tern	-27.8%	(to 1,249 Apparently Incubating Adults)

In addition, 567 shag nests and 3,296 individual razorbills were located during whole-island counts of these species, decreases of 40.1% and 20.2% respectively since the last complete counts in 1993.

1.2 Population changes at monitored plots

Fulmars, shags and kittiwakes all declined at monitoring plots in 1998. Fulmars and shags declined substantially, by 32.5% and 17.2% respectively across all plots counted. Kittiwakes continued their steady long-term decline; overall numbers at monitoring plots were 13.6% lower in 1998 than in 1997. Guillemot numbers showed little change, with a non-significant overall decrease of 1.75% across three plots monitored. Two counts of black guillemots between North Light and South Light in the spring indicated a decline of 37.0%, from 254 in 1997 to 160 in 1998.

1.3 Breeding success

Breeding success was average or slightly below average for most species in 1998. However, Arctic terns, Arctic skuas and kittiwakes had their worst year since 1990.

1.4 Adult survival

Adult kittiwake survival was apparently extremely low over the 1997-1998 winter, with only 25.6% of marked birds being resighted in the colony at Goorn. Despite intensive searching around the area, no more colour-ringed birds were located. Puffin survival was estimated at 83.5% between 1997 and 1998, although the fresh remains of several colour-ringed individuals that had been predated by great skuas were found during the 1998 breeding season.

1.5 Diet

Few food samples were obtained from most species, with the exception of puffins. Sandeels were the principal food items for shags, kittiwakes, guillemots and razorbills in 1998. Gadoids were the principal food items for puffins, indicating that a shortage of sandeels occurred during the breeding season. Mean load weight of food samples collected from adult puffins was below average, and sandeels given to chicks were longer on average than in 1997.

2 Introduction and objectives

The Joint Nature Conservation Committee (JNCC) has a responsibility to advise on the condition of the marine environment. Seabirds are one of the more important components of this environment and the UK has internationally important populations of several species. The JNCC's Seabird Monitoring Programme has been designed to assess population changes and breeding success of selected species of seabirds at a range of colonies. In addition, selected 'key site' colonies have been targeted for more detailed monitoring of breeding performance, annual survival rates and feeding ecology. These sites are geographically spread in order to give as full a coverage as possible of British waters. Fair Isle is a very suitable site in northern Britain, situated between the two important archipelagos of Orkney and Shetland.

Long-term studies on numbers, breeding success, adult survival, chick growth and chick diet have been undertaken on up to 11 species on Fair Isle since 1986, with JNCC (formerly NCC) support. Due to the long period of immaturity and high annual survival rates of seabirds, it is essential that the continuity of such long-term studies be maintained. As part of its Seabird Monitoring Programme, the JNCC has contracted the Fair Isle Bird Observatory Trust (FIBOT) to:

(a) monitor numbers of fulmar *Fulmarus glacialis*, gannet *Morus bassanus*, shag *Phalacrocorax aristotelis*, Arctic skua *Stercorarius parasiticus*, great skua *Stercorarius skua*, kittiwake *Rissa tridactyla*, Arctic tern *Sterna paradisaea*, common tern *Sterna hirundo*, guillemot *Uria aalge*, razorbill *Alca torda*, black guillemot *Cepphus grylle* and puffin *Fratercula arctica* nesting on Fair Isle;

(b) monitor breeding success of fulmar, gannet, shag, Arctic skua, great skua, kittiwake, common tern, Arctic tern, guillemot, razorbill, black guillemot and puffin;

(c) monitor adult survival of kittiwake and puffin;

(d) assess frequency of feeding visits by parents to guillemot and puffin chicks through timed watches, and identify prey composition of food brought to the colonies during the chick rearing period by collecting regurgitated samples or pellets for the following species: shag, kittiwake, guillemot, razorbill and puffin; and

(e) undertake special studies on species as agreed between the JNCC nominated officer and FIBOT, e.g. weighing and measuring samples of chicks of all accessible species.

This report presents the results of seabird monitoring on Fair Isle in 1998, the 13th season of work. Some of the data collected in previous years have been reanalysed and therefore some of the results for the years 1986-97 published in this report may differ slightly from those in previous reports.

3 Methods

In addition to annual or regular total island counts, population changes of fulmar, shag, kittiwake, guillemot, and black guillemot are monitored in plots. Full details of methods used are presented in Riddiford & Osborn (1986, 1987), Riddiford & Silcocks (1988), Harvey *et al.* (1989, 1990, 1992), Harvey & Orsman (1991), Riddington *et al.* (1994, 1995, 1996, 1997) and Walsh *et al.* (1995).

4 Results

The results summarised below are presented in full in Tables 1-25 and Appendices 1-4.

4.1 Whole-island census 1998

Some species are counted annually. Other species, too numerous to count annually, are counted every fifth year. The target species in 1998 were razorbill and shag.

4.1.1 Razorbill: The 1998 census of razorbill took place between 31 May and 12 June. The maximum count of 3,296 individual birds was down 20.2% on the 1993 count of 4,130 birds. The most notable reductions in numbers were in the Buness area and the south-west of the island, although the decline was island-wide. The species is difficult to count as many of the breeding areas are in boulder beaches and some birds may have been missed because they would not flush out from under boulders. However, this would not account for the reduced numbers of birds in the two areas mentioned above. The lack of birds in the Malcolm's Head area mirrors the decline of shags there also.

4.1.2 Shag (Table 1): Apparently Occupied Nests (AONs) were counted during the last week of May and first three weeks of June. The final count of 556 AONs plus 11 traces represents a 40.1% decrease from the 1993 count of 946. Numbers of shags in monitoring plots also declined from 1997 to 1998 (section 4.2.2). The most notable reductions in the number of AONs were on the north-west, south-west and north shores of the island, although the decline was island-wide.

4.1.3 Gannet (Tables 2 & 3): Breeding gannets were counted from land on 14 June (with a boat-based count of Inner Stack also on 14 June). There was a small increase in the number of AONs, up 4.5% from 1,116 AONs in 1997 to 1,166 in 1998. A single pair nested on Sheep Craig in 1997, but in 1998 only one bird returned to that site.

4.1.4 Arctic skua (Table 2): Sixty-seven Apparently Occupied Territories (AOTs) were counted between 27 May and 6 June. Territory distribution was similar to 1997, but numbers were down by 31 AOTs (- 31.6%).

4.1.5 Great skua (Table 2): Great skua AOTs were counted between 27 May and 6 June, decreasing by 48.0% from 152 in 1997 to 79 in 1998. Territory distribution was similar to that in 1997, although less concentrated. However, several territories were found on Byerwall, where there had not been any in 1997.

4.1.6 Common gull (Table 2): Eight pairs of common gulls *Larus canus* initially attempted to breed in 1998, settling on croft land at Setter (Horstibrekkers). However, several pairs dispersed from this area after some nest construction (seven scrapes with nest material), with one pair nesting on Johnny Arcus' Park, two pairs just north of the Hill Dyke on Tirryfield, and two pairs on Byerwall.

4.1.7 Common tern (Table 2): Only three pairs are estimated to have bred in 1998 (one on Buness and two at South Light), although precise numbers are difficult to assess with this species owing to their habit of nesting in much larger Arctic tern colonies.

4.1.8 Arctic tern (Tables 2 & 4): Population size decreased from 1,730 Apparently Incubating Adults (AIAs) in 1997 to 1,249 AIAs in 1998, a decline of 27.8%. Arctic tern AIAs were counted on 28 May, 11 June, and 14 June. Wind conditions when the birds first arrived meant that aircraft often flew very low over Tirryfield and seemed to disturb the birds, resulting in a rapid dispersal to other sites. South Park was a new colony, while other sites that had previously been part of the Tirryfield 'supercolony' became colonies in their own right.

4.2 Population changes in monitoring plots

4.2.1 Fulmar monitoring plots (Table 5): Numbers of Apparently Occupied Sites (AOS) declined overall (all plots combined) by 32.5%. Numbers of AOS showed a marked decline at three plots (North Haven -68.1%, South Ramnigeo -61.1%, and Heilli Stack/Linni Geo -37.7%), while the other two plots, South Gunnawark and Easter Lother, showed increases of 10.4% and 6.9% respectively.

4.2.2 Shag monitoring plots (Table 6): In 1998 numbers of nests declined in four of the five plots counted, with a decrease of 17.2% for all plots combined, compared with a decline of 20.9% for all five in 1997. The decline was particularly marked at South Ramnigeo (-31.9%), but was only 3.8% at South Gunnawark. One more nest was present at South Naaversgill in 1998 than in 1997.

4.2.3 Kittiwake monitoring plots (Table 7): Total numbers of AONs in the monitoring plots declined by 13.6% between 1997 and 1998. Only one plot showed a small increase (Stroms Heelor). Of the other sites, all but one (Holms/Dog Geo) declined by more than 10%.

4.2.4 Guillemot monitoring plots (Table 8; Appendix 1): There was no significant change in numbers of attendant adults at monitoring plots in 1998, with a non-significant decrease of 1.8% (independent samples t-test, $t = 0.615$, d.f. = 12, $p = 0.55$). Only three plots were compared over four dates (the recommended minimum is five counts), because data from the other two plots and on other dates were collected outwith the specified time limits. Hence, these results should be treated with some caution, but they suggest little change from 1997. In individual plots, there was no change from 1997 at North Gunnawark ($t = 0.095$, d.f. = 12, $p = 0.93$), a slight decrease at Kristal Kame ($t = 1.187$, d.f. = 14, $p = 0.255$) and an increase at Guidicum ($t = 1.777$, d.f. = 13, $p = 0.099$), but, as with the combined totals, none of these changes was statistically significant.

4.2.5 Razorbill: Too few valid counts were made of the razorbill population monitoring plot at Lericum to enable statistical comparison to be made with the 1997 results.

4.2.6 Black guillemot (Table 9a, 9b): All counts took place between 0600-0900 BST. Black guillemots continued their decline for a 10th year at Busta Geo (Table 9a). At the Shetland Oil Terminal Environmental Advisory Group monitoring plot on the east coast from North Light to South Light, the maximum count of 160 in breeding plumage was 37.0% less than the 1997 count of 254 (Table 9b). There was also one winter plumage bird present. A whole-island count on 30 April resulted in a total of 206 birds. This indicates that the 37% decline recorded on the east coast was not merely due to redistribution of birds around the island onto the west coast.

4.3 Breeding success

4.3.1 Fulmar (Table 10): In 1998, fulmar productivity was at its lowest since 1990, averaging 0.33 chicks fledged per AOS across the five monitored plots. South Gunnawark again had the lowest productivity (0.23 chicks per pair), but birds at North Haven fared much better than in recent years, with a productivity of 0.43, the highest of the five sites monitored.

4.3.2 Gannet (Table 11): Gannets had another successful season in 1998, with 149 chicks fledging from 187 AONs. This level of productivity, 0.80 chicks per AON, is well above the average of 0.71 (s.e. ± 0.03) for the previous 10 years.

4.3.3 Shag (Table 12): In 1998, shag productivity along the section of coast from Mavers Geo to Johnny's Peats was similar to that recorded in 1996 and 1997, with a minimum of 102 chicks (possibly up to 104) fledging from 71 nests, a mean productivity of 1.44 chicks per nest.

4.3.4 Arctic skua (Table 13): The season began well for Arctic skuas, with an estimated 60 chicks in 67 AOTs. However, when most chicks were within one week of fledging, it rapidly became one of the poorest breeding seasons recorded on Fair Isle, with an estimated count of just nine fledged chicks on 27-29 July. This productivity rate of 0.13 chicks fledged per AOT is well below average for recent seasons, and was mainly attributable to predation by great skuas, although two well-grown chicks were killed on the road. The progress of 38 nests was monitored in more detail. These contained a total of 67 eggs, but only 54 young hatched (three eggs were addled, two chicks died during hatching, and eight eggs disappeared) and five later died of presumably natural causes. Most of the remaining 49 chicks (equivalent to 1.3 per nest) were ringed and monitored, and survived almost to fledging age. However, due to predation by great skuas in the week prior to fledging, only nine fledged (the total for the whole colony), and at least one of these was killed by a great skua within two weeks after fledging.

