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Seabird numbers and breeding success in Britain and Ireland, 1993

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Further information on patterns or trends shown in the report, or on particular regions or colonies, can also be obtained through the report compilers.

CONTENTS **Page no.**

SUMMARY

This is fifth annual report on the results of seabird monitoring at colonies throughout Britain and Ireland, produced jointly by JNCC, RSPB and SOTEAG, as part of JNCC's Seabird Monitoring Programme. Breeding success and population changes noted at seabird colonies in 1993 are presented, with comparative results for the period 1986-92. A summary of the main results is given below.

Species	*Recent population trend (based on regional samples 1986-93, unless otherwise noted; see main text for 1992-93 changes)*	*Average breeding output in 1993 (estimated number of chicks fledged per breeding pair)*
Red-throated diver	In Shetland, overall trend unclear but significant recent decline in some areas.	Moderately high (0.82 chicks/pair) in Shetland, low (0.54) in Orkney, both similar to 1992 figures.
Fulmar	Significant increases Shetland, SE Scotland, NE England, and Wales; no significant trend in three other regions.	Moderately high overall (0.44 chicks/pair at 33 colonies), < 1992; highest in Shetland (0.52), lowest in SW Britain (0.35).
Manx shearwater	Substantial decline noted on Canna (NW Scotland) between 1973 and 1993.	Below average on Canna (0.47 chicks/pair) and on Skomer (Wales) (0.21).
Storm petrel	Evidence of major decline on Skomer and Skokholm (Wales) since 1970s.	No data.
Leach's petrel	Small colony on Ramna Stacks (Shetland) stable.	No data.
Gannet	Data for smaller colonies only (Fair Isle, Troup Head, Bempton, and Great Saltee): all showed significant increases.	Moderately high (0.65 chicks/pair at six colonies), slightly < 1992.
Cormorant	Significant decrease Shetland; significant increases NE England, NE Ireland, and at inland colonies in England; no significant trend evident for seven coastal regions.	High (2.46 chicks/pair, similar to 1992) at single study-colony in N Scotland.
Shag	Significant decrease Shetland, significant increase NE England, no obvious trend in four regions.	Moderately high overall (1.35 chicks/pair at 13 colonies), slightly < 1992; highest in Shetland (1.58), lowest (0.21) on Isle of May (SE Scotland).
Arctic skua	Complete surveys in 1992 showed little net change in Orkney (+2.1% since 1982) and Shetland (-1.4% since 1985/86).	High in Shetland (*c*1.0 chicks/pair at 13 colonies), similar to 1992, but low in Orkney (0.41 at 5 colonies), < 1992.
Great skua	Complete surveys in 1992 showed a 22% increase in Orkney since 1982 and a 10% increase in Shetland since 1985/86.	Moderately high in Shetland (*c*0.8 chicks/pair at ten colonies), > 1992, but low in Orkney (0.34 at three colonies), < 1992.

Species	*Recent population trend (based on regional samples 1986-93, unless otherwise noted; see main text for 1992-93 changes)*	*Average breeding output in 1993 (estimated number of chicks fledged per breeding pair)*
Larus gulls (fuller details in report for 1994)	Notable decline in inland population in NW Ireland since 1977; continued increase by lesser black-backed gulls in several coastal regions, but herring gull numbers roughly stable, or declining, in most regions.	A notably unsuccessful year for black-headed & common gulls in western Scotland (<0.15 chicks/pair) and for lesser black-backed gulls on Skomer (Wales).
Kittiwake	Significant decreases Shetland (1981-92) and SE Ireland; no obvious trend in eight regions.	Moderate (0.63 chicks/pair at 54 colonies), significantly < 1992; lowest in NE & SE Scotland (0.22) but highest in several other N Sea regions (0.9-1.0); also low in SW Britain / SE Ireland (0.43).
Sandwich tern	Stable numbers in Britain and Ireland as a whole; significant increase SE Ireland, but no significant trend in ten regions.	Moderately high (≤0.75 chicks/pair at 20 colonies), slightly < 1992; lowest in NE England (0.0) and NE Scotland (0.08), highest in SE England (1.29).
Roseate tern	Stable or increasing in Britain and Ireland as a whole, with notable recent increase in SE Ireland, mainly on Rockabill.	High (1.49 chicks/pair at seven colonies, range 0.8-2.0), similar to 1992.
Common tern	Significant increase SE Ireland, significant decreases NW & SE England; no significant trend in seven regions, or in England and Wales as a whole	Moderately high (*c*0.75 chicks/pair at 50 colonies, similar to 1992); lowest in Scottish regions(0.45-0.57) and NW England (0.15).
Arctic tern	Significant decrease NE Ireland, significant increase Wales; trends elsewhere uncertain.	Low (*c*0.4 chicks/pair overall at 95+ colonies in Britain, < 1992 in Scotland); lowest in SE, NE & NW Scotland (0.07-0.13), highest in Wales (0.85).
Little tern	Significant decrease Britain as a whole (and SE England).	Low (0.40 chicks/pair at 54 colonies), < 1992; lowest in NE Scotland and SE Ireland (0-0.05), highest in Wales (1.04).
Guillemot	Significant increases N & NE Scotland, and Wales; no significant trend in six regions.	High (0.72 chicks/pair at 12 colonies), slightly < 1992; lowest (0.44) on Papa Westray (Orkney) but mainly high elsewhere.
Razorbill	Significant increases Wales and SE Scotland; no significant trend in six regions.	Few data: moderate to high (0.68 chicks/pair) at three colonies; lowest (0.55) on Skomer (Wales).
Black guillemot	Shetland populations generally increasing, but local decreases in 1993 caused by a major oil-spill; notable decrease on Papa Westray (Orkney) since 1983.	Few data: high on Fair Isle (1.23, > 1992), moderate to low on Papa Westray (0.5-0.8, < 1992).
Puffin	Notable increases on Coquet Island and Farne Islands (NE England); mainly stable at other major colonies counted recently.	Few data: high overall (0.70 chicks/pair at four colonies), but slightly < 1992.

1. INTRODUCTION

This is fifth annual report on the results of seabird monitoring at colonies throughout Britain and Ireland, produced jointly by JNCC, RSPB and SOTEAG, as part of JNCC's Seabird Monitoring Programme (SMP). Breeding success and population changes noted at seabird colonies in 1993 are summarised, with comparative results mainly from the period the period 1986-92.

Th Seabird Monitoring Programme is designed to help coordinate seabird monitoring on a UK-wide basis, ensuring that adequate data are collected on breeding numbers and breeding performance of seabirds. The programme helps JNCC, RSPB and partner organisations (including the statutory country agencies) to monitor aspects of the overall health of the wider marine environment around the UK and to provide sound and up-to-date advice relevant to the conservation needs of breeding seabirds. Where possible, results are collated for Britain and Ireland as a whole, along with the Isle of Man and the Channel Islands, to provide a wider context.

By producing an annual report, we aim to draw attention to notable changes in seabird numbers or success which may merit direct conservation action or further research. The information included is also intended to provide feedback to the many individuals and organisations contributing data (see below), placing results for individual colonies or regions in a wider context and, we hope, providing encouragement to observers to continue their valuable work.

Complete surveys of breeding seabirds in these islands are, at present, undertaken at 10-year to 15-year intervals (see Lloyd *et al.* 1991). However, it important to be aware of shorter-term changes which may indicate environmental or human factors affecting seabirds. Monitoring of populations can provide some of the information required, but assessment of breeding productivity is also important, as numbers of chicks reared can provide a very rapid indication of, for example, changes in food availability. Understanding any population changes that are seen, or predicting how populations are likely to change in future, also requires information on breeding success (among other parameters).

The format of the report is, in general, similar to that in previous years, and some background information on data sources and conventions is repeated below. Summary details of seabird monitoring methods were given in the 1989 report and in Appendix 1 of the 1990 report (Walsh *et al.* 1990, 1991). Details of methods may also be obtained from the report compilers, and a *Seabird monitoring handbook* is currently being prepared by JNCC, RSPB, the Institute of Terrestrial Ecology and the Seabird Group.

Except where specifically noted, the results presented refer to coastal/marine populations of seabirds, but limited reference is made to inland results for some species (notably cormorant). Collation of data for inland colonies may be more complete in future reports.

Any offers of help for future seasons, or comments on this report, would be greatly appreciated. We would be keen to receive information on breeding success or year-to-year population changes for any species. In addition to results of regular, ongoing monitoring, we would be pleased to receive unpublished or unreported data on numbers or breeding success at *any* seabird colony in Britain or Ireland, whether coastal or inland. Such data would be added to the long-term databases maintained by JNCC and RSPB, including the JNCC/Seabird Group Seabird Colony Register and the RSPB Tern Database.