4.3.5 Great skua (Table 13): Widespread cannibalism prompted by food shortages (twenty rings recovered from predated chicks) resulted in a lower fledging rate than initially expected. A count on 25 August revealed 69 chicks to be fledged or nearly fledged. Some chicks fledged much earlier than this, and we estimate the total number of fledglings to have been 79, a productivity rate of 1.00 per AOT.

4.3.6 Common gull (Table 14): One fledgling was seen on Byerwall, and two more were seen to the south of the Hill Dyke in 1998. Productivity was estimated to be 0.6 chicks per pair with eggs, or 0.4 chicks per pair including pairs where breeding was not confirmed.

4.3.7 Kittiwake (Tables 15 & 16): Kittiwake breeding success on Fair Isle in 1998 averaged 0.15 chicks fledged per pair, the lowest since 1990 (the height of the sandeel shortage), when it was estimated that no chicks fledged successfully. Shaldi Cliff, Stroms Heelor and Trottie Kame were the only sites where productivity of more than 0.20 chicks per pair was recorded.

4.3.8 Common tern (Table 17): No common tern chicks fledged in 1998.

4.3.9 Arctic tern (Table 17): Arctic terns had their worst ever year on Fair Isle in 1998. Only one chick fledged from 1,249 AIAs, a productivity of less than 0.1%.

4.3.10 Guillemot (Table 18): Guillemots fared well again in 1998, with productivity at the two monitoring sites averaging 0.71 chicks fledged per AIA.

4.3.11 Razorbill (Table 19): Breeding success at Easter Lother was estimated at 0.80 chicks assumed fledged (present on 28 June) per egg laid (as of 23 May) at marked sites. This represents the highest productivity at this site since records began in 1990.

4.3.12 Black guillemot (Table 20): Black guillemots apparently had a poor breeding season, with an average of only 0.69 chicks fledged per active nest in a small sample of 13 nests. Information on success was patchy, with a total absence of accessible pairs in the south-east of the island, although many birds were seen there during the census. Further north, in South Haven and Mavers Geo, nests could potentially have been very productive if they had not been flooded out by heavy rainfall in early July, which caused high mortality of both eggs and young.

4.3.13 Puffin (Table 21): Overall productivity was 0.58 chicks fledged per occupied burrow (79 burrows with eggs), well below the 1987 to 1997 average of 0.75 (s.e. $\pm$ 0.02).

4.4 Adult survival estimates

4.4.1 Kittiwake (Tables 22 & 23): Only five visits were made to the colour-ringed population of kittiwakes at Goorn over the 1998 breeding season because very few adults had returned and therefore more visits were deemed unnecessary. Other colonies in the area were also checked, but no colour-ringed birds were found. Eleven individuals whose colour combination could be ascertained were seen on two or more occasions at Goorn, including one bird last seen in 1996 and one last seen in 1994. The minimum survival estimate for this population over the 1997-98 winter was 11/48 = 22.9%, which was much lower than average for the Goorn colony during the previous five years. Thirteen new birds were colour-ringed in 1998, but one was killed by a great skua within a few days of ringing.

4.4.2 Puffin (Tables 22 & 23): Fifty-four visits (*c.* 50 hours) were made to the colour-ringed population at Roskilie in 1998, during which 76 colour-ringed individuals of known history were observed. These included: three last seen in 1987, one last seen in 1990, one last seen in 1991, one last seen in 1993, and three last seen in 1996. Twenty-six new birds were colour-ringed in 1998. Survival rate for winter 1997-98 was 76/95 = 80.0%, and the updated survival rate for 1996-97 was 91/97 = 93.8%. The low apparent survival rate for 1997-1998 is probably due to intense predation during the 1998 breeding season by great skuas.

4.5 Diet

The apparent shortage of sandeels around Fair Isle in 1998 meant that many chicks were undernourished and prevented the collection of large numbers of food samples from most species.

4.5.1 Gannet: No food samples were collected from gannets as poor weather prevented access to the colonies.

4.5.2 Shag (Appendix 2): Nine samples were collected from shags, between 28 June and 6 July. As in past years, sandeels were the main constituent, with eight of these samples (88.9%) composed entirely of sandeels.

4.5.3 Kittiwake (Appendix 2): Ten identifiable samples, all exclusively sandeel, were collected on 7 and 18 June.

4.5.4 Guillemot (Table 24; Appendix 2): A total of 81 identifiable food items was observed during five two-hour feeding watches at the Peitron colony. Typically, virtually all of these (98.8%) were sandeels. The feeding rates recorded, which varied between 0.08 and 0.27 items per hour (mean 0.17), were, like 1997, rather lower than average for recent seasons. Only four food samples were collected from the colonies (between 22 and 30 June) and all comprised sandeels. The mean weight of fish brought in was 17.4g, and mean length was 155 mm.

4.5.5 Razorbill (Appendix 2): Nine food samples, containing 18 individual fish, were collected from the colonies between 20 June and 7 July. As with guillemots, these samples were composed solely of sandeels. However, the mean length was lower at 90.9 mm, which was to be expected since the razorbill samples often contained more than one item. Mean load weight was 6.1 g.

4.5.6 Puffin (Table 25, Appendix 2): Fifty-seven samples, containing a total of 264 individual fish, were collected from puffins. Sandeels formed 17.8% by number of the fish collected. Gadoids were relatively more frequent than normal, comprising 77.3% of the total number of fish, and were the main component of puffin samples throughout July, suggesting that there may have been a shortage of sandeels during the breeding season. Provisioning rates by adult puffins were the highest since systematic studies began on Fair Isle, with an average of 8.2 visits per burrow per day being recorded during an all-day feeding watch at Roskilie on 9 July. During this watch, 64.9% of 778 identified fish were gadoids and 35.1% were sandeels.

4.6 Chick weights and wing lengths (see Appendix 3)

Data were collected on the weights and wing lengths of chicks of fulmar (Table A3.1), shag (table A3.2), Arctic skua (Table A3.3), great skua (Table A3.4), herring gull (Table A3.5), lesser black-backed gull (Table A3.6), kittiwake (Table A3.7), Arctic tern (Table A3.8), guillemot (Table A3.9), razorbill (Table A3.10), black guillemot (Table A3.11) and puffin (Table A3.12).

4.7 Adult weights and wing lengths (see Appendix 4)

Data were collected on weights and wing lengths of adult fulmar (Table A4.1), shag (Table A4.2), kittiwake (Table A4.3), Arctic tern (Table A4.4), guillemot (Table A4.5), razorbill (Table A4.6) and puffin (Table A4.7).

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6 References

Harvey, P.V., & Orsman, C.J. 1991. Fair Isle seabird monitoring scheme: report to Joint Nature Conservation Committee of sixth season's work 1991. *JNCC Report,* No. 22.

Harvey, P.V., Proctor, R., & Donald, C. 1990. Fair Isle seabird monitoring scheme 1990. *Nature Conservancy Council, CSD Report,* No. 1164.

Harvey, P.V., Riddington, R., Votier, S.C., & Taylor R. 1992. Fair Isle seabird monitoring scheme: report to Joint Nature Conservation Committee of seventh season's work 1992. *JNCC Report,* No. 129.

Harvey, P.V., Silcocks, A.F., & Howlett, P. 1989. Fair Isle seabird monitoring scheme: report to Nature Conservancy Council of fourth season's work 1989. *Nature Conservancy Council, CSD Report,* No. 991.

Riddiford, N., & Osborn, K. 1986. Fair Isle seabird monitoring scheme: report to Nature Conservancy Council of establishment and first season's work (1986). *Nature Conservancy Council, CSD Report,* No. 689.

Riddiford, N., & Osborn, K. 1987. Fair Isle seabird monitoring scheme: report to Nature Conservancy Council of second season's work 1987. *Nature Conservancy Council, CSD Report,* No. 853.

Riddiford, N., & Silcocks, A.F. 1988. Fair Isle seabird monitoring scheme: report to Nature Conservancy Council of third season's work 1988. *Nature Conservancy Council, CSD Report,* No. 879.

Riddington, R., Hewson, C.M., Wilson, K.A., & Newall, M. 1995. Fair Isle seabird studies 1995. *JNCC Report*, No. 254.

Riddington, R., Newell, M.A., & Votier, S.C. 1996. Fair Isle seabird studies 1996. *JNCC Report*, No. 265.

Riddington, R., Thompson, G., Ward, N.C., & Reid, J. 1994. Fair Isle seabird monitoring scheme: report to Joint Nature Conservation Committee of ninth season's work 1994. *JNCC Report,* No. 214.

Riddington, R., Bull J., Newell M.A., & Reid, J.M. 1997. Fair Isle seabird studies 1997. *JNCC Report*, No. 274.

Walsh, P.M., Halley, D.J., Harris, M.P., del Nevo, A., Sim, I.M.W., & Tasker, M.L. 1995. *Seabird monitoring handbook for Britain and Ireland.* Peterborough, JNCC/RSPB/ITE/Seabird Group.

Tables

Table 1 Shag total island census counts 1969-1998

Year	*No. nests*	*% change between surveys*
1969	1,530	
1975	1,491	-2.5%
1986	1,099	-26.3%
1990	1,043	-5.1%
1993	946	-9.3%
1998	567	-40.1%
Overall change 1969-1998	-963	-62.9%

Figures refer to Apparently Occupied Nests (AONs). Note that the 1990 and subsequent counts are inclusive of trace nests. All earlier counts are exclusive of trace nests.

Table 2 Annual total island census counts for 1986-1998, with percentage change 1997-1998

Year	*Gannet*	*Arctic skua*	*Great skua*	*Common gull*	*Common tern*	*Arctic tern*
1987	304	95	72	10	37	211
1988	488	78	78	9	59	345
1989	676	114	72	10	25	283
1990	643	105	75	9	7	400
1991	687	99	79	9	10	650
1992	781	109	110	10	17	1,100
1993	764	107	101	10	9	808
1994	825	93	101	7	3	615
1995	965	87	130	5	6	1,200
1996	1,090	86	120	6	5	1,250
1997	1,116	98	152	5	7	1,730
1998	1,166	67	79	5	3	1,249
% change 1997-98	+4.5%	-31.6%	-48.0%	0.0%	-57.1%	-27.8%

Counting units are AONs (gannet), AOTs (Arctic skua, great skua), number of nests with eggs (common gull 1986-1998, terns 1986-1988), AIAs (terns 1989-1998).

Table 3 Gannet counts by colony in 1997 and 1998

Location	*1997*	*1998*
Outer Stack	327	324
Inner Stack	93	168
Yellow Head	38	38
Dronger	97	91
North Felsigeo	313	309
Toor O' Da Ward Hill	131	165
Matchi Stack	43	50
Kame o' Guidicum	73	23
Sheep Rock	1	0
Total	1,116	1,166

Figures are counts of Apparently Occupied Nests (AONs), i.e. nest material with adult(s) present.

Table 4 Numbers of Arctic tern AIAs in various colonies

Colony	*28th May*	*11th June*	*14th June*	*29th June*
Buness	49	78		0
Eas Brecks	386	-	253	23
Byerwall	29	2		0
Sukki Mire	60	57	50	0
Tirryfield	436	270		0
Horstbrekkers	150	190		0
South Park	113	248		0
South Light	26	39		0
Total	1,249	1,137*	-	23

* Including 253 from 14th June.

Table 5 Fulmar population change at five monitored plots 1986-1998

Year	*North Haven*	*South Gunnawark*	*South Ramnigeo*	*Easter Lother*	*Heilli Stack/ Linni Geo*	*All sites*
1986	118	90	125	90	87	510
1987	136	59	103	71	70	439
1988	72	66	121	68	71	398
1989	96	60	107	79	77	419
1990	104	67	107	72	73	423
1991	86	73	109	82	51	401
1992	95	62	134	102	76	469
1993	59	50	113	89	50	361
1994	65	50	109	86	63	373
1995	77	49	106	91	64	387
1996	78	54	110	118	71	431
1997	69	48	113	101	69	400
1998	22	53	44	108	43	270
% change 1997-98	-68.1%	+10.4%	-61.1%	+6.9%	-37.7%	-32.5%
% change 1986-98	*	-41.1%	-64.8%	+20.0%	-50.6%	-47.1%*

Figures refer to Apparently Occupied Sites (AOS), defined as apparently incubating birds present at a suitable nest site on each of three visits to plots between 1 June and 10 June. * All sites % change for 1986-98 excludes North Haven due to change in study site with construction of new pier and breakwater in 1992-93.