Sources of information for the report

Information is collated from many sources, including: research or wardening staff of RSPB, SOTEAG and JNCC; wardening staff of Scottish Natural Heritage (SNH), English Nature (EN) and the Countryside Council for Wales (CCW); organisations including local wildlife trusts, universities, bird observatories, ringing groups, the Institute of Terrestrial Ecology, the Seabird Group, and others; and many individual fieldworkers. A full list is given under Acknowledgments (report section 3).

Seabird monitoring by JNCC focuses particularly on marine species such as fulmar, shag, kittiwake and auks, for which changes in breeding populations, success or other parameters may provide evidence of changes in the marine environment as a whole. The most detailed monitoring is undertaken at several geographically-dispersed 'key sites', largely through contracts placed with other organisations. These sites include the Isle of May (SE Scotland), Fair Isle (Shetland), Canna (NW Scotland) and Skomer (Wales). Long-term monitoring of numbers and breeding success is also undertaken on Orkney Mainland, on St Kilda (NW Scotland) and in Grampian (NE Scotland), in cooperation with SNH.

Monitoring of breeding success of cliff-breeding species is encouraged by JNCC at many other colonies, partly by contributing to fieldwork costs of volunteers through contracts with the Seabird Group. Collaboration with the Seabird Group also involves the Seabird Colony Register, a database of colony counts for Britain and Ireland, which is maintained as part of the Seabird Monitoring Programme. Many observers and organisations (including SOTEAG and RSPB) contribute to the Register annually, and the counts can in many cases be used in assessing annual population changes in particular regions.

The majority of coastal colonies in Britain and Ireland were censused for the Register in 1985-87, providing a baseline for future largescale surveys of this kind. Population changes since the previous full survey (the Seabird Group's Operation Seafarer in 1969-70) are summarised by Lloyd *et al.* 1991; a summary is given here in table 1.1, with updates based on more recent data for some tern and skua species. It is hoped that a full repeat census of coastal colonies will take place near the end of this decade.

Through their network of reserves, RSPB monitor the numbers and breeding success of a range of species throughout the UK. For cliff-breeding species, populations and breeding success are monitored using the same methods as JNCC and SOTEAG. Monitoring of terns in Britain is largely coordinated by RSPB, with collation of data from many other organisations and individuals in addition to RSPB staff. The roseate tern is the subject of a special, international study by RSPB, aimed at conserving the species in the northeast Atlantic as a whole. In the northern isles (Shetland and Orkney), monitoring of arctic terns and skuas is undertaken at many colonies. Other monitoring or survey effort is directed at species including petrels.

In Shetland, Aberdeen University, under contract to SOTEAG, carries out extensive population-monitoring of cliff-breeding species and black guillemots. For some species (fulmar, guillemot and razorbill), annual counts are carried out in sample plots; for shag, kittiwake and black guillemot, counts are made of longer stretches of coastline at intervals of two years or more. Assessment of breeding success has been carried out at many colonies since the mid 1980s. This work is funded by the Sullom Voe Association Ltd, and forms part of a wider scheme of biological monitoring in Shetland.

Data for some Irish colonies are also collated by JNCC and RSPB (in part through the latter's wardening staff), helping to place patterns or trends for British colonies in a wider context. Contacts are maintained with organisations including the Wildlife Service of the Office of Public Works, the Irish Wildbird Conservancy, and the National Trust. Counts or productivity-monitoring at some colonies are grant-aided by the Seabird Group.

Data-presentation and methods

Fuller details are given in the 1989 report, but some indications of the potential limitations of information presented in this report are given below.

Population changes: use of regional samples and annual indices

To allow a concise and standardised presentation of population data for each seabird species, individual colonies have, in most cases, not been considered in detail here (notable exceptions being gannet, Manx shearwater, petrels and some terns). Original counts used in assessing population changes are included in limited-circulation appendices held by JNCC, RSPB and SOTEAG. Population changes of seabirds are known to vary markedly between different parts of the Britain and Ireland, and monitoring effort is uneven. For most species (the

exceptions being several of the terns), it is thus not practicable to assess year-to-year changes for the population as a whole.

Instead, the coastline has been subdivided into 14 'regions', as defined in table 1.2 below. For most species, population data have been summarised region-by-region. Valid counts (see below) of whole colonies (or of sample plots within different colonies) have been summed for each year-to-year comparison. By using such regions, the aim is to draw attention to any common patterns shown by a number of regions, as well as to highlight any notable changes shown by colonies in particular regions.

Not all monitored colonies are counted annually, and population comparisons between years are thus often based on different combinations of colonies. Recent population trends (1986-93) have been estimated using a system of population indices, with 1986-87 average counts set as an arbitrary 100. Most colonies counted in 1993 were also counted in one or both of those years, when most of the coverage for the Seabird Colony Register was achieved. (See 1989 report for fuller details of index calculations, and table 1.1 for summaries of net population changes between 1969 and *c*1986.) The statistical significance of each population trend is tested by linear regression of the logarithms of index values against year; significant trends are those where the slope of the line fitted to the index values differs significantly from zero.

Regional population changes are also tabulated for 1992-93. Note that changes between these years will not necessarily match changes shown by population indices, as not all colonies included in 1993 index values may have been counted in 1992. In general, index values for the current year are calculated by comparison with the year providing the most complete recent set of counts for comparison. (The exceptions are terns, for which a stricter 'chain method' of calculating indices has been used, based only on colonies counted in consecutive years; a high proportion of colonies of these species is counted annually.) Some short-term fluctuations shown by the annual indices may reflect the use of data for different colonies in different years, and may thus be of little significance. Counts of some seabird populations can also show natural, temporary, fluctuations in numbers attempting to breed. With longer runs of data, however, such methodological or temporary effects should have relatively little influence on apparent trends.

Accuracy and representativeness of seabird counts

In comprehensive assessments of long-term changes in seabird numbers, for example between 1969-70 and 1985-87 (Lloyd *et al.* 1991), there is inevitably some loss of count accuracy at the expense of obtaining complete coverage. For this report, stricter criteria have been used to select counts for assessment of short-term changes. These criteria vary between species, and cover such factors as census unit ('pairs' or adult individuals) and the timing, frequency and apparent accuracy of counts. For most species, single, well-timed counts of apparently occupied nests are sufficient. The possibility of undetected variations in count accuracy, timing of season or completeness of counts should be borne in mind, however. For the most 'difficult' species, guillemot and razorbill, 5-10 counts of adults attending colonies in June each year are needed in order to minimise the effect of day-to-day variations in numbers. (Repeat counts of apparently occupied fulmar sites are also recommended.)

Where replication of counts, under a restricted range of counting conditions, is necessary, it is rarely possible to count the whole of a large colony. Counts of sample plots within a colony are usually needed. but these plots will not necessarily be representative of the colony as a whole. Random selection of plots is therefore recommended, although this is not always achieved. Even this does not allow for colony expansion, or inability to sample from the whole colony (some sections may be difficult or impossible to count accurately from land).

As mentioned above, the seabird colonies regularly monitored may not be representative of British or Irish populations as a whole. Representativeness within particular regions is more likely to be achieved, but cannot be assumed (especially if few colonies or small population samples are monitored). In particular, if monitoring efforts are directed at individual colonies, the formation of new colonies elsewhere may be missed. Coverage of extensive stretches of coastline is a more satisfactory approach for species not requiring replicate counts. This approach is used, for example, in SOTEAG's monitoring of shags, kittiwakes and black guillemots in Shetland.

Breeding success: use of 'low-input' methods

For general monitoring purposes, the number of chicks fledged per breeding (or nest-occupying) pair is the most useful parameter. This is less time-consuming to assess than, for example, clutch-size, hatching success, or fledging success of hatched

chicks, although will reflect all of these (to varying degrees). Productivity of species other than terns is usually assessed for sample plots (ideally *c*50 'pairs' each) within colonies. For such species, figures presented here have generally been averaged (rather than combined) between plots. Random selection of plots improves the likelihood of achieving representativeness within a colony. For terns, whole-colony assessments of productivity are usually made. Note that for some species or regions, few colonies are monitored as yet, so that results may not be geographically representative.