Table 6 Shag population change at five monitored plots 1986-1998

Year	*North Ramnigeo*	*South Ramnigeo*	*South Naaversgill*	*South Gunnawark*	*Lericum*	*All sites*
1986	27	38	52	64	36	217
1987	30	31	28	49	102	240
1988	24	53	45	48	51	221
1989	20	73	42	53	53	241
1990	20	60	25	43	54	202
1991	27	53	17	38	63	198
1992	21	49	16	26	63	175
1993	20	35	19	24	76	174
1994	26	46	17	24	58	171
1995	18	37	20	23	62	160
1996	26	51	24	33	72	206
1997	16	47	19	26	55	163
1998	13	32	20	25	45	135
% change 1997-98	-18.8%	-31.9%	+5.3%	-3.8%	-18.2%	-17.2%
% change 1986-98	-51.2%	-15.8%	-61.5%	-60.9%	+25.0%	-37.8%

Figures refer to number of nests (counted during a single visit to each plot between 4 June and 24 June).

Table 7 Kittiwake population change at 10 monitored plots 1986-1998

Year	*SG*	*L*	*DN*	*HDG*	*JP*	*SH*	*SC*	*DS*	*TK*	*B*	*All sites*
1986	*c.*207	*c.*166	*c.*203	*c.*207	*c.*217	-	-	-	-	-	-
1987	*c.*217	*c.*165	*c.*188	*c.*205	*c.*208	*c.*93	*c.*93	*c.*91	*c.*94	*c.*92	1,446
1988	197	137	189	204	176	94	111	87	100	111	1,406
1989	196	155	184	218	177	92	124	85	97	99	1,427
1990	178	142	186	200	178	82	125	80	106	86	1,363
1991	162	140	182	169	154	76	120	72	100	78	1,253
1992	172	146	160	142	155	81	110	81	111	72	1,230
1993	139	106	139	130	127	71	83	54	97	51	997
1994	129	97	136	130	124	81	80	52	83	63	975
1995	127	92	130	134	109	78	68	51	67	61	917
1996	121	79	137	135	117	73	69	44	88	61	924
1997	115	78	138	126	110	62	63	47	87	59	885
1998	100	69	117	123	97	64	47	31	71	46	765
% change 1997-98	-13.0%	-11.5%	-15.2%	-2.4%	-11.8%	+3.2%	-25.4%	-34.0%	-18.4%	-22.0%	-13.6%
% change 1986-98	-51.7%	-58.4%	-42.4%	-40.6%	-55.3%	-31.8%	-49.5%	-66.0%	-24.5%	-50.0%	-47.1%

Figures refer to mapped AONs, based on 15-20 visits to each plot between 14 May and 12 August. Sites are SG: South Gunnawark; L: Lericum; DN: Da Nizz; HDG: Holms/Dog Geo; JP: Johnny's Peats; SH: Stroms Heelor; SC: Shaldi Cliff; DS: Da Swadin; TK: Trottle Kame; B: Bergaroo.

Table 8 Guillemot population change at five monitored plots 1986-1998

Year	*Shaldi Cliff*	*North Gunnawark*	*Guidicum*	*Da Swadin*	*Kristal Kame*	*All sites*	*Three valid sites in 1998*
1986	496	306	506	243	-	-	
1987	475	174	456	282	1,891	3,278	2,521
1988	365	165	432	254	1,172	2,388	
1989	410	174	433	292	1,166	2,475	
1990	313	130	288	219	807	1,757	
1991	405	173	353	287	1,333	2,551	
1992	461	185	456	357	1,702	3,161	
1993	458	183	401	402	1,601	3,045	
1994	437	352	338	367	1,440	2,934	
1995	470	145	302	453	1,305	2,675	
1996	483	158	344	439	1,279	2,703	
1997	513. 2	170. 7	323. 4	490. 9	1,428.2	2,926.4	1,922.3
1998 (no. of counts)	-	170. 3 (4)	347.2 (5)	-	1,377.2 (6)	-	1,888.5 (4)
% change 1997-98		-0. 23% n.s.	+7.36% n.s.		-3. 57% n.s.		-1.76 n.s.
% change 1986/7-98		-44. 4%	-31. 4%		-27. 2%		-25.1%

Combined plots data for 1998 are based on four counts in 1998 between 5 and 15 June. Data from Shaldi Cliff and Da Swadin were not valid in 1998, so data for the other three plots are compared to those for the same three sites combined in 1997. Additional counts in 1998 were used for some individual plot comparisons, as indicated. Sample size for all plots was 10 in all other years except 1988 and 1986 (nine), and 1994 (eight). Statistical significance of differences 1997-1998: n.s. = not significant.

Table 9a Black guillemot counts, Busta Geo, 1987-1998

	1987	*1988*	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*
Count 1	40	32	41	39	30	32	26	24	23	22	13	6
Count 2	43	40	40	33	35	32	25	25	14	21	19	5

Count dates were: 1987 (12/4, 23/4); 1988 (1/5, 12/5); 1989 (9/4, 27/4); 1990 (7/4, 21/4); 1991 (13/4, 22/4), 1992 (17/4, 29/4), 1993 (14/4, 25/4), 1994 (16/4, 22/4), 1995 (14/4, 21/4), 1996 (26/4, 30/4), 1997 (16/4, 20/4). 1998 (19/4, 30/4).

Table 9b Black guillemot counts, North Light - South Light, east side, 1982-1998

	1982	*1986*	*1987*	*1989*	*1991*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*
Count 1	244	254	220	281	230	183	238	214	189	254	153
Count 2	-	-	209	286	241	190	240	216	224	230	160
% change (max. counts)		+4.1	-13.4	+23.1	-15.7	-21.2	+20.8	-10.0	+3.6	+11.8	- 37.0

Counts are number of individuals in breeding plumage.

Table 10 Fulmar breeding success at five monitored plots 1986-1998

Plot	*1986*	*1987*	*1988*	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*
NHV	0.32	0.66	0.35	0.48	0.25	0.24	0.37	0.46	0.28	0.33	0.32	0.26	0.43
SGU	0.53	0.69	0.38	0.43	0.21	0.52	0.58	0.51	0.48	0.47	0.31	0.29	0.23
SRA	0.58	0.50	0.42	0.63	0.36	0.60	0.55	0.51	0.53	0.54	0.55	0.42	0.30
ELO	0.54	0.56	0.45	0.62	0.29	0.49	0.59	0.71	0.53	0.55	0.51	0.39	0.31
H/L	0.60	0.58	0.55	0.47	0.23	0.73	0.64	0.66	0.70	0.56	0.48	0.42	0.37
Mean	0.51	0.60	0.43	0.53	0.27	0.52	0.55	0.57	0.50	0.49	0.43	0.36	0.33
±SE	±.05	±.03	±.03	±.04	±.03	±.08	±.05	±.05	±.07	±.04	± 0.05	± 0.03	±0.03

Plot codes: NHV = North Haven, SGU = South Gunnawark, SRA = South Ramnigeo, ELO = Easter Lother, H/L = Heilli Stack/ Linni Geo. Fulmar productivity is measured as number of chicks fledged per AOS. From 1986 to 1994, an AOS was defined as a site occupied on three consecutive visits in early June, plus any other site within the monitoring plot where a chick was subsequently present. However, estimates of productivity should strictly define AOS only as those sites found to be occupied on three consecutive checks in June (Walsh *et al.* 1995) as the addition of sites which were not found to be occupied in early June but at which a chick was subsequently seen will cause upward bias in productivity estimates. Productivity figures calculated by this more rigorous definition are given for 1995-98.

Table 11 Gannet breeding success 1986-98

	1986	*1987*	*1988*	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*
Occupied nests	124	107	126	147	159	150	129	152	141	166	222	222	187
Chicks fledged	84	51	98	114	95	78	94	117	109	125	149	157	149
Productivity	0.68	0.48	0.78	0.78	0.60	0.52	0.73	0.78	0.77	0.75	0.67	0.71	0.80

Table 12 Shag breeding success 1986-1998

	1986	*1987*	*1988*	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*
Occupied nests	66	64	64	59	62	95	74	72	79	71	85	89	71
Chicks fledged	100	77	83	84	60	112	122	130	130	94	117	115	102
Productivity	1.52	1.20	1.30	1.42	0.97	1.18	1.65	1.81	1.65	1.38	1.38	1.29	1.44

Table 13 Breeding success of Arctic skua and great skua, 1989-1998

Species	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*
Arctic skua	0.33	0.03	0.75	1.2	0.8-0.9	0.70	0.75-0.80	0.88	0.82	0.13
Great skua	0.79	0.68	0.70	0.5-0.8	1.0-1.2	1.20	1.15	0.83	0.76	1.00

Productivity = number of chicks fledged per AOT.

Table 14 Breeding success of common gull, 1989-1998

	1989	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*
Productivity	1.10	0.90	0.22	0	0.40	0.57	0.60	1.0	0.4	0.6

Productivity = number of chicks fledged per nest

Table 15 Kittiwake breeding success, 1998

Plot	*AONs*	*Traces*	*Chicks fledged*	*Productivity*
South Gunnawark	103	8	10	0.10
Lericum	70	3	5	0.07
Da Nizz	120	11	14	0.12
Holms/Dog Geo	126	8	17	0.13
Johnny's Peats	101	5	17	0.17
Stroms Heelor	65	3	16	0.25
Shaldi Cliff	49	3	15	0.31
Da Swadin	35	-	1	0.03
Trottie Kame	73	1	17	0.23
Bergaroo	49	4	3	0.06
Mean, all plots				0.15

Productivity = number of chicks fledged per AON

Table 16 Kittiwake breeding success at monitored plots, 1986-1998

Plot	*1986*	*1987*	*1988*	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*
S. Gunnawark	1.01	1.15	0.08	0.34	0	0.78	1.09	0.69	1.33	1.03	1.09	0.74	0.10
Lericum	1.26	1.10	0.09	0.39	0	0.90	1.42	1.04	1.00	0.60	1.15	0.55	0.07
Da Nizz	1.02	1.05	0.06	0.40	0	0.92	1.43	1.13	1.37	0.97	1.36	0.53	0.12
Holms/Dog Geo	0.92	1.03	0.07	0.19	0	0.50	1.32	1.06	1.32	0.88	1.49	0.69	0.13
Johnny's Peats	1.08	1.04	0.06	0.36	0	0.74	1.20	0.93	1.30	1.04	1.38	0.75	0.17
Stroms Heelor		0.99	0.04	0.38	0	1.08	1.54	1.13	1.02	0.71	1.36	0.81	0.25
Shaldi Cliff		1.00	0.13	0.29	0	1.01	1.24	1.17	1.21	1.09	1.17	1.00	0.31
Da Swadin		0.94	0.14	0.32	0	1.00	1.15	1.02	1.06	0.14	0.59	0.21	0.03
Trottie Kame		0.84	0.11	0.59	0	1.10	1.34	1.30	1.43	1.10	1.35	0.75	0.23
Bergaroo		0.96	0.04	0.42	0	0.86	1.25	1.35	1.27	1.03	1.36	0.58	0.06
Mean all plots	1.06	1.01	0.08	0.37	0	0.89	1.30	1.08	1.23	0.87	1.23	0.66	0.15
± s.e.	±0.06	±0.03	±0.01	±0.01		±0.06	±0.04	±0.06	±0.05	±0.09	±0.08	±0.07	±0.03