In most cases, the 'low-input' methods used will overestimate the productivity of breeding pairs slightly. The methods used for fulmar, shag, kittiwake, guillemot and puffin were developed for the Seabird Monitoring Programme by Harris (1989), and can be applied to similar species. Field tests of these methods suggest that the degree of overestimation is generally up to 10 or 20%, depending on the frequency of monitoring visits during the season. This is considered acceptable, as major geographical or year-to-year changes will still be obvious. Where methods are known to have differed greatly between years this is noted for the relevant colony.

Table 1.1 **Counts or estimates of total breeding populations of seabirds in Britain and Ireland in 1985-87 (mainly) (Seabird Colony Register).** Units are 'pairs' for most species (apparently occupied nest-sites or, for skuas, territories), with the exception of auks (individual birds). See Lloyd *et al.* 1991 (from which most counts are taken) for further details; figures for skuas, and roseate and arctic tern include recent updates

	Coastal population		% change[c]	Total population[d]	
	Britain[a]	Britain & Ireland[b]	1969-87 B & I coast	Britain[a]	Britain & Ireland[b]
Fulmar	537 000	571 000	+85%	537 000	571 000
Manx shearwater[e]	250 000+	*c*275 000	?	250 000+	*c*275 000
Storm petrel	41+ cols	72+ colonies	?	41+ cols.	72+ cols.
Leach's petrel	7+ colonies	8+ colonies	?	7+ cols.	8+ cols.
Gannet	158 700	187 900	+36%	158 700	187 900
Cormorant	6 000	10 400	+30%	6 800	11 700
Shag	36 400	47 300	+40%	36 400	47 300
Arctic skua[f]	3 200	3 200	≤ +220%	3 200	3 200
Great skua[f]	8 500	8 500	≤ +150%	8 500	8 500
Black-headed gull	77 300	84 200	+13%	167 000	233 000
Common gull	14 800	15 700	+21%	67 800	71 400
Lesser black-backed gull	62 300	65 700	+31%	82 300	88 700
Herring gull	135 000	191 000	-43%	150 000	206 000
Great black-backed gull	18 300	23 300	+3%	18 400	23 400
Kittiwake	492 000	544 000	+22%	492 000	544 000
Sandwich tern	14 000	18 400	+53%	14 000	18 600
Roseate tern[g]	75-80	580-590	-80%	75-80	580-590
Common tern	11 800	14 700	-1%	12 700	16 000
Arctic tern[h]	42 400	44 900	-14%	42 900	45 500
Little tern	2 400	2 800	+40%	2 400	2 800
Guillemot	1 047 000i	1 203 001i	+118%	1 047 000i	1 203 001i
Razorbill	147 000i	182 000i	probably +	147 000i	182 000i
Black guillemot	37 500i	40 500i	probably +	37 500i	40 500i
Puffin[i]	898 000i	940 000i	slightly +?	898 000i	940 000i

Notes:

[a] Figures for Britain exclude Isle of Man and Channel Isds (included under Britain & Ireland).

[b] Irish figures include some estimates (mainly for fulmar, shag and gulls) for coastal sections which had not been surveyed by 1988.

[c] Net change based on comparison with total recorded during the 1969-70 'Operation Seafarer' survey (re-analysis of counts summarised by Cramp *et al.* 1974); differences in count methods prevent direct comparison for some species.

[d] British & Irish totals for some species include estimates of inland populations, to be revised once further information has been collated for the SCR.

[e] Manx shearwater figures very approximate (midpoints of population estimates).

[f] Skua figures include are from 1992 survey of Orkney & Shetland, plus 1991-93 updates for Handa and St Kilda, otherwise 1985-87. Although some nest inland in mainland Scotland, all are treated as coastal here.

[g] Roseate tern figures are from 1993 (this report), with allowance for small numbers at uncounted colonies.

[h] Arctic tern figures include Shetland and Orkney counts from the 1989 RSPB survey (Avery *et al.* 1993), with counts of individuals divided by 1.5 to give an estimate of pairs;

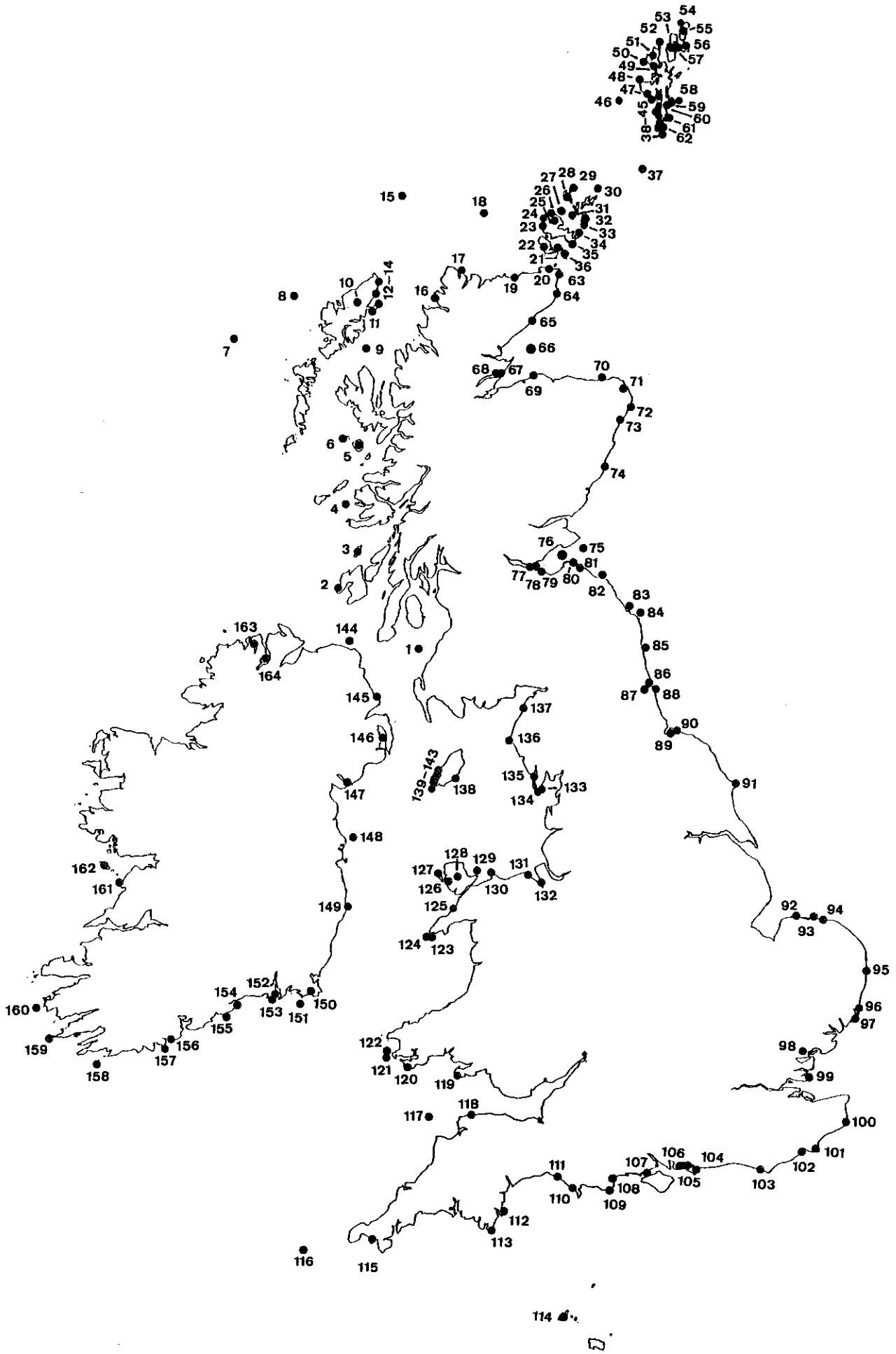
[i] Puffin figures very approximate (include high proportion of counts of pairs, multiplied by two to give individuals).