Productivity = number of chicks fledged per AON

Table 17 Breeding success of Arctic tern and common tern, 1988-1998

	Arctic tern			*Common tern*		
Year	*AIAs*	*Chicks fledged*	*Productivity*	*AIAs*	*Chicks fledged*	*Productivity*
1988	345	1	0.00	59	2	0.03
1989	283	36	0.13	25	1	0.04
1990	400	1	0.00	7	0	0
1991	650		1.0-1.3	10	2	0.20
1992	1,100	1,100+	1.0+	17	*c.*16	1.00
1993	808	50	0.06	9	1	0.11
1994	615	150	0.24	3	4	1.33
1995	1,200	200	0.17	6	0	0
1996	1,250	900+	0.75	5	3	0.60
1997	1,730	800+	0.46	7	*c.* 7	1.00
1998	1,249	1	0.00	2	0	0.00

Productivity = number of chicks fledged per pair (apparently incubating adults, AIAs)

Table 18 Guillemot breeding success at two monitored plots, 1988-1998

	Peitron		*Da Swadin*		
Year	*AIAs*	*Productivity*	*AIAs*	*Productivity*	*Mean productivity*
1988	53	0.77	54	0.80	0.78
1989	57	0.79	60	0.78	0.78
1990	58	0.72	48	0.71	0.72
1991	136	0.79	57	0.61	0.70
1992	102	0.75	39	0.72	0.74
1993	148	0.86	50	0.84	0.85
1994	151	0.77	45	0.67	0.74
1995	117	0.68	48	0.65	0.67
1996	157	0.74	57	0.77	0.75
1997	106	0.69	55	0.84	0.74
1998	142	0.71	77	0.71	0.71

Productivity = number of chicks fledged per apparently incubating adult (AIA) - i.e. 'active sites'

Table 19 Razorbill breeding success, Easter Lother, 1990-1998

	1990	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*
No. eggs laid	48	64	69	77	72	47	78	100	75
Productivity	0.69	0.58	0.55	0.77	0.64	0.49	0.72	0.61	0.80

Productivity = number of chicks assumed fledged per eggs laid

Table 20 Black guillemot breeding success at monitored nests, 1987-1998

	1987	*1988*	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*
Nests with eggs	25	14	43	33	48	47	31	19	32	30	23	13
Chicks fledged	12	8	46	24	41	47	38	11	23	17	10	9
Productivity	0.48	0.57	1.07	0.73	0.85	1.00	1.23	0.58	0.72	0.57	0.43	0.69

Productivity = number of chicks assumed to have fledged per site with egg(s).

Table 21 Puffin breeding success at monitored burrows, 1987-1998

	1987	*1988*	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*
Sites with eggs	93	71	101	96	120	97	110	64	109	109	124	79
Chicks fledged	65	54	77	55	104	73	76	53	81	87	98	46
Productivity	0.70	0.75	0.76	0.57	0.87	0.75	0.69	0.83	0.74	0.80	0.79	0.58

Productivity = number of chicks assumed to have fledged per burrow with egg.

Table 22 Survival estimates for breeding adult kittiwakes and puffins, 1996-1998

Species	*Number of colour-marked birds known alive in 1997*	*Number seen 1998*	*% survival*
Kittiwake	48	11	22.9%
Puffin	95	76	80.0%

Table 23 Updated kittiwake and puffin year-on-year survival estimates, 1987-1997

Species	*86-87*	*87-88*	*88-89*	*89-90*	*90-91*	*91-92*	*92-93*	*93-94*	*94-95*	*95-96*	*96-97*
Kittiwake	-	-	-	-	-	89.3%	72.0%	78.7%	83.8%	90.2%	91.7%
Puffin	93.9%	86.4%	91.5%	86.4%	78.8%	81.9%	88.9%	84.0%	90.3%	94.7%	93.8%

Table 24 Numbers of fish fed to guillemot chicks and feeding rates at Peitron colony, 1998

Date	22/6	26/6	29/6	1/7	5/7
No. chicks	55	55	57	54	30
No. sandeels	20	25	15	15	5
No. gadoids	0	0	1	0	0
No. sprats	0	0	0	0	0
Other	0	0	0	0	0
Unidentified	4	5	2	0	2
Feeding rate (item per chick per hour)	0.22	0.27	0.16	0.14	0.08

Counts made between 11.00 - 16.00 BST

Table 25 Weight and composition of puffin food samples, Fair Isle, 1986-1998

Year	*Sample dates*	*Mean weight*	*Total no. fish*	*Percentage total fish*					
				Sandeels		*Gad.*	*Sprat*	*Rock.*	*Unid.*
				Large	*Small*				
1986	27/06-23/07	7.0 ± 0.8 (20)	44	26	70	2	0	2	0
1987	03/07-03/08	4.6 ± 0.4 (27)	32	22	78	0	0	0	0
1988	02/07-21/07	6.0 ± 0.6 (34)	159	5	37	51	5	1	0
1989	02/07-24/07	9.3 ± 0.6 (64)	428	4	77	16	2	1	0
1990	29/06-02/08	7.6 ± 0.4 (73)	613	1	45	42	0	13	0
1991	22/06-21/07	10.0 ± 0.5 (72)	385	18	75	4	0	3	0
1992	25/06-16/07	9.1 ± 0.4 (107)	520	12	17	61	0	7	3
1993	12.07	6.0 ± 0.9 (15)	52	6	38	0	4	52	0
1994	28/07-16/07	9.8 ± 1.3 (18)	99	9	74	16	0	0	1
1995	24/06-17/07	7.7 ± 1.0 (28)	143	13.3	42.7	35.6	7.7	0.7	0
1996	11/07-27/07	10.1 ± 0.9 (26)	163	2.5	85.9	6.1	5.5	0	0
1997	07/07-20/07	8.5 ± 0.8 (44)	449	0.2	38.8	37.4	1.3	13.8	6.7
1998	20/06-20/07	5.3 ± 0.45 (57)	264	3.8	14.0	77.3	0	0	4.9

Key: Rock. = Rockling; Gad. = Gadoid; Unid. = unidentified; large sandeels are > 100 mm length.

Appendix 1 **Fair Isle guillemot census counts, June 1998**

COLONY: North Gunnawark	**OBSERVER: Charles A. Holt**			
DATE:	5	8	13	15
START TIME:	1520	1150	1155	1010
PLOT COUNT	168	177	156	180
Loafers*	27	9	2	12
CLOUD	8	7	2	5
RAIN	1	1	1	1
SEA	2	2	2	2
SWELL	2	2	1	2
VISIBILITY, COLONY	1	1	1	1
VISIBILITY, SEA	1	1	1	1
WIND SPEED	4	4	1	2
WIND DIRECTION	E	NW	W	NE

KEY

Cloud cover in oktas. Wind speed is Beaufort scale.
Rain: 1 = none, 2 = discontinuous light, 3 = discontinuous heavy, 4 = continuous light, 5 = continuous heavy.
Sea: 1 = flat calm, 2 = small waves, 3 = large waves, 4 = white wave crests, 5 = waves breaking high onto rocks.
Swell: 1 = no swell, 2 = light swell, 3 = moderate swell, 4 = heavy swell.
Visibility: 1 = good, 2 = fair, 3 = poor.

* birds present but not on breeding ledges.

COLONY: Guidicum	**OBSERVER: Charles A. Holt**				
DATE:	5	8	*11*	13	15
START TIME:	1440	1100	*1540*	1215	1050
PLOT COUNT	327	340	*389*	330	350
Loafers	8	0	*0*	29	6
CLOUD	8	7	*3*	2	5
RAIN	1	1	*1*	1	1
SEA	2	2	*2*	2	2
SWELL	2	2	*2*	1	2
VISIBILITY, COLONY	1	1	*1*	1	1
VISIBILITY, SEA	1	1	*1*	1	1
WIND SPEED	4	4	*4*	1	2
WIND DIRECTION	E	NW	*NW*	NW	NE

KEY

Cloud cover in oktas. Wind speed is Beaufort scale.
Rain: 1 = none, 2 = discontinuous light, 3 = discontinuous heavy, 4 = continuous light, 5 = continuous heavy.
Sea: 1 = flat calm, 2 = small waves, 3 = large waves, 4 = white wave crests, 5 = waves breaking high onto rocks.
Swell: 1 = no swell, 2 = light swell, 3 = moderate swell, 4 = heavy swell.
Visibility: 1 = good, 2 = fair, 3 = poor.

Note: data in italics used for individual plot comparisons only. Data in normal type combined with those from other plots for overall comparison.

* birds present but not on breeding ledges.

COLONY: Kristal Kame	OBSERVER: Steven J. Turner					
DATE:	5	8	13	15	*17*	*19*
START TIME:	1405	1420	1015	1200	*1415*	*1200*
PLOT COUNT						
A	1149	1110	1023	1158	*1132*	*1044*
B	256	297	234	299	*279*	*282*
Loafers	78	1	48	58	*1*	*12*
CLOUD	8	8	3	5	*7*	*1*
RAIN	1	2	1	1	*1*	*1*
SEA	3	3	2	2	*3*	*2*
SWELL	2	3	2	2	*3*	*2*
VISIBILITY, COLONY	1	1	1	1	*1*	*1*
VISIBILITY, SEA	1	1	1	1	*1*	*1*
WIND SPEED	4	4	2	3	*3*	*3*
WIND DIRECTION	ESE	NNE	N	NE	*NE*	*E*

KEY

Cloud cover in oktas. Wind speed is Beaufort scale.
Rain: 1 = none, 2 = discontinuous light, 3 = discontinuous heavy, 4 = continuous light, 5 = continuous heavy.
Sea: 1 = flat calm, 2 = small waves, 3 = large waves, 4 = white wave crests, 5 = waves breaking high onto rocks.
Swell: 1 = no swell, 2 = light swell, 3 = moderate swell, 4 = heavy swell.
Visibility: 1 = good, 2 = fair, 3 = poor.

Note: data in italics used for individual plot comparisons only. Data in normal type combined with those from other plots for overall comparison.

* birds present but not on breeding ledges.

Appendix 2 Food sample collections and feeding watches in 1998

Table A2.1 Shag food samples, 1998

Sample no.	*Date*	*Site*	*Weight*	*Principal constituents*
1	28.06	Lericum cave	22.5	Sandeel
2	28.06	Lericum cave	13.8	Sandeel
3	28.06	Lericum cave	38.3	Sandeel
4	28.06	Lericum cave	39.0	Sandeel
5	03.07	Da Nizz	14.4	Sandeel
6	03.07	Easter Geo o Skroo	14.4	Unidentified
7	06.07	Finniquoy	49.5	Sandeel
8	06.07	Finniquoy	19.5	Sandeel
9	06.07	Finniquoy	24.0	Sandeel

Number of samples: 9
Mean load weight = 26.2 $\pm$ 4.33 (SE)

Load composition:	*Species*	*% of loads of which principal constituent*
	Sandeel	88.9
	Clupeid	0.0
	Gadoid	0.0
	Unidentified	11.1

Table A2.2 Kittiwake food samples, 1998

Sample no.	*Date*	*Site*	*Bird age*	*Wet mass (g)*	*Principal constituents*
1	07.06	Shaldi Cliff	Ad	59.5	Sandeel
2	07.06	Shaldi Cliff	Pull	11.4	Sandeel
3	07.06	Shaldi Cliff	Pull	16.8	Sandeel
4	07.06	Shaldi Cliff	Pull	11.2	Sandeel
5	07.06	Sooth Mila Hesslands	Pull	13.3	Sandeel
6	07.06	Sooth Mila Hesslands	Pull	11.4	Sandeel
7	18.06	Goorn	Ad	2.8	Sandeel
8	18.06	Goorn	Ad	29.3	Sandeel
9	18.06	Goorn	Ad	5.5	Sandeel
10	18.06	South Ramnigeo	Ad	13.7	Sandeel

Number of samples: 10
Mean load weight (all) = 17.5g $\pm$ 5.17(SE)
(pull. only) = 12.8g $\pm$ 1.06(SE)
(ad. only) = 22.2g $\pm$ 10.41(SE)

Load composition:	*Species*	*% of loads of which principal constituent*
	Sandeel	10/10 = 100%