Table 1.2 **Groupings of coastal counties or districts used is assessing population changes for regional samples.** The regions are based on Figure 2 of Lloyd *et al.* (1991), except that Shetland and Orkney are each treated separately from 'NE Scotland' and the Inverness-to-Caithness coastline is treated separately ('N Scotland') from 'NW Scotland' here

County / district name (numbers refer to figure 1.1. which shows boundaries)	**Region**
Louth (1), Meath (2), Dublin (3), Wicklow (4), Wexford (5), Waterford (6)	SE Ireland
Cork (7), Kerry (8), Limerick (9), Clare (10)	SW Ireland
Galway (11), Mayo (12), Sligo (13), Leitrim (14), Donegal (15)	NW Ireland
Londonderry (16), Antrim (17), Down (18)	NE Ireland
Annandale & Eskdale (19), Nithsdale (20), Stewartry (21), Wigtown (22), Kyle & Carrick (23), Cunninghame (24), Inverclyde (25), Dunbarton (26), Argyll & Bute (27)	SW Scotland
Lochaber (28), Skye & Lochalsh (29), Western Isles (30), W coast of Ross & Cromarty (31), NW coast of Sutherland (32)	NW Scotland
Orkney (34)	Orkney
Shetland (35)	Shetland
Caithness (33), east coast of Sutherland (32), east coast of Ross & Cromarty (31), Inverness (32)	N Scotland
Nairn (37), Moray (38), Banff & Buchan (39), Gordon (40), City of Aberdeen (41), Kincardine & Deeside (42)	NE Scotland
Angus (43), City of Dundee (44), NE Fife (45), Kirkcaldy (46), Dunfermline (47), West Lothian, City of Edinburgh (48), East Lothian (49), Berwickshire (50)	SE Scotland
Northumberland (51), Tyne & Wear (52), Durham (53), Cleveland (54), North Yorkshire (55), Humberside (56), Lincolnshire (57)	NE England
Norfolk (58), Suffolk (59), Essex (60)	E England
Kent (61), East Sussex (62), West Sussex (63), Hampshire (64), Isle of Wight (65)	SE England
Dorset (66), Cornwall/Isles of Scilly (67), Devon (68), Somerset (69), Avon (70), Gloucestershire, Channel Islands (82)	SW England / Channel Islands
Gwent (71), South Glamorgan (72), Mid Glamorgan (73), West Glamorgan (74), Dyfed (75), Gwynedd (76), Clwyd (77)	Wales
Merseyside (78), Lancashire (79), Cumbria (80), Isle of Man (81)	NW England / Isle of Man
Londonderry (16), Antrim (17), Down (18)	NE Ireland

Figure 1.1 **Coastal counties / districts of Britain and Ireland.** See table 1.2 for details of the coastal regions (combinations of counties or districts) used in this report. Reproduced, with permission, from Lloyd, C., Tasker, M.L., & Partridge, K. 1991. *The status of seabirds in Britain and Ireland.* London, T. & A.D. Poyser

Figure 1.2 **Colonies/ locations referred to in this report** (numbers refer to map opposite)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2 SPECIES ACCOUNTS

2.1 Red-throated diver *Gavia stellata*

Breeding numbers and success (figures 2.1.1-2, table 2.1.1))

Numbers of successful pairs (with chicks in mid July) are monitored annually in Shetland study areas including parts of Unst, Eshaness, North Roe and Bressay. No significant trend is evident over the period 1980-93 (figure 2.1.1). The number of productive pairs fell in 1993, compared to 1992, but was still above average for the period. Average brood-size near fledging, also assessed in these areas, fell slightly in 1993, but remained above average (and markedly higher than in the period 1987-91) (Shetland Ringing Group 1993).

Numbers of successful pairs can reflect changes in both breeding population and in the proportion of pairs which are successful. More limited information on numbers of confirmed breeding pairs is available for some parts of Shetland. At a study area in Northmavine (NW Mainland), the population fell significantly during the period 1981-93, from a peak of 28 pairs in 1982 to only 7 in 1993 (figure 2.1.2). If other possible pairs are taken into account (empty nest scrapes or other adults on lochs), the downward trend is still significant. A decrease is also evident at Hermaness, on Unst, from 11 confirmed pairs in 1986-87 to 8 in 1991-93.

As usual, more detailed assessments of breeding success were made at several Shetland and Orkney colonies in 1993 (table 2.1.1.). In Shetland, overall breeding success was slightly lower than in 1992, but higher than the 1986-91 average. Success was highest at Hermaness (1.5 chicks/pair) and on Foula it was the most successful season yet recorded (1.0 chicks/pair from 10-11 pairs); divers on Fetlar were much less successful (0.44 chicks/pair). In Orkney, overall productivity was only 0.54 chicks/pair, similar to 1992. This was slightly above average for Orkney in recent years, and success improved on Orkney Mainland (0.78 chicks/pair, similar to 1991).

Discussion

Breeding success of this species remains low in Orkney and parts of Shetland, and marked variation between study areas suggest that local influences such as disturbance continue to be important. Orkney's red-throated divers have generally been less successful than Shetland birds in recent years, apparently reversing the situation seen in the 1970s (Booth 1982, Gomersall 1986). Whether or not this might reflect any changes in relative availability of food is not known.

As noted in previous reports, records of breeding success or population changes from elsewhere in Scotland would be useful for comparative purposes.

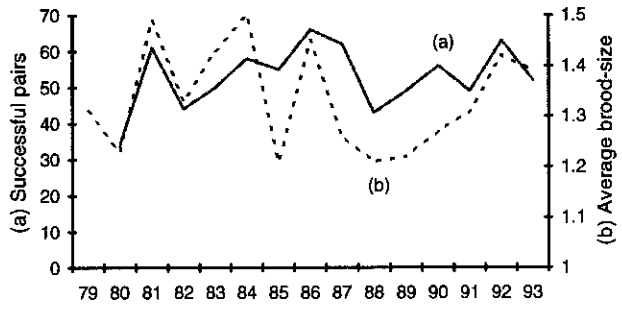

Figure 2.1.1 **Annual variation in (a) numbers of successful pairs and (b) average brood-size near fledging at red-throated diver study areas in Shetland** (parts of Unst, Eshaness, North Roe and Bressay) (data from Shetland Ringing Group 1993). Annual rate of change in number of successful pairs is calculated by regression of the log of each count against year; there was no significant trend

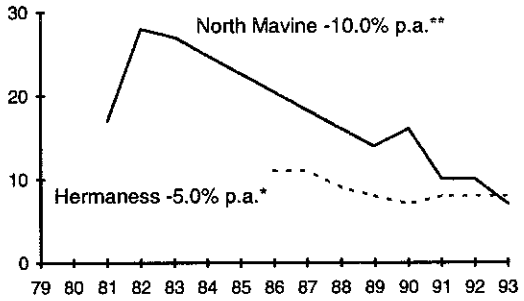

Figure 2.1.1 **Annual variation in numbers of confirmed breeding pairs in North Mavine study-area and at Hermaness, Shetland.** Average annual rates of change are calculated by regression of the log of each count against year (significant trends: * P<0.05; ** P<0.01)

Table 2.1.1 **Red-throated diver breeding success, 1986-93**: estimated number of chicks fledged per breeding pair. Note that numbers of pairs do not necessarily indicate total populations in study areas. For 1986-91, the mean ±standard error of annual figures is presented

	1986-91 years	**fledged/pair mean**	s.e.	1992 prs	**fledged /pr**	1993 prs	**fledged /pr**
Hermaness	6	**0.83**	0.10	8	**1.87**	8	**1.50**
Fetlar	6	**0.40**	0.08	18	**0.60**	18	**0.44**
Yell	6	**0.58**	0.14	21	**0.86**	17	**0.76**
Foula	5	**0.45**	0.07	12	**0.58**	10-11	**1.0-1.1**
SHETLAND sample total	6	**0.55**	0.06	59	**0.86**	53-54	**0.82**
Hoy	3	**0.58**	0.07	61	**0.59**	64	**0.52**
Rousay	4	**0.24**	0.06	11	**0.27**	12	**0.33**
Mainland	3	**0.53**	0.12	14	**0.43**	18	**0.78**
ORKNEY sample total	4	**0.43**	0.02	86	**0.52**	94	**0.54**

2.2 Fulmar *Fulmarus glacialis*

Breeding numbers (table & figure 2.2.1)

Numbers of apparently occupied sites in sample populations fell slightly in monitored Scottish regions between 1992 and 1993, but increased slightly in England and Wales. Some of these changes may reflect fluctuations in attendance of non-breeders from year to year or from day to day, although the use of replicate counts in a few regions helps compensate for the latter source of variation. Longer-term trends, over the period 1986-93, indicate that sample populations in all regions are increasing (significant trends shown for Shetland, SE Scotland, NE England and Wales) or at least stable.

Breeding success (table 2.2.2)

Productivity was again moderately high overall, with an average 0.44 (±s.e. 0.03) chicks fledged per occupied site at 33 British colonies. For colonies studied in both 1992 and 93, there was little overall change: an average increase by 0.02 (±0.03) chicks/site ($t_{27} = 0.88$, not significant).