Table A2.3 Guillemot food samples, 1998

Sample no.	*Date*	*Site*	*Weight (g)*	*Length (mm)*	*Principal constituents*
1	22.06	South Gunnawark	8.3	132	Sandeel
2	23.06	Hol o Klaver	20.0	145	Sandeel
3	28.06	Lericum	16.4	125	Greater sandeel
4	30.06	Hol o Klaver	24.9	216	Greater sandeel

Number of samples: 4
Mean load weight =17.4, ± 3.5 (SE)
% sandeel = 100%

Table A2.4 Razorbill food samples, 1998

Sample no.	*Date*	*Site*	*Weight (g)*	*Length (mm)*	*Principal constituents*
1	18.06	South Ramnigeo	2.5	50	Sandeel
2	18.06	South Ramnigeo	2.6	99	Sandeel
3	21.06	South Naaversgill	9.3	111	Sandeel
				105	Sandeel
4	24.06	Wester Lother	8.1	114	Sandeel
				103	Sandeel
5	24.06	Wester Lother	9.2	138	Sandeel
6	26.06	North Ramnigeo	7.0	84	Sandeel
				84	Sandeel
				84	Sandeel
				70	Sandeel
7	30.06	Hol o Klaver	2.4	76	Sandeel
				73	Sandeel
8	01.07	North Gunnawark	8.4	114	Sandeel
				73	Sandeel
				70	Sandeel
				69	Sandeel
9	03.07	Easter Geo o Skroo	5.1	120	Sandeel

Number of samples: 9
Mean load weight = 6.1g ± 0.98(SE); n=9
Mean length of sandeels = 90.9 mm ± 5.42(SE); n=18

Table A2.5 Puffin food samples, 1998

No. of samples	57
Dates collected	20 June – 27 July
Mean load weight	5.3 ± 0.45 (SE)

Species composition	*No.*	*Mean length (mm) ± SE*	*% by no.*
Sandeel (all)	47	82.6 ± 4.59	17.8
Sandeel (< 100 mm)	37	69.8 ± 2.27	14.0
Sandeel (> 100 mm)	10	130.0 ± 10.72	3.8
Gadidae *	204	39.6 ± 0.96	77.3
Unidentified	13	35.4 ± 3.73	4.9

* Note that 'Gadidae' includes gadoids not specifically identified, which could included rockling.

Table A2.6 Summary of puffin feeding watch 9 July, 03.00 - 23.00 hrs

Burrow no.	*No. feeds*	*Sandeel*	*Sandeel/Gadoid*	*Gadoid*	*Sprat*	*Meals delivered too quickly to be identified*
1	3	5	-	7	-	1
2	2	-	-	3	-	2
3	1	7	-	-	-	-
4	3	3	-	-	-	2
5	9	8	-	9	-	3
6	5	12	-	16	-	1
7	4	2	-	12	-	1
8	1	-	-	-	-	1
9	12	22	-	7	-	6
10	13	18	-	6	-	7
11	7	7	-	16	-	2
12	6	4	-	7	-	2
13	12	7	-	11	-	2
14	14	-	-	-	-	1
15	11	9	-	53	-	3
16	8	2	-	13	-	3
17	10	7	-	15	-	6
18	6	9	-	6	-	3
19	9	6	-	11	-	5
20	12	19	-	17	-	3
21	5	9	-	13	-	1
22	3	-	-	1	-	2
23	6	14	-	-	-	4
24	18	19	-	44	-	4
25	14	5	-	18	-	8
26	6	12	-	-	-	3
27	9	6	-	12	-	3
28	15	8	-	46	-	4
29	2	-	-	8	-	1
30	15	8	-	16	-	9
31	6	2	1	5	-	2
32	8	2	-	12	-	4
33	12	6	-	48	-	1
34	7	20	-	10	-	-
35	10	4	-	31	-	4
36	4	1	-	20	-	-
37	16	10	-	12	-	11
Total	304	273	1	505	0	115

Average no. feeding visits per burrow per day = 8.2

Appendix 3 Weights and wing lengths of chicks in 1998

Table A3.1 Fulmar: chicks weighed and measured four times

Date	*Weight*	*Wing*	*Date*	*Weight*	*Wing*	*Date*	*Weight*	*Wing*	*Date*	*Weight*	*Wing*
31.07	665	114	05.08	605	145	10.08	820	170	17.08	680	216
31.07	540	112	05.08	725	140	10.08	850	173	17.08	770	217
31.07	830	168	05.08	770	199	10.08	890	228	17.08	550	257
31.07	560	111	05.08	695	152	10.08	730	186	17.08	790	221
31.07	800	105	05.08	810	134	10.08	1,080	168	17.08	940	210
31.07	860	98	05.08	940	139	10.08	1,040	178	17.08	1,060	220
31.07	730	133	05.08	710	180	10.08	800	206	17.08	1,060	245
31.07	950	118	05.08	775	156	10.08	910	182	17.08	920	225
31.07	780	112	05.08	885	153	10.08	1,205	191	17.08	1,050	230
31.07	960	152	05.08	910	183	10.08	1,140	206	17.08	920	245
31.07	660	104	05.08	690	131	10.08	910	155	17.08	980	195
31.07	665	110	05.08	765	150	10.08	695	178	17.08	750	220
31.07	1,050	170	05.08	1,270	203	10.08	950	235	17.08	1,200	270
31.07	680	107	05.08	750	147	10.08	1,100	180	17.08	1,030	222
31.07	730	82	05.08	680	122	10.08	1,030	162	17.08	1,200	209
31.07	760	148	05.08	770	184	10.08	990	211	17.08	770	246
31.07	620	90	05.08	500	129	10.08	800	160	17.08	900	200
31.07	800	116	05.08	770	151	10.08	1,140	178	17.08	1,120	216
31.07	670	107	05.08	675	139	10.08	810	172	17.08	730	218
31.07	880	121	05.08	840	156	10.08	975	190	17.08	950	235
31.07	1,240	151	05.08	910	187	10.08	1,330	215	17.08	1,330	255
31.07	980	140	05.08	985	178	10.08	1,080	202	17.08	1,080	248
31.07	665	104	05.08	620	140	10.08	750	170	17.08	620	210
31.07	990	140	05.08	800	171	10.08	1,220	203	17.08	1,020	248
31.07	900	167	05.08	1,045	200	10.08	1,090	232	17.08	1,020	276
31.07	1,010	152	05.08	1,000	187	10.08	980	220	17.08	1,200	258
31.07	780	160	05.08	840	191	10.08	995	220	17.08	975	260
31.07	1,120	188	05.08	1,230	217	10.08	1,320	240	17.08	990	270

Weights are grams and wing lengths are millimetres.

Table A3.2a Shag: chicks weighed and measured once

Date	*Weight (g)*	*Wing (mm)*	*Brood size*	*Date*	*Weight (g)*	*Wing (mm)*	*Brood Size*
22.06.98	810	88	2	02.07.98	600	58	3
22.06.98	825	89	2	02.07.98	930	88	3
23.06.98	500	62	3	02.07.98	700	61	3
24.06.98	1,275	129	2	02.07.98	700	63	3
24.06.98	1,200	122	2	02.07.98	510	65	3
26.06.98	1,180	115	3	02.07.98	700	69	3
26.06.98	1,030	103	3	02.07.98	750	70	3
26.06.98	1,210	125	3	02.07.98	1,140	125	2
26.06.98	1,015	110	3	02.07.98	1,110	108	2
26.06.98	1,310	136	3	02.07.98	1,010	75	2

Table A3.2a (cont.) Shag: chicks weighed and measured once

26.06.98	1,420	135	3	02.07.98	730	80	1
26.06.98	960	97	3	02.07.98	870	84	3
26.06.98	750	81	3	02.07.98	790	105	3
26.06.98	800	87	3	02.07.98	770	95	3
26.06.98	650	68	3	02.07.98	1,420	145	2
26.06.98	1,000	94	3	02.07.98	1,220	142	2
26.06.98	900	95	3	02.07.98	550	56	3
26.06.98	650	71	3	02.07.98	860	79	3
26.06.98	570	59	3	02.07.98	740	73	3
26.06.98	690	69	3	02.07.98	1,420	119	2
28.06.98	590	64	3	02.07.98	1,180	108	2
28.06.98	710	80	3	02.07.98	590	59	2
28.06.98	770	85	3	02.07.98	650	68	2
28.06.98	1,450	165	2	02.07.98	800	83	2
28.06.98	1,330	147	2	02.07.98	690	64	2
28.06.98	1,050	120	2	03.07.98	730	73	3
28.06.98	1,150	111	2	03.07.98	650	69	3
28.06.98	960	104	2	03.07.98	650	62	3
28.06.98	975	100	2	03.07.98	640	67	2
28.06.98	1,580	164	2	03.07.98	600	65	2
28.06.98	1,640	158	2	03.07.98	920	103	2
28.06.98	450	50	3	03.07.98	830	80	2
28.06.98	1,480	150	2	03.07.98	530	50	2
28.06.98	1,290	154	2	03.07.98	590	50	2
28.06.98	1,100	124	2	06.07.98	2,100	225	2
28.06.98	1,250	148	2	06.07.98	2,000	221	2
28.06.98	760	80	3	08.07.98	1,650	190	2
28.06.98	660	73	3	08.07.98	1,440	172	2
28.06.98	680	76	3	08.07.98	1,570	196	2
28.06.98	680	66	3	08.07.98	1,570	191	3
28.06.98	660	75	3	08.07.98	1,750	203	3
28.06.98	1,480	149	2	08.07.98	1,775	256	3
28.06.98	1,280	144	2	08.07.98	1,550	197	2
28.06.98	830	83	2	08.07.98	1,475	173	2
28.06.98	820	86	2	08.07.98	1,250	152	2
28.06.98	950	92	1	08.07.98	1,850	252	3
28.06.98	1,050	110	2	08.07.98	1,800	264	3
28.06.98	1,270	117	2	08.07.98	1,650	182	1
28.06.98	1,060	106	2	10.07.98	1,550	230	3
28.06.98	1,000	97	2	10.07.98	1,850	236	3
28.06.98	2,000	221	?	10.07.98	1,560	222	3
28.06.98	1,800	190	?	10.07.98	1,010	119	2
28.06.98	1,900	220	?	10.07.98	1,150	125	2
28.06.98	1,800	225	?	15.07.98	1,320	153	3
28.06.98	2,250	225	?	15.07.98	1,350	148	3
28.06.98	1,300	114	3	15.07.98	1,150	133	3
28.06.98	1,430	128	3	15.07.98	1,000	115	3
28.06.98	1,200	122	3	15.07.98	1,250	140	3
28.06.98	560	53	2	15.07.98	1,300	142	3
28.06.98	370	45	2	15.07.98	840	110	3

Table A3.2a (cont.) Shag: chicks weighed and measured once

28.06.98	670	62	3	15.07.98	1,190	128	3
28.06.98	770	70	3	15.07.98	1,170	122	3
29.06.98	480	49	3	15.07.98	720	103	3
29.06.98	600	60	3	15.07.98	1,110	128	3
29.06.98	480	50	2	15.07.98	1,400	152	3
02.07.98	920	90	2	15.07.98	1,130	140	3
02.07.98	1,610	173	1	15.07.98	1,620	157	3
02.07.98	750	68	3	15.07.98	1,360	150	3
02.07.98	760	68	3	15.07.98	1,800	170	3
02.07.98	740	72	3	15.07.98	1,045	112	2

Table A3.2b Shag: chicks weighed and measured twice

Date 1	*Weight (g)*	*Wing (mm)*	*Brood size*	*Date 2*	*Weight (g)*	*Wing (mm)*
20.6.98	500	56	3	2.7.98	1,360	132
20.6.98	600	58	3	2.7.98	1,400	142
20.6.98	570	56	3	2.7.98	1,200	132
24.6.98	1,125	115	2	7.7.98	1,700	147
24.6.98	1,275	133	2	7.7.98	1,850	200
24.6.98	900	98	1	7.7.98	1,760	179
24.6.98	800	88	3	7.7.98	1,500	168
24.6.98	900	87	3	7.7.98	1,650	160
24.6.98	750	84	3	7.7.98	1,450	170
24.6.98	725	75	2	7.7.98	1,650	215
25.6.98	730	80	3	2.7.98	1,170	128
25.6.98	810	78	3	2.7.98	1,160	130
26.6.98	1,400	172	2	3.7.98	1,460	260
26.6.98	1,550	175	2	3.7.98	1,420	290
28.6.98	900	83	3	8.7.98	1,550	157
28.6.98	820	89	3	8.7.98	1,450	163
28.6.98	690	65	1	8.7.98	1,250	153
29.6.98	810	79	2	15.7.98	1,750	185
29.6.98	700	68	2	15.7.98	1,500	170
29.6.98	640	66	3	15.7.98	1,600	171
29.6.98	580	54	3	15.7.98	1,550	162
29.6.98	590	58	3	15.7.98	1,630	164
29.6.98	550	56	3	15.7.98	1,370	166
29.6.98	650	63	3	15.7.98	1,700	172
29.6.98	490	49	2	15.7.98	1,480	159
29.6.98	700	71	3	15.7.98	1,750	182
29.6.98	740	79	3	15.7.98	1,600	179
29.6.98	480	55	3	15.7.98	1,100	154
29.6.98	550	60	1	15.7.98	1,250	162
2.7.98	650	63	3	15.7.98	1,550	159
2.7.98	600	65	3	15.7.98	1,400	155
2.7.98	500	52	3	15.7.98	1,350	146
7.7.98	1,450	140	2	15.7.98	1,930	190
7.7.98	1,400	140	2	15.7.98	1,770	193

Table A3.2c Shag: chicks weighed and measured three times

Date 1	*Weight*	*Wing*	*Brood size*	*Date 2*	*Weight*	*Wing*	*Date 3*	*Weight*	*Wing*
22.6.98	600	63	2	29.6.98	1,010	105	17.7.98	1,750	204
22.6.98	500	54	2	29.6.98	1,120	116	17.7.98	1,700	198
24.6.98	1,070	102	2	7.7.98	1,690	217	15.7.98	1,950	223
28.6.98	1,050	102	2	6.7.98	1,566	151	10.7.98	1,720	175
28.6.98	1,010	99	2	6.7.98	1,620	154	10.7.98	1,800	173

Weights are grams and wing lengths are millimetres.

Table A3.3a Arctic skua: chicks weighed and measured once

Date	*Weight (g)*	*Wing (mm)*	*Brood size*	*Date*	*Weight (g)*	*Wing (mm)*	*Brood size*
17.6.98	73	39	1	1.7.98	320	149	?
28.6.98	195	85	2	1.7.98	292	141	1
28.6.98	140	69	2	2.7.98	310	120	1
28.6.98	80	36	1	2.7.98	40	25	2
30.6.98	170	81	1	2.7.98	380	204	2
30.6.98	225	105	2	2.7.98	340	187	2
30.6.98	295	140	?	2.7.98	190	111	1
30.6.98	185	85	?	2.7.98	180	93	2
30.6.98	155	73	?	2.7.98	260	110	2
30.6.98	140	72	?	4.7.98	330	145	?
1.7.98	380	182	2	6.7.98	350	155	?
1.7.98	325	188	2	6.7.98	370	214	1
1.7.98	300	156	?	7.7.98	225	165	2
1.7.98	90	35	2	7.7.98	425	228	2
1.7.98	60	32	2	7.7.98	420	214	2
1.7.98	425	188	2	10.7.98	372	242	1
1.7.98	430	172	2	13.7.98	430	231	2
1.7.98	260	84	?	13.7.98	319	191	?
1.7.98	62	26	2	13.7.98	360	204	?
1.7.98	215	95	?	13.7.98	300	167	2
1.7.98	345	169	?	13.7.98	370	167	2

Table A3.3b Arctic skua: chicks weighed and measured twice

Date 1	*Weight (g)*	*Wing (mm)*	*Brood size*	*Date 2*	*Weight (g)*	*Wing (mm)*
24.6.98	65	33	1	2.7.98	247	105
29.6.98	250	149	1	3.7.98	325	185
1.7.98	260	134	?	7.7.98	350	195
1.7.98	190	85	2	9.7.98	305	168
1.7.98	295	155	2	9.7.98	333	219
3.7.98	375	161	1	7.7.98	350	193

Table A3.3c Arctic skua: chicks weighed and measured three times

Date 1	*Weight*	*Wing*	*Brood size*	*Date 2*	*Weight*	*Wing*	*Date 3*	*Weight*	*Wing*
28.6.98	250	112	1	3.7.98	367	179	7.7.98	403	211
21.6.98	100	48	2	9.7.98	310	146	9.7.98	355	217

Weights are grams and wing lengths are millimetres.

Table A3.4a Great skua: chicks weighed and measured once

Date	*Weight (g)*	*Wing (mm)*	*Brood size*	*Date*	*Weight (g)*	*Wing (mm)*	*Brood size*
30.6.98	340	55	2	12.7.98	750	164	2
30.6.98	310	48	2	13.7.98	245	44	2
1.7.98	290	50	2	13.7.98	650	126	2
1.7.98	575	80	2	13.7.98	170	32	?
1.7.98	465	65	2	13.7.98	700	150	?
1.7.98	255	49	?	13.7.98	520	84	?
1.7.98	245	36	?	13.7.98	540	86	?
1.7.98	270	39	2	13.7.98	750	127	2
1.7.98	320	43	2	21.7.98	1,020	237	2
2.7.98	280	39	2	21.7.98	1,025	240	2
2.7.98	325	50	2	21.7.98	470	90	1
2.7.98	240	36	2	21.7.98	490	119	2
2.7.98	430	58	2	21.7.98	650	119	2
2.7.98	570	81	1	21.7.98	900	185	1
3.7.98	420	55	1	22.7.98	610	109	1
3.7.98	450	68	2	22.7.98	870	200	1
3.7.98	490	70	2	22.7.98	780	219	2
3.7.98	430	80	?	22.7.98	920	228	2
3.7.98	340	52	?	22.7.98	410	121	1
3.7.98	240	38	2	22.7.98	330	45	2
3.7.98	260	40	2	22.7.98	370	73	2
3.7.98	190	33	2	22.7.98	920	213	2
3.7.98	165	35	2	22.7.98	820	234	2
3.7.98	490	70	1	22.7.98	825	230	2
3.7.98	350	48	1	22.7.98	740	167	2
3.7.98	360	50	2	22.7.98	660	163	2
3.7.98	370	72	2	22.7.98	650	138	2
3.7.98	460	57	1	22.7.98	775	158	1
3.7.98	290	45	1	24.7.98	830	232	2
3.7.98	460	57	1	24.7.98	1,180	256	?
4.7.98	460	72	?	24.7.98	1,020	265	?
4.7.98	320	48	1	24.7.98	730	168	?
4.7.98	330	55	?	24.7.98	230	38	?
4.7.98	1,020	156	1	24.7.98	720	171	?
4.7.98	480	70	2	29.7.98	1,250	290	?
4.7.98	335	61	2	29.7.98	1,210	302	?
4.7.98	635	99	1	29.7.98	1,210	296	?
7.7.98	400	59	?	30.7.98	710	193	?

Table A3.4a (cont.) Great skua: chicks weighed and measured once

7.7.98	465	88	?	30.7.98	830	230	?
7.7.98	530	109	1	30.7.98	1,290	258	?
7.7.98	700	123	2	30.7.98	870	194	?
12.7.98	750	135	2	31.7.98	1070	313	?

Table A3.4b Great skua: chicks weighed and measured twice

Date 1	*Weight (g)*	*Wing (mm)*	*Brood Size*	*Date 2*	*Weight (g)*	*Wing (mm)*
1.7.98	555	88	?	22.7.98	1170	265
1.7.98	315	58	2	12.7.98	770	140
1.7.98	210	34	2	22.7.98	550	128
1.7.98	180	34	2	22.7.98	590	149
2.7.98	300	47	?	9.7.98	630	100
2.7.98	650	112	1	9.7.98	970	174
2.7.98	505	78	1	23.7.98	1360	283
2.7.98	240	31	2	23.7.98	820	202
3.7.98	290	44	2	22.7.98	870	193
3.7.98	390	56	2	22.7.98	930	227
3.7.98	230	42	1	5.7.98	280	42
3.7.98	870	152	1	13.7.98	1020	240
4.7.98	320	48	1	23.7.98	900	220
4.7.98	590	120	2	23.7.98	1190	283
4.7.98	750	195	2	23.7.98	1460	280
4.7.98	300	44	2	12.7.98	500	101
4.7.98	460	51	2	12.7.98	700	123
4.7.98	340	50	2	12.7.98	660	112
4.7.98	710	134	2	7.7.98	800	163
4.7.98	425	58	2	21.7.98	790	196
4.7.98	730	106	2	13.7.98	1150	193
4.7.98	630	81	2	13.7.98	1000	170
12.7.98	1,030	200	2	23.7.98	840	201
13.7.98	730	134	2	21.7.98	680	194
13.7.98	520	82	2	23.7.98	710	165

Table A3.5 Herring gull: chicks weighed and measured once

Date	*Weight (g)*	*Wing (mm)*	*Date*	*Weight (g)*	*Wing (mm)*
20.06	173	39	24.06	310	62
20.06	310	44	24.06	250	45
20.06	415	71	24.06	220	39
20.06	253	47	24.06	100	30
20.06	570	105	25.06	140	39
20.06	720	146	25.06	210	38
20.06	520	105	25.06	110	30
20.06	205	36	25.06	210	44
20.06	130	33	25.06	200	42
20.06	235	42	25.06	150	49
20.06	183	37	25.06	490	111
20.06	175	40	25.06	160	37
20.06	420	80	25.06	520	115
20.06	225	37	25.06	295	50
20.06	338	56	25.06	140	50
20.06	160	33	24.07	880	265
20.06	160	37	24.07	700	232
20.06	160	36	24.07	1,020	320
24.06	220	38			

Table A3.6 Lesser black-backed gull: chicks weighed and measured once

Date	*Weight (g)*	*Wing (mm)*	*Date*	*Weight (g)*	*Wing (mm)*
24.06	135	43	24.06	120	30
24.06	90	30	24.06	120	39
24.06	230	48	24.06	110	32
24.06	115	34	24.06	80	31
24.06	190	44	24.06	100	33
24.06	150	40	24.06	140	35
24.06	180	44	24.06	100	33
24.06	185	45	24.06	290	62
24.06	100	31	01.07	85	27
24.06	250	59	01.07	75	25
24.06	120	30	24.07	250	168

Table A3.7a Kittiwake: chicks weighed and measured once

Date	*Weight (g)*	*Wing (mm)*	*Brood size*	*Date*	*Weight (g)*	*Wing (mm)*	*Brood size*
30.6.98	160	60	1	1.7.98	150	65	2
30.6.98	220	83	3	1.7.98	240	103	2
30.6.98	225	80	2	1.7.98	130	72	2
30.6.98	245	84	2	1.7.98	220	95	2
30.6.98	180	66	2	1.7.98	190	68	1
30.6.98	95	35	1	1.7.98	100	38	2
30.6.98	185	60	1	1.7.98	170	66	2
30.6.98	220	95	1	1.7.98	100	29	1
30.6.98	180	50	1	1.7.98	280	139	2
30.6.98	240	100	2	1.7.98	230	113	2
30.6.98	225	90	2	2.7.98	270	131	2
30.6.98	60	32	2	2.7.98	202	115	2
30.6.98	100	40	2	2.7.98	280	143	2
30.6.98	220	75	2	2.7.98	280	149	2
30.6.98	180	65	2	2.7.98	170	55	1
30.6.98	170	57	1	3.7.98	260	110	1
30.6.98	280	118	2	3.7.98	190	103	1
30.6.98	300	125	2	3.7.98	125	87	3
30.6.98	165	62	1	3.7.98	180	92	3
30.6.98	135	40	1	5.7.98	295	155	1
30.6.98	310	120	2	5.7.98	275	136	1
30.6.98	290	115	2	5.7.98	225	130	1
30.6.98	160	49	2	5.7.98	170	89	1
30.6.98	140	44	2	5.7.98	235	104	1
1.7.98	240	105	2	5.7.98	320	167	2
1.7.98	190	101	2	5.7.98	220	144	2
1.7.98	180	56	1	5.7.98	180	91	1
1.7.98	210	106	1	5.7.98	100	36	1
1.7.98	280	141	1	5.7.98	200	115	1
1.7.98	340	150	1	5.7.98	340	340	2
1.7.98	200	102	2	5.7.98	200	200	2
1.7.98	270	118	2	5.7.98	190	98	1
1.7.98	290	161	2	6.7.98	190	89	1
1.7.98	220	128	2	6.7.98	220	150	1
1.7.98	200	77	1	6.7.98	260	170	1
1.7.98	100	48	2	6.7.98	345	172	2
1.7.98	170	73	2	6.7.98	195	120	2