No individual region (or combinations of regions) showed any significant changes in success compared to 1992, although slight increases (especially in Shetland) or decreases (especially on the east coast of mainland Scotland) were noted. As in 1992, Shetland fulmars were among the most successful, averaging 0.52 ±0.03 chicks/site at seven colonies, with higher breeding output at all colonies compared to their 1986-91 averages. Productivity was also high at W Scottish colonies (0.54 ±0.09 chicks/site at three colonies). Fulmars breeding 'inland' on Rousay (Orkney) failed totally, as in 1992, but coastal populations in Orkney were generally productive. Once again, breeding output appeared to be lowest at colonies in southwest Britain (average 0.35 ±0.08 chicks/site at nine colonies from Dorset to the Isle of Man). It may be that a high proportion of non-breeders or inexperienced breeders at some sites may contribute to such low apparent success; for example, a colony on the West Bay / Burton cliffs in Dorset produced only two large chicks from 49 sites (0.04/site).

Discussion

Monitoring both numbers and breeding success of fulmars is difficult to do with much accuracy, so relatively minor fluctuations in results can be difficult to interpret. Increased use of monitoring methods involving replicate counting or mapping of nest-sites would improve accuracy. Nevertheless, on available information, the species continues to be successful overall, with breeding output evidently sufficient to allow continued population growth of this long-lived species.

Table 2.2.1 **Population changes at monitored fulmar colonies, 1992-93** (apparently occupied sites in June). Superscript = number of colonies with 10+ AOS counted in 1992; counts with a reported inaccuracy of >±5%, and regional samples <100 AOS, are excluded. Figures for regions in block capitals are based on the means of 3-10 annual counts of study plots within each colony

	NW Scotland	SHETLAND	N SCOTLAND	SE SCOTLAND	NE England	Wales	NW Eng. & I. of Man
1992	942	2528	1330	328	223	767	586
1993	922	2441	1275	303	248	792	597
% change	-2.1^{3}	-3.4^{7}	-4.1^{4}	-7.6^{1}	$+11.2^{1}$	$+3.2^{3}$	$+1.9^{6}$

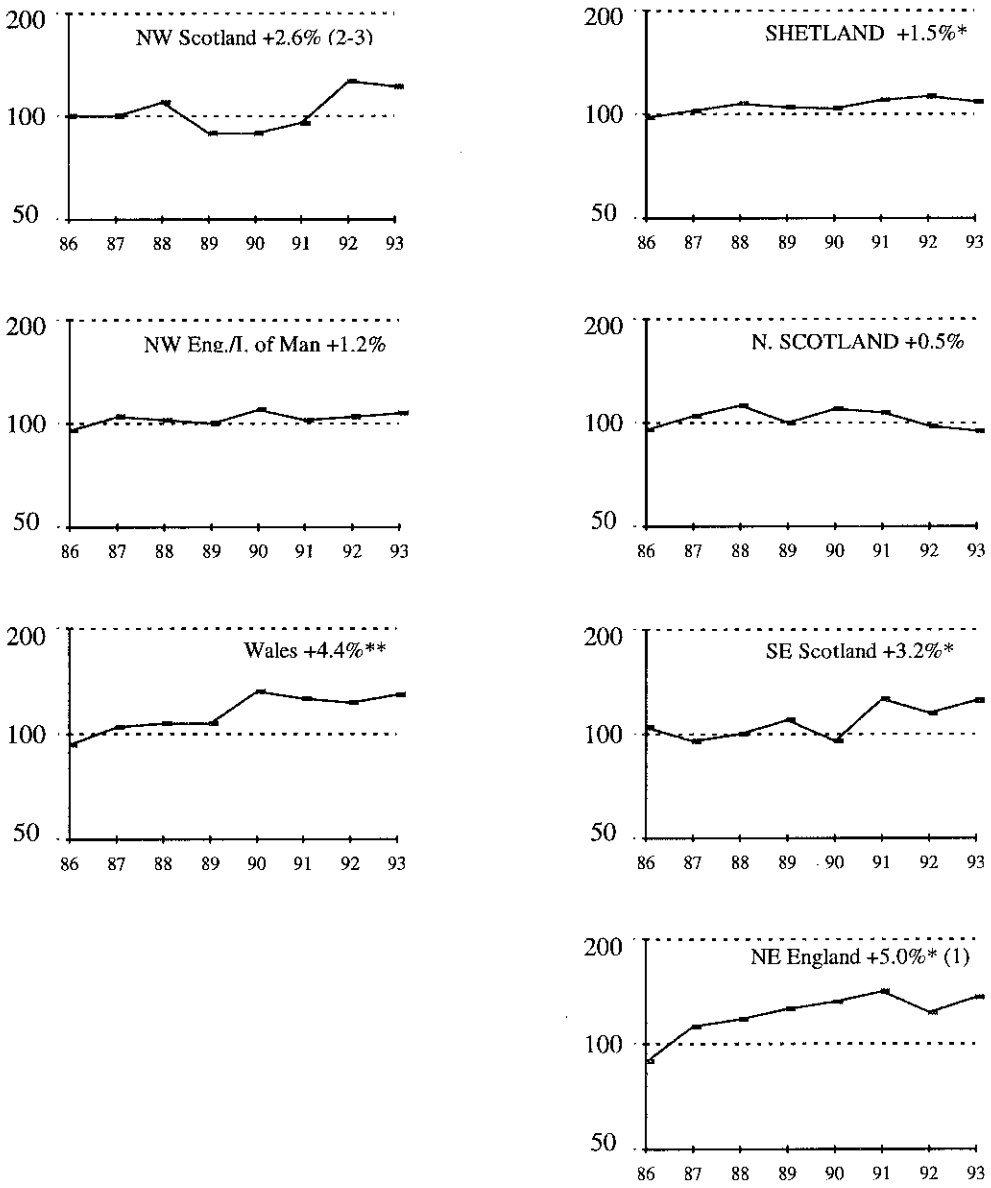

Figure 2.2.1 **Regional population indices for breeding fulmars, 1986-93 (apparently occupied sites in June).** Average annual rates of change are calculated by regression of log of index against year (significant trends: * P<0.05; ** P<0.01). Region names in block capitals = based on 3-10 counts of study plots each year. No. of colonies counted in each year = 3+ (unless 1 or 2 indicated)

Table 2.2.2 **Fulmar breeding success, 1986-93:** number of chicks fledged per apparently occupied site. Figures are based on regularly-occupied sites or on the average numbers of occupied sites in June. For 1992 and 1993, productivity is presented as mean & standard error of figures from three or more plots (standard error is equivalent to half-range of figures from two plots); n = number of sites (plots). * indicates coverage of most or all of colony

Colony	1986-91 fledged/site			1992 fledged/site			1993 fledged/site		
	yrs	mean	s.e.	n	mean	s.e.	n	mean	s.e.
Ailsa Craig (Kyle & Carrick)		-		12	**0.83**		14	**0.71**	
Colonsay (Argyll & Bute)	5	**0.45**	0.03	73(2)	**0.48**	0.10		-	
Canna (Lochaber)	6	**0.39**	0.05	44(2)	**0.34**	0.13	66(3)	**0.50**	0.05
St Kilda (W Isles)	2	**0.43**	0.02	321(3)	**0.44**	0.02		-	
Lewis (W Isles)	2	**0.34**	0.06		-			-	
Handa (Sutherland)	3	**0.55**	0.07	121(1)	A**0.34**		131(1)	A**0.40**	
Faraid Head (Sutherland)	2	**0.44**	0.10		-				
Hermaness, Unst (Shetland)A	3	**0.34**	0.01	280(2)	**0.30**	0.13	286(2)	**0.43**	0.09
Eshaness a (Shetland)A	6	**0.43**	0.04	273(5)	**0.43**	0.05	285(3)	**0.45**	0.04
Eshaness b				279(7)	**0.48**	0.05		-	
Noss a (Shetland)A	6	**0.40**	0.04	462(3)	**0.43**	0.04	491(4)	**0.51**	0.03
Noss b							437(4)	**0.61**	0.02
Westerwick a (Shetland)A	2	**0.37**	0.04	84(1)	**0.41**	-	84(1)	**0.59**	
Westerwick b		-		76(1)	**0.45**	-		-	
Troswick Ness a (Shetland)A	6	**0.45**	0.02	927(6)	**0.46**	0.03	916(6)	**0.47**	0.04
Troswick Ness b		-		95(1)	**0.56**	-		-	
Sumburgh Head a (Shetland)A	6	**0.47**	0.05	216(3)	**0.57**	0.02	211(3)	**0.56**	0.04
Sumburgh Head b		-		30(1)	**0.59**	-		-	
Fair Isle (Shetland)	6	**0.47**	0.05	469(5)	**0.55**	0.05	302(5)	**0.57**	0.05
North Ronaldsay (Orkney)	1	**0.34**			-			-	
North Hill, Papa Westray (Ork.)	3	**0.44**	0.03	88	**0.54**		74	**0.69**	
Costa Head (Orkney)	3	**0.49**	0.04	198(3)	**0.53**	0.02	211(3)	**0.56**	0.04
Row Head (Orkney)	1	**0.54**		31(1)	**0.71**			-	
Mull Head (Orkney)	3	**0.39**	0.03	192(5)	**0.41**	0.10	246(5)	**0.42**	0.01
Gultak (Orkney)	3	**0.41**	0.07	150(4)	**0.55**	0.11	212(4)	**0.47**	0.02
Hoy (Orkney)	3	**0.54**	0.05	180(3)	**~0.51**	0.05	144(2)	**0.31**	0.05
Rousay, inland (Orkney)	3	**0.51**	0.01	45	A**0**		142	**0**	
Rousay, coastal (Orkney)	2	**0.56**	0.06	101(3)	A**0.47**	0.01		-	