Table A3.7b Kittiwake: chicks weighed and measured twice

Date 1	*Weight (g)*	*Wing (mm)*	*Date 2*	*Weight (g)*	*Wing (mm)*	*Brood size*
30.6.98	225	87	6.7.98	190	131	1
30.6.98	250	90	6.7.98	285	150	1
30.6.98	215	83	6.7.98	155	108	3
30.6.98	295	101	6.7.98	300	161	3
30.6.98	255	106	6.7.98	270	123	2
30.6.98	245	95	6.7.98	270	150	2
30.6.98	215	70	6.7.98	240	115	2
30.6.98	215	83	6.7.98	215	118	1
30.6.98	300	116	6.7.98	255	162	1
30.6.98	280	106	6.7.98	280	167	1
30.6.98	260	95	6.7.98	220	152	2
30.6.98	210	78	6.7.98	170	107	2
30.6.98	195	73	6.7.98	235	126	2

Table A3.8a Arctic tern: chicks weighed and measured once

Date	*Wing (mm)*	*Weight (g)*	*Date*	*Wing (mm)*	*Weight (g)*
30.06	105	109	30.06	50	43
30.06	108	107	30.06	59	44
30.06	40	58	01.07	40	54
30.06	46	46	01.07	12	17
30.06	24	29	01.07	25	35
30.06	31	50	01.07	17	25
30.06	30	41	01.07	10	19
30.06	23	28	01.07	15	18
30.06	20	21	01.07	70	86
30.06	45	61	01.07	15	18
30.06	41	45	01.07	85	87
30.06	15	19	01.07	85	112
30.06	20	20	01.07	85	134
30.06	58	43	01.07	60	78
30.06	25	23			

Table A3.9a Guillemot: chicks weighed and measured once

Date	*Weight (g)*	*Wing (mm)*	*Date*	*Weight (g)*	*Wing (mm)*
18.6.98	118	27	23.6.98	235	64
18.6.98	176	33	23.6.98	240	53
18.6.98	80	27	23.6.98	240	51
18.6.98	120	33	23.6.98	200	54
18.6.98	240	49	23.6.98	160	30
18.6.98	160	35	23.6.98	260	79
18.6.98	130	33	23.6.98	140	33
18.6.98	230	51	23.6.98	230	65
18.6.98	260	63	23.6.98	220	58
18.6.98	230	49	23.6.98	230	64
18.6.98	150	33	23.6.98	60	27
18.6.98	280	65	23.6.98	140	38
18.6.98	100	27	23.6.98	230	64
18.6.98	100	29	23.6.98	160	39
18.6.98	115	28	23.6.98	180	37
18.6.98	120	29	23.6.98	220	47
18.6.98	140	32	23.6.98	100	27
18.6.98	240	40	23.6.98	160	36
18.6.98	95	27	23.6.98	230	60
21.6.98	150	31	23.6.98	160	32
21.6.98	130	32	23.6.98	160	37
21.6.98	120	27	23.6.98	130	33
21.6.98	120	32	23.6.98	180	55
21.6.98	180	35	23.6.98	170	43
21.6.98	150	35	23.6.98	160	42
21.6.98	195	38	23.6.98	150	40
22.6.98	185	39	23.6.98	70	33
22.6.98	195	46	24.6.98	150	47
22.6.98	235	47	24.6.98	230	45
22.6.98	176	39	24.6.98	200	44
23.6.98	280	66	24.6.98	165	44
23.6.98	255	62	24.6.98	185	43
23.6.98	95	29	24.6.98	175	35
23.6.98	190	39	24.6.98	165	38
23.6.98	270	63	24.6.98	105	33
23.6.98	210	42	24.6.98	190	43
23.6.98	180	44	24.6.98	220	55
23.6.98	120	36	24.6.98	225	62
23.6.98	150	38	24.6.98	220	51
23.6.98	230	69	24.6.98	225	70
23.6.98	150	42	24.6.98	115	29
23.6.98	180	56	24.6.98	215	43
23.6.98	190	53	24.6.98	210	56
23.6.98	210	69	24.6.98	160	42
23.6.98	160	48	24.6.98	215	46
23.6.98	160	40	24.6.98	60	25
23.6.98	240	59	24.6.98	220	48
23.6.98	210	49	24.6.98	165	37

Table A3.9a (cont.) Guillemot: chicks weighed and measured once

23.6.98	240	63	24.6.98	185	41
23.6.98	250	66	24.6.98	185	35
23.6.98	245	62	24.6.98	225	39
23.6.98	160	42	24.6.98	250	68
23.6.98	180	39	24.6.98	245	72
23.6.98	240	58	24.6.98	165	43
23.6.98	180	34	24.6.98	175	39
23.6.98	240	58			

Table A3.9b Guillemot: chicks weighed and measured twice

Date 1	*Weight (g)*	*Wing (mm)*	*Date 2*	*Weight (g)*	*Wing (mm)*
18.6.98	123	29	22.6.98	195	34
18.6.98	86	25	22.6.98	145	31

Table A3.10a Razorbill: chicks weighed and measured once

Date	*Weight (g)*	*Wing (mm)*	*Date*	*Weight (g)*	*Wing (mm)*
18.6.98	129	34	22.6.98	160	53
18.6.98	75	27	22.6.98	110	30
18.6.98	90	30	22.6.98	100	30
18.6.98	150	42	22.6.98	100	40
18.6.98	165	55	22.6.98	155	48
18.6.98	190	72	22.6.98	150	49
18.6.98	170	45	22.6.98	105	39
18.6.98	110	35	22.6.98	205	62
18.6.98	160	48	22.6.98	155	51
18.6.98	160	56	22.6.98	205	73
18.6.98	215	75	22.6.98	115	45
18.6.98	120	39	22.6.98	165	38
18.6.98	160	59	22.6.98	178	48
18.6.98	125	34	22.6.98	177	45
18.6.98	140	43	22.6.98	125	40
18.6.98	160	54	22.6.98	165	51
18.6.98	125	38	22.6.98	135	38
18.6.98	105	37	22.6.98	125	42
18.6.98	100	34	22.6.98	115	31
18.6.98	100	35	22.6.98	164	55
18.6.98	190	62	22.6.98	175	55
18.6.98	150	53	22.6.98	100	45
18.6.98	150	55	22.6.98	200	58
18.6.98	100	30	22.6.98	150	60
18.6.98	80	36	22.6.98	180	72

Table A3.10a (cont.) Razorbill: chicks weighed and measured once

18.6.98	70	29	22.6.98	140	45
18.6.98	80	32	22.6.98	185	52
18.6.98	120	43	22.6.98	105	38
18.6.98	120	41	22.6.98	115	36
18.6.98	160	41	22.6.98	125	38
18.6.98	120	38	22.6.98	175	59
18.6.98	140	42	22.6.98	105	38
18.6.98	90	28	22.6.98	200	65
21.6.98	150	49	22.6.98	195	65
21.6.98	60	26	22.6.98	220	70
21.6.98	150	41	22.6.98	210	74
21.6.98	130	45	22.6.98	190	74
21.6.98	140	43	22.6.98	195	58
21.6.98	150	49	22.6.98	190	68
21.6.98	200	61	22.6.98	180	50
21.6.98	157	40	22.6.98	205	71
21.6.98	67	25	22.6.98	170	55
21.6.98	180	47	22.6.98	205	86
21.6.98	160	46	22.6.98	150	43
21.6.98	60	26	22.6.98	140	50
21.6.98	60	26	22.6.98	170	35
21.6.98	80	27	28.6.98	205	66
21.6.98	150	41	28.6.98	187	62
21.6.98	125	36	28.6.98	198	58
22.6.98	140	38	28.6.98	220	77
22.6.98	190	70	28.6.98	220	81
22.6.98	60	25	28.6.98	188	54
22.6.98	105	31	28.6.98	180	61
22.6.98	100	33	28.6.98	225	58
22.6.98	145	52	28.6.98	215	75
22.6.98	115	43	28.6.98	178	61

Table A3.10b Razorbill: chicks weighed and measured twice

Date 1	*Weight (g)*	*Wing (mm)*	*Date 2*	*Weight (g)*	*Wing (mm)*
18.6.98	130	41	28.6.98	216	81
18.6.98	95	32	22.6.98	167	48
18.6.98	105	37	22.6.98	220	75
18.6.98	70	29	22.6.98	165	51
22.6.98	110	34	28.6.98	205	57
22.6.98	186	54	28.6.98	190	72
22.6.98	135	43	28.6.98	203	66
22.6.98	195	62	28.6.98	200	77
22.6.98	145	49	28.6.98	202	70
22.6.98	163	45	28.6.98	225	70
22.6.98	89	34	28.6.98	163	55
22.6.98	146	45	28.6.98	180	67
22.6.98	127	38	28.6.98	185	60
22.6.98	115	39	28.6.98	178	59

Table A3.10c Razorbill: chicks weighed and measured three times

Date 1	*Weight*	*Wing*	*Date 2*	*Weight*	*Wing*	*Date 3*	*Weight*	*Wing*
18.6.98	170	54	22.6.98	215	74	28.6.98	217	84
18.6.98	100	33	22.6.98	167	51	28.6.98	220	79
18.6.98	120	42	22.6.98	165	61	28.6.98	170	79
18.6.98	130	35	22.6.98	187	50	28.6.98	219	75
18.6.98	100	43	22.6.98	127	56	28.6.98	160	72
18.6.98	110	36	22.6.98	166	49	28.6.98	223	75
18.6.98	100	35	22.6.98	166	53	28.6.98	201	75
18.6.98	105	34	22.6.98	185	57	28.6.98	201	76
18.6.98	105	36	22.6.98	166	55	28.6.98	220	77
18.6.98	105	39	22.6.98	186	58	28.6.98	200	78

Weights are grams and wing lengths are millimetres.

Table A3.11a Black guillemot: chicks measured once

Date	*Weight (g)*	*Wing (mm)*	*Brood size*
23.07	380	125	1
30.07	270	79	1
30.07	330	101	1

Table A3.11b Black guillemot: chicks measured twice

Date 1	*Weight (g)*	*Wing (mm)*	*Date 2*	*Weight (g)*	*Wing (mm)*	*Brood Size*
15.07	218	57	30.07	400	121	2
15.07	194	47	30.07	365	108	2
20.07	50	25	24.08	375	132	2
20.07	50	24	24.08	390	144	2

Table A3.12a Puffin: chicks weighed and measured once

Date	*Weight (g)*	*Wing (mm)*	*Date*	*Weight (g)*	*Wing (mm)*
21.6.98	170	60	5.7.98	45	14
25.6.98	180	57	5.7.98	65	125
26.6.98	145	50	6.7.98	110	39
29.6.98	280	98	6.7.98	173	65
29.6.98	140	44	6.7.98	217	78
29.6.98	110	30	6.7.98	210	80
29.6.98	150	50	6.7.98	162	69
2.7.98	160	78	6.7.98	75	25
2.7.98	242	87	6.7.98	90	27
2.7.98	65	29	15.7.98	200	108
2.7.98	97	43	15.7.98	230	117
2.7.98	106	44	15.7.98	240	122
2.7.98	138	103	15.7.98	220	100
2.7.98	275	101	15.7.98	205	101
2.7.98	215	76	15.7.98	95	43
2.7.98	235	101	15.7.98	265	130
2.7.98	123	42	15.7.98	170	95
2.7.98	200	88	15.7.98	112	55
2.7.98	200	79	15.7.98	85	41
2.7.98	95	44	15.7.98	115	34
2.7.98	130	60	15.7.98	220	124
2.7.98	170	79	15.7.98	195	104
2.7.98	90	45	15.7.98	110	46
2.7.98	110	44	15.7.98	360	130
2.7.98	70	20	15.7.98	240	115
3.7.98	195	74	15.7.98	110	42
5.7.98	235	102			

Table A3.12b Puffin: chicks weighed and measured twice

Date 1	*Weight (g)*	*Wing (mm)*	*Date 2*	*Weight (g)*	*Wing (mm)*
20.6.98	120	34	2.7.98	210	84
25.6.98	170	65	15.7.98	260	123
25.6.98	190	58	15.7.98	170	93
2.7.98	282	114	15.7.98	180	138
2.7.98	97	43	15.7.98	110	72
2.7.98	113	46	15.7.98	165	93
2.7.98	95	47	15.7.98	163	80
2.7.98	222	90	15.7.98	230	125
2.7.98	105	37	15.7.98	150	67
2.7.98	168	73	15.7.98	240	120
2.7.98	119	47	15.7.98	170	77
2.7.98	182	77	15.7.98	210	109
2.7.98	235	80	15.7.98	254	117
2.7.98	241	106	15.7.98	250	136
2.7.98	195	85	15.7.98	185	119
2.7.98	100	48	15.7.98	95	61
2.7.98	280	97	15.7.98	305	133
2.7.98	200	86	15.7.98	247	125

Table A3.12c Puffin: chicks weighed and measured three times

Date 1	*Weight*	*Wing*	*Date 2*	*Weight*	*Wing*	*Date 3*	*Weight*	*Wing*
20.6.98	160	38	2.7.98	195	82	15.7.98	230	120
20.6.98	105	31	2.7.98	180	79	15.7.98	195	117
20.6.98	82	30	2.7.98	155	72	15.7.98	175	114
20.6.98	78	27	2.7.98	120	60	15.7.98	140	83
20.6.98	125	35	2.7.98	200	87	15.7.98	250	119
25.6.98	160	59	2.7.98	210	90	15.7.98	300	125
25.6.98	130	58	2.7.98	227	85	15.7.98	295	124
25.6.98	170	58	2.7.98	210	87	15.7.98	265	123

Weights are grams and wing lengths are millimetres.

Appendix 4 Weights and wing lengths of adults in 1998

Table A4.1 Fulmar adult weights and wing lengths

Date	*Weight (g)*	*Wing (mm)*	*Date*	*Weight (g)*	*Wing (mm)*
02.04	865	328	15.07	710	326
27.04	595	330	15.07	730	341
16.05	710	320	15.07	810	336
13.07	760	325	16.07	710	335
15.07	710	330	16.07	820	355
15.07	730	319	16.07	720	350
15.07	850	332	16.07	660	319
15.07	870	322	16.07	560	310
15.07	860	332	16.07	900	359
15.07	610	325	16.07	720	330
15.07	800	327	27.07	950	315
15.07	620	324			

Table A4.2 Shag adult weights and wing lengths

Date	*Weight (g)*	*Wing (mm)*	*Sex*	*Date*	*Weight (g)*	*Wing (mm)*	*Sex*
22.6.98	1,650	255		26.6.98	2,050	266	F
22.6.98	?	275	F	26.6.98	1,770	272	F
22.6.98	1,625	257	F	26.6.98	1,600	274	F
22.6.98	1,875	275	M	26.6.98	1,900	277	M
22.6.98	1,950	276	M	26.6.98	1,850	275	M
22.6.98	1,900	255		26.6.98	1,900	269	M
22.6.98	1,900	273		26.6.98	2,050	277	M
22.6.98	1,900	271		26.6.98	1,850	271	M
22.6.98	1,825	264	M	28.6.98	1,900	265	
22.6.98	2,075	278	M	28.6.98	1,800	261	
22.6.98	1,752	262		28.6.98	1,850	271	
22.6.98	1,650	259	F	29.6.98	2,000	272	F
22.6.98	1,765	251	F	29.6.98	1,800	265	F
23.6.98	1,800	265	F	29.6.98	1,660	269	F
23.6.98	2,035	274		2.7.98	1,520	262	F
23.6.98	1,875	274	M	8.7.98	2,050	263	
23.6.98	2,050	271	M	8.7.98	1,940	267	F
23.6.98	1,825	265	M	8.7.98	1,980	265	F
23.6.98	1,775	260		8.7.98	1,950	269	F
24.6.98	2,125	275		8.7.98	1,750	265	F
24.6.98	1,625	264	F	15.7.98	1,610	257	F

Table A4.3 Kittiwake adult weights and wing lengths

Date	*Weight (g)*	*Wing (mm)*	*Date*	*Weight (g)*	*Wing (mm)*
18.6.98	380	315	2.7.98	330	306
18.6.98	370	289	2.7.98	280	302
18.6.98	380	310	2.7.98	350	312
18.6.98	340	304	3.7.98	354	305
18.6.98	360	?	3.7.98	320	300
18.6.98	400	307	3.7.98	280	295
18.6.98	400	313	3.7.98	320	316
18.6.98	330	?	3.7.98	320	257
30.6.98	330	301	5.7.98	310	303
30.6.98	350	315	5.7.98	370	308
30.6.98	355	300	5.7.98	320	315
30.6.98	380	312	5.7.98	295	304
30.6.98	365	305	5.7.98	350	315
30.6.98	325	311	5.7.98	300	301
30.6.98	365	312	6.7.98	355	302
30.6.98	320	307	6.7.98	365	320
30.6.98	280	302	6.7.98	345	290
30.6.98	350	312	6.7.98	400	310
30.6.98	365	312	6.7.98	360	295
30.6.98	320	307	6.7.98	305	305

Table A4.4 Arctic tern adult weights and wing lengths

Date	*Weight (g)*	*Wing (mm)*	*Date*	*Weight (g)*	*Wing (mm)*
19.6.98	95	276	19.6.98	135	279
19.6.98	110	272	19.6.98	110	268
19.6.98	85	282	19.6.98	90	263
19.6.98	106	264	20.6.98	110	286
19.6.98	116	292	20.6.98	107	270
19.6.98	115	286	20.6.98	95	268
19.6.98	106	287	20.6.98	101	278
19.6.98	105	285	20.6.98	95	272
19.6.98	105	267	20.6.98	108	272
19.6.98	95	269	20.6.98	110	278
19.6.98	110	284	20.6.98	115	289
19.6.98	108	279	20.6.98	95	270
19.6.98	108	273	20.6.98	125	276
19.6.98	100	272	20.6.98	110	274
19.6.98	110	271	20.6.98	105	268
19.6.98	115	292	20.6.98	112	272
19.6.98	105	276	20.6.98	105	280
19.6.98	105	265	20.6.98	110	282
19.6.98	100	266	20.6.98	105	264
19.6.98	110	288	20.6.98	100	269
19.6.98	115	280	01.7.98	90	269
19.6.98	105	274	20.6.98	95	274
19.6.98	100	275	20.6.98	110	293
19.6.98	105	273	20.6.98	109	269

Table A4.5 Guillemot adult weights and wing lengths

Date	*Weight (g)*	*Wing (mm)*	*Date*	*Weight (g)*	*Wing (mm)*
21.6.98	935	205	23.6.98	1,020	205
21.6.98	1,000	207	23.6.98	970	213
21.6.98	965	206	23.6.98	900	195
21.6.98	935	204	23.6.98	860	196
21.6.98	895	198	23.6.98	1,070	206
22.6.98	1,200	212	26.6.98	900	203
22.6.98	945	196	26.6.98	780	203
22.6.98	985	210	26.6.98	950	200
23.6.98	940	207	26.6.98	950	207
23.6.98	930	217	26.6.98	890	203
23.6.98	955	196	26.6.98	888	206
23.6.98	950	206	26.6.98	970	203
23.6.98	990	210	26.6.98	790	190
23.6.98	1,020	210	26.6.98	930	212
23.6.98	1,000	206	26.6.98	940	207
23.6.98	1,020	211	26.6.98	900	207
23.6.98	985	204	26.6.98	890	208
23.6.98	1,045	208	26.6.98	880	205
23.6.98	965	211	26.6.98	910	198
23.6.98	1,130	204	26.6.98	880	213
23.6.98	900	205	26.6.98	910	209
23.6.98	880	210			

Table A4.6 Razorbill adult weights and wing lengths

Date	*Weight (g)*	*Wing (mm)*	*Date*	*Weight (g)*	*Wing (mm)*
21.6.98	665	201	21.6.98	695	199
21.6.98	695	198	21.6.98	605	194
21.6.98	665	200	21.6.98	640	185
21.6.98	575	199	21.6.98	600	198
21.6.98	650	202	21.6.98	610	197
21.6.98	670	198	22.6.98	665	192
21.6.98	590	199	22.6.98	675	192
21.6.98	650	190	22.6.98	660	199
21.6.98	700	190	22.6.98	665	198
21.6.98	580	190	22.6.98	665	192
21.6.98	640	200	22.6.98	595	188
21.6.98	680	198	22.6.98	640	196
21.6.98	580	194	22.6.98	615	195
21.6.98	620	192	22.6.98	605	198
21.6.98	580	198	22.6.98	635	197
21.6.98	600	199	22.6.98	665	202
21.6.98	600	190	22.6.98	605	195
21.6.98	730	198	22.6.98	705	196
21.6.98	630	194	22.6.98	655	195
21.6.98	740	196	22.6.98	735	192

Table A4.6 (cont.) Razorbill adult weights and wing lengths

21.6.98	705	202	22.6.98	515	208
21.6.98	615	200	22.6.98	610	195
21.6.98	690	192	22.6.98	730	205
21.6.98	590	202	22.6.98	700	201
21.6.98	560	190	22.6.98	630	198
21.6.98	615	199	22.6.98	580	197
21.6.98	615	199	23.6.98	665	200
21.6.98	685	204	23.6.98	660	204

Table A4.7 Puffin adult weights and wing lengths

Date	*Weight (g)*	*Wing (mm)*	*Date*	*Weight (g)*	*Wing (mm)*
25.6.98	410	165	11.7.98	430	163
25.6.98	425	160	12.7.98	385	158
25.6.98	470	164	12.7.98	420	163
25.6.98	405	159	12.7.98	430	162
25.6.98	395	151	12.7.98	405	157
2.7.98	380	161	12.7.98	400	159
4.7.98	425	161	12.7.98	380	161
4.7.98	408	160	12.7.98	450	163
4.7.98	432	152	12.7.98	390	160
4.7.98	405	159	12.7.98	440	165
4.7.98	455	165	12.7.98	405	160
5.7.98	425	167	12.7.98	400	159
5.7.98	470	164	12.7.98	415	162
6.7.98	488	166	12.7.98	385	161
6.7.98	370	168	12.7.98	410	158
10.7.98	350	159	12.7.98	380	156
10.7.98	470	166	12.7.98	455	168
10.7.98	420	165	12.7.98	445	162
10.7.98	420	161	12.7.98	405	161
10.7.98	365	149	12.7.98	395	159
11.7.98	375	164	12.7.98	405	155
11.7.98	360	157	12.7.98	385	162
11.7.98	420	165	12.7.98	360	155
11.7.98	420	157	12.7.98	450	160
11.7.98	380	164	12.7.98	445	158
11.7.98	420	160	12.7.98	385	158
11.7.98	380	159	12.7.98	435	168
11.7.98	370	161	12.7.98	399	164
11.7.98	380	162	15.7.98	400	165
11.7.98	375	151	15.7.98	400	161
11.7.98	420	162	16.7.98	420	159
11.7.98	380	155	16.7.98	370	166
11.7.98	400	157			