Colony	1986-91 fledged/site			1992 fledged/site			1993 fledged/site		
	yrs	mean	s.e.	n	mean	s.e.	n	mean	s.e.
St John's Head (Caithness)	1	**0.50**			-			-	
Sandside Head (Caithness)	2	**0.56**	0.02		-			-	
Iresgeo (Caithness)[A]	6	**0.32**	0.04	591(5)	**0.34**	0.01	543(3)	**0.21**	0.09
An Dun (Caithness)[A]	6	**0.31**	0.03	494(5)	**0.37**	0.03	484(5)	**0.28**	0.02
Easter Ross (Ross & Cromarty)		-			-		9	**0.56**	
Isle of May (NE Fife)	6	**0.43**	0.05	129	**0.47**		121	**0.44**	
Tantallon (E Lothian)	5	**0.40**	0.06	89(2)	**0.63**	0.10	134(3)	**0.51**	0.09
St Abb's Head (Berwick)	1	**0.30**		330(*)	**0.31**		303(*)	**0.31**	
Farne Islands (Northumberland)	6	**0.54**	0.05	127(4)	**0.66**	0.01	148(4)	**0.56**	0.07
Coquet Island (Northumberland)		-			-		52	**0.63**	
Weybourne-Sheringham (Norfolk)	1	**0.37**			-			-	
West Bay/Burton (Dorset)		-			-		49	**~0.04**	
Annet (Isles of Scilly)		-			-		13	**0.38**	
Guernsey (Channel Islands)	6	**~0.28**	0.05		-		10	**~0.40**	
Skomer (Dyfed)	2	**0.60**	0.03	99	**0.42**		84	**0.71**	
Bardsey (Gwynedd)	1	**0.6**			-			-	
Calf of Man (Isle of Man)	1	**0.44**			-			-	
Traie Vane-Gob yn Ushtey (I.M.)	4	**~0.24**	0.03	112(*)	**~0.18**		117(*)	**~0.10**	
Around Peel Hill (Isle of Man)	4	**~0.20**	0.02	280(*)	**~0.26**		237(*)	**~0.27**	
Glen Maye (Isle of Man)	6	**~0.33**	0.07	24(*)	**~0.29**		23(*)	**~0.61**	
Bradda (Isle of Man)	1	**~0.29**		49	**~0.24**		42	**~0.48**	
Douglas (Isle of Man)	1	**~0.40**		68	**~0.43**		91	**~0.16**	

[A] = figures based on average number of occupied sites in June; ~ = figures based on a single count of occupied sites in June. In both cases, number of breeding pairs may be overestimated to a greater degree than if regularly-occupied sites are used (and thus fledging success per breeding pair may be underestimated).

a, b = results based on different methods at same colony

2.3 Manx shearwater *Puffinus puffinus*

Breeding numbers

Occupancy of study burrows was again low on Canna (Lochaber), with eggs found in only 17 (49%) of 35 burrows. A survey of the whole island was made in April, to locate burrows marked with shearwater droppings, and, correcting for burrow occupancy, a total population of 124-144 breeding pairs was estimated (Swann 1993). A similar survey in 1973-74 had estimated 1000-1500 pairs (Swann & Ramsay 1976), indicating that the Canna population has declined substantially,

Approximate estimates for some other colonies in 1993 included: 50-100 pairs/territories on the Calf of Man (as in 1991); 150-200 occupied burrows on Great Saltee (Wexford); and 1000-5000 individuals on Great Skellig (Kerry). In the Isles of Scilly, adults were again ringed on Annet, Round Island and Gugh, although breeding numbers remain unclear (Robinson 1993).

Breeding success

Productivity on Canna continued to be below average for the period since 1976, with 0.47 large chicks/pair from 17 burrows with eggs (0.46/pair in 1992) (Swann 1993). At a study area on Skomer (Dyfed), a much larger colony, only 0.21 chicks fledged per pair laying (compared to 0.50 for the same area in 1991-92). On Skomer, very wet weather in May (when many nest burrows were flooded) was believed to have contributed to poor success (Perrins 1993).

Discussion

Like other burrowing seabirds, Manx shearwaters are very vulnerable to predation by mammals which have been accidentally (or deliberately) introduced to islands with colonies. Rats pose a particular threat, and predation by brown rats *Rattus norvegicus* is known to occur on Canna (Swann & Ramsay 1984). Both breeding success and numbers of occupied burrows on Canna have declined in recent years and the presence of rats seems likely to be an important factor.

None of the larger colonies in Britain or Ireland was censused in 1993, but it is hoped that repeat counts on Rum (Lochaber) and Skomer will take place in the near future. Population estimates for any colony (or confirmation of breeding presence) will continue to be of interest.

2.4 Storm petrel *Hydrobates pelagicus*

Breeding numbers

Monitoring continued on Mousa, Shetland in 1993. Two different methods were used to census the population in a sample of the island's walls. One method, mapping of calls at night in order to build up a cumulative total of calling birds, was repeated as in 1990-92. The second method involved playback of taped Churr-calls during daylight near the entrances to likely nest-sites (tape played for 15 seconds every meter along a 150-m length of wall). Both methods gave a similar population estimate (*c*2500 calling birds) based on the sample of walls surveyed. A full island population estimate was not attempted this year on Mousa; a preliminary estimate of 4500-5000 calling birds was made in 1992.

In Orkney, churring birds were heard on Muckle Green Holm in June (50+ churring birds were present in 1990), and nesting was noted on Auskerry (possibly a large colony). The population on Sule Skerry was estimated as 'not large,' probably Order 3 magnitude (100-1000 pairs) (Blackburn & Budworth 1994). In the Treshnish Isles (Argyll & Bute), birds were heard churring at several locations on both Fladda and Lunga (where 2000+ occupied sites were estimated in 1986).

In Wales, a minimum of 35 occupied sites were located on Skomer using taped calls, with a total estimate of only *c*50 pairs. A severe decline has evidently occurred, with ringing studies suggesting that numbers are much lower than in the 1970s, although the reasons for this are not clear. On nearby Skokholm, an attempt was made in 1992 to locate all occupied sites in the drystone wall system using an image-intensifier and taped calls. The walls are estimated to hold under 25% of the total population on Skokholm, and 98 sites were identified in 1992. Similar results were obtained in 1993 when churring birds were listened for along on a smaller sample of the wall system. Future plans on Skokholm include continued monitoring and an attempt to obtain a full population estimate for the island.

In SW England, a ringing program continued in 1993 on the Isle of Scilly, with 1270 birds netted on five islands, and a substantial population was again indicated (although actual breeding numbers are difficult to assess). On Annet, an estimated 100+ birds were calling from one boulder beach in late May, and further work may allow an estimate of the whole-island population (Robinson 1994).

In SW Ireland, the colony on Great Skellig (Kerry) was estimated as in the region of 1-5000 individuals in 1993 (1969-73 estimates were in the range 1-10000 pairs). Breeding was also confirmed on Bull Rock (Cork), where 2-5000 pairs were estimated in 1969. Two pairs of storm petrels bred on Fastnet Rock (Cork) during 1988-92; the only previous breeding record there was of a pair in 1972.

Discussion

Preliminary results suggest that the use of tape-playback during daylight hours to obtain population estimates may be a useful technique in future. However, further testing of the technique on a variety of substrates will be necessary. Further details of techniques are available from JNCC or RSPB.

2.5 Leach's petrel *Oceanodroma leucorhoa*

Breeding numbers

Gruney, Ramna Stacks (Shetland) was found to hold 21 occupied burrows in 1993 (compared to 18 in 1992). Responses were noted to playback of Chatter-calls and Purr-calls at burrow entrances during daylight and burrow contents were examined using a fibre-optic endoscope. In Leach's petrel, each sex is know to respond specifically to Chatter-calls of the same sex (Taoka *et al.* 1989), and calls of both sexes were used (unless an immediate response occurred). A visit on 6 July induced responses from 11 Leach's and 8 storm petrels. Four additional Leach's and three storm petrels responded to tapes on a second visit on 8 August. All responses by Leach's petrels were Chatter-calls (storm petrels responded with their alarm call). Endoscope checks confirmed breeding Leach's petrels in 16 burrows, with a further 5 occupied during daylight but showing no signs of a breeding attempt.

On Sule Skerry (Orkney), increased numbers of Leach's petrels were mist-netted in 1993 (74 birds). As in previous years, tape-lures were used, so many (perhaps all) birds caught will have been non-breeding visitors; actual proof of breeding has not been obtained here since 1933 (Blackburn & Budworth 1994). At the large colony on North Rona (Western Isles), where *c*1000 pairs were estimated in 1972, a total of 459 birds were mist-netted without a tape-lure over five nights in June. Based on catch-per-effort, numbers there were possibly down compared to 1974 (Murray & Love 1993).

Discussion

Colonies of Leach's petrel are particularly difficult to monitor due to their inaccessibility, and it is likely that not all are known. Further details of petrel census techniques are available from JNCC or RSPB.

2.6 Gannet *Morus bassanus*

Breeding numbers (table & figure 2.6.1)

Counts are available for four of the smaller colonies in 1993. The two mainland colonies, in particular, continue to grow rapidly, including a 10% increase since 1992 at Bempton (Humberside) and 19% increase at Troup Head (Banff and Buchan) (a colony first recorded in 1988). A slight decrease was noted on Fair Isle (Shetland). However, 1986-93 trends for all four colonies indicate significant increases (including Great Saltee, Wexford, with 1100-1250 occupied sites in 1993).

Breeding success (table 2.6.2)

Overall productivity was moderately high, at 0.65 (±0.04) chicks estimated fledged/pair at six colonies. This was a slight (but non-significant) reduction compared to 1992 (average change -0.07 ±0.05 chicks/pair). A reduction in success was most apparent on Ailsa Craig (Kyle & Carrick), from 0.77 to 0.53 chicks/pair; at this colony, poor weather (snow and ice) in May was believed to have caused many birds to fail at the egg stage.

Discussion

A repeat census of British and Irish gannetries is being organised in 1994-95 by Stuart Murray and Sarah Wanless, ten years after the last full survey (Wanless 1987). Counts of the larger colonies (few of which have been surveyed more recently) will allow assessment of overall rates of change; total numbers in Britain and Ireland had increased by the equivalent of 2.0% per year between 1969-70 and 1984-85.

Table 2.6.1 **Population changes at individual gannet colonies, 1992-93** (peak counts of apparently occupied nests in June-July)

	Fair Isle (Shetland)	Troup Head (Banff & Buchan)	Bempton (Humberside)
1992	781	278	1365
1993	764	331	1510
% change	-2.2	+19.1.	+10.6

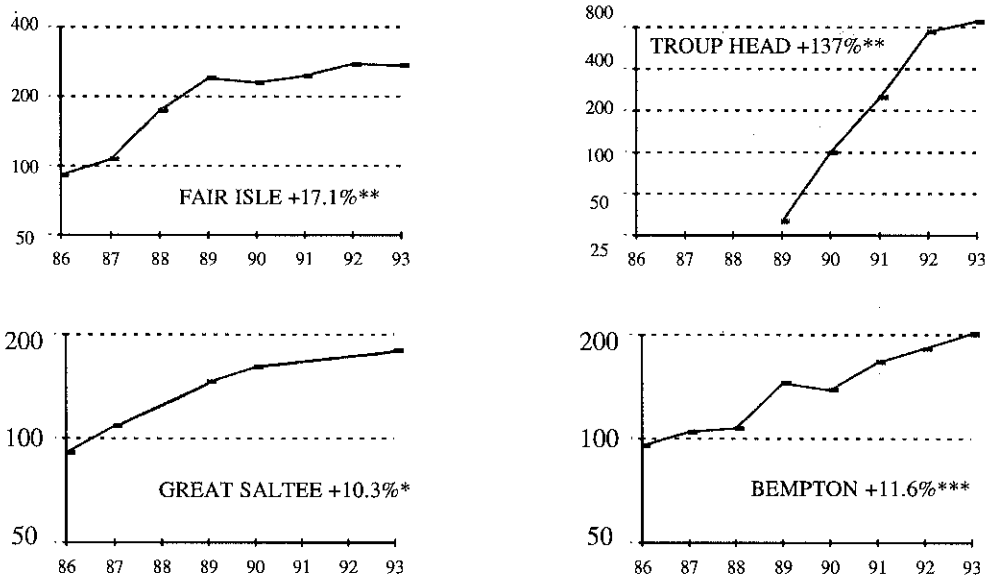

Figure 2.6.1 **Population indices for monitored gannet colonies, 1986-93 (occupied nests or sites in June/July).** Average annual rates of change are calculated by regression of log of index against year (significant trends: * P<0.05; ** P<0.01; *** P<0.001). Baseline population (index = 100) is set as the average of 1986-87 counts (except Troup Head, where 1990 is set as the baseline year)

Table 2.6.2 **Gannet breeding success, 1986-93**: number of chicks fledged per occupied nest or per egg/apparently incubating adult. For 1992 and 1993, productivity is presented as mean & standard error of figures from three or more plots (equivalent to mean & half-range for two plots); n = numbers of nests (plots). * indicates coverage of most visible parts of colony

Colony	1986-91 fledged/nest			1992 fledged/nest			1993 fledged/nest		
	yrs	mean	s.e.	n	mean	s.e.	n	mean	s.e.
Ailsa Craig (Kyle & Carrick)	1	**0.66		62(1)	**0.77		62(1)	**0.53	
Hermaness, Unst (Shetland)	3	**0.72**	0.04	247(1)	**0.60**		244(1)	**0.61**	
Noss a (Shetland)	6	~0.69	0.02	377(4)	~0.62	0.04	579(6)	~0.70	0.03
Noss b		-		178(2)	**0.78	0.03	381(4)	**0.66	0.03
Fair Isle (Shetland)	6	**0.64**	0.05	129	**0.73**		152	**0.78**	
Troup Head (Banff & Buchan)	3	~0.65	0.18	237(*)	~0.57		322(*)	~0.59	
Bempton (Humberside)	6	**0.75**	0.03	136(6)	**0.86**	0.02	128(4)	**0.74**	0.04

~ = figures based on comparison of August count of chicks with peak or single May/June count of occupied, well-built nests; other figures are based on regular checks of mapped nests. ** = based on 'active nests' (egg or apparent incubation recorded). a, b = results based on different methods at same colony

2.7 Cormorant *Phalacrocorax carbo*

Breeding numbers (table & figure 2.7.1)

Sample populations increased between 1992 and 1993 in 6 of the 10 coastal regions covered, most notably in Shetland (+17%, based on complete coverage), Wales (+14%) and NE Ireland (+16.5%). However, marked decreases occurred in SE Scotland (-37%) and SW England (-18%). Over the period 1986-93, most regional populations have increased (significant trends for NE England and NE Ireland), or at least remained stable. The main exception has been Shetland, where numbers have declined significantly.

Inland populations in England continue to increase rapidly, with a 40% increase 1992-93 to at least 820 nests in six colonies. Abberton Reservoir (Essex) reached a record 526 nests in 1993 (414 in 1992), and is currently the largest known colony in Britain. A colony in Cambridgeshire increased to 133 nests (76 in 1992), while at least three other counties held inland colonies in 1993.

Breeding success

As usual, little information was available. Productivity was reported for only one colony, North Sutor (Ross & Cromarty), where 74 nests in two plots fledged an average of 2.46 (±s.e. 0.02) chicks/nest, little change from 1992 (2.61) or 1991 (2.54). Brood sizes of productive nests in Shetland were again high, averaging 3.1 large chicks/brood, as in 1992 (Okill & Osborn 1993).

Discussion

Populations of cormorants appear to be healthy as a whole, and the only real evidence of recent declines comes from Shetland, where there was some recovery in 1993. Marked short-term decreases occasionally occur in some regions, but seem generally be of a temporary nature (e.g. Wales in 1991); as shown to a greater degree by shags, there is evidence that, in some years, a high proportion of adult cormorants may not nest. The decrease seen in the Firth of Forth (SE Scotland) in 1993 was particularly severe, and coincided with an even greater decrease in shag numbers; counts in 1994 will thus be of great interest.

Rapid growth of the inland population in England must have derived in large part from recruitment of coastally-bred birds, although some Continental birds of the race *sinensis* might be involved (Sellers 1993). Detailed productivity data are not yet available for the inland colonies, so the relative contribution of locally-bred and immigrant recruits to ongoing growth is difficult to assess. Indeed, more information on productivity at coastal colonies would be useful.

Many of the counts summarised above have been provided to the Seabird Monitoring Programme from the Cormorant Breeding Colony Survey organised by Dr R. M. Sellers (offers of help to: Rose Cottage, Ragnall Lane, Walkley Wood, Nailsworth, Glos. GL6 0RU). Around 50% of the UK population is currently covered, and the main gap in coverage is NW Scotland.

Table 2.7.1 **Population changes at monitored cormorant colonies, 1992-93** (apparently occupied nests in May-June). Superscript = number of colonies counted in both years. Regional samples <50 AONs are excluded

	SW Scotland	Shetland	Orkney	N Scotland	SE Scotland	NE England
1992	122	225	204	470	478	322
1993	126	264	199	476	300	327
% change	$+3.3^{2}$	$+17.3^{5}$	-2.4^{2}	$+1.3^{6}$	-37.2^{5}	$+1.5^{3}$

	INLAND, England	SW England	NW Eng. & I. of Man	Wales	NE Ireland
1992	587	389	119	862	206
1993	820	319	113	983	240
% change	$+39.7^{6}$	-18.0^{9+}	-5.0^{4}	$+14.0^{10}$	$+16.5^{3}$

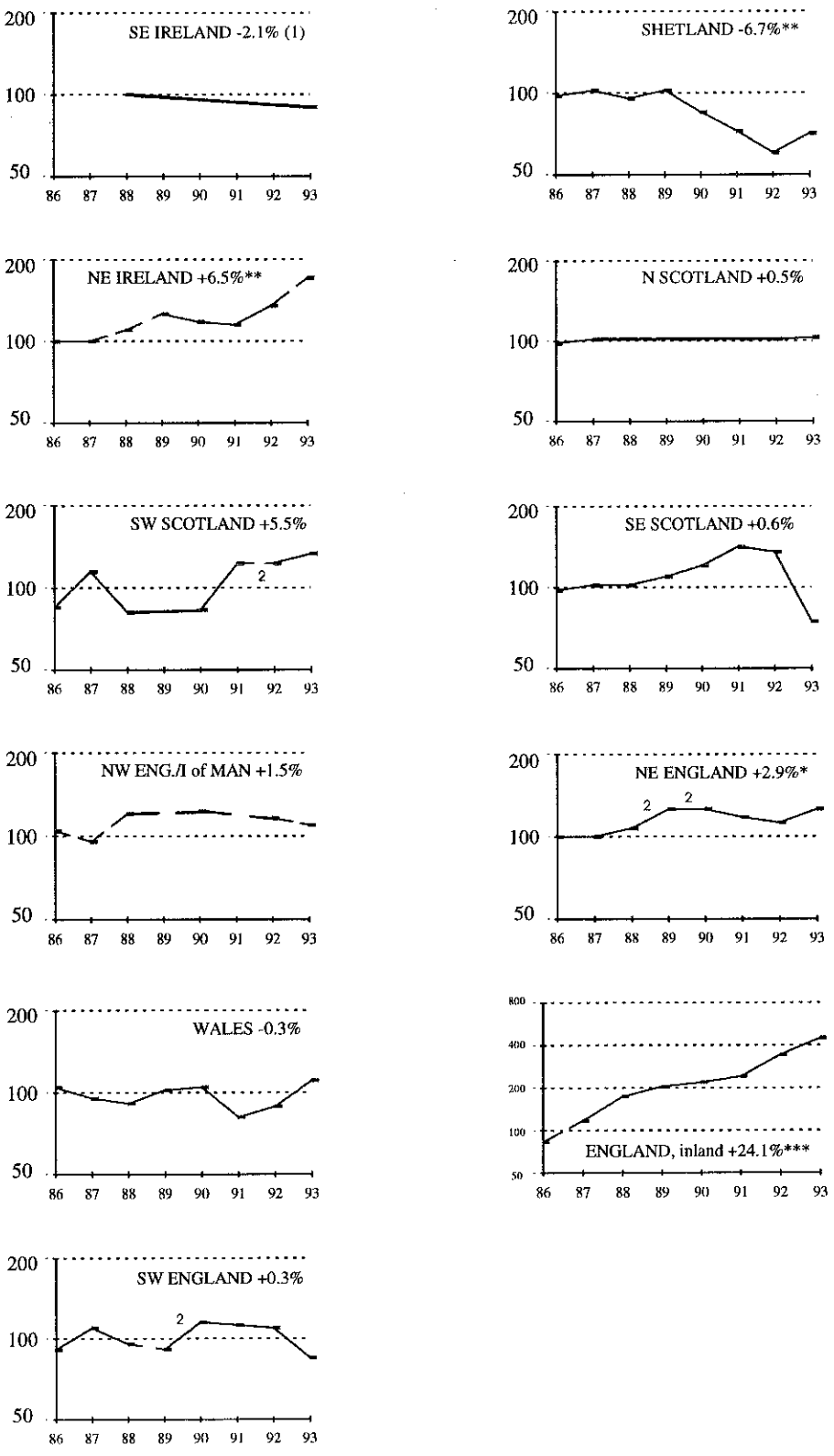

Figure 2.7.1 **Population indices for breeding cormorants, 1986-93 (occupied nests or sites in May/June).** Average annual rates of change are calculated by regression of log of index against year (significant trends: * P<0.05; ** P<0.01; *** P<0.001). Broken trend lines are based on sample counts of 50-200 AONs. Number of colonies counted in each region in each year = 3+ (unless 1 or 2 indicated)

2.8 Shag *Phalacrocorax aristotelis*

Breeding numbers (table & figure 2.8.1)

Monitored populations decreased (by 14-60%) in all Scottish regions between 1992 and 1993. The decrease appeared to be most severe in SE Scotland, but the season was very late in the Firth of Forth and some colonies were probably counted too early (early June, normally the peak period). In addition, on the Isle of May, at least, it was evident that many adults present had not nested (Harris 1993). In contrast, numbers increased again in NE England, mainly on the Farne Islands, continuing an ongoing trend (significant increase during 1986-93). Little information was available from southern colonies; most notably, numbers on Great Saltee (Wexford) have fallen by more than 50% from 450 in 1986 to 180 in 1993.

Shag populations in Shetland were of particular interest in 1993, following the *Braer* oil-spill in southern Shetland which killed over 800 shags in January (see black guillemot, *section 2.24*). Counts at a range of Shetland colonies indicated that study populations have continued to decline since the late 1980s (significant trend during 1986-93). On most coasts, changes in shag numbers in 1993 were either slight or consistent with ongoing trends, suggesting that the impact of the *Braer* spill on the Shetland population was not widespread. However, numbers in SW Shetland were markedly lower than in 1986-89. At Sumburgh Head, in particular, numbers halved between 1992 (298 nests) and 1993 (145), probably a direct effect of the spill.

Breeding success (table 2.8.2)

Average breeding output at 13 colonies was moderately high, at 1.35 (±s.e. 0.04) chicks fledged/nest. This was lower than in 1992 (revised average of 1.6 chicks/nest), but not consistently or significantly so (average change -0.09 ±0.13 chick/nest, $t_{10} = 0.72$).

Shags in Shetland bred more successfully than those monitored elsewhere, rearing an average of 1.58 (±0.11) chick/nest at eight colonies, with Hermaness birds the most successful overall (1.98 chicks/nest). In SE Scotland and NE England, productivity fell markedly at study colonies, particularly the Isle of May (only 0.22 chicks/nest, the lowest figure recorded at any British colony during 1986-93).

Discussion

'Non-breeding' events, when large numbers of adult shags are present at a colony but do not build nests or lay eggs, have now been well-documented, particularly on the Isle of May (Aebischer & Wanless 1992). The 1993 'crash' there (and in the Firth of Forth as a whole) was perhaps the most extreme one yet but, in common with other such years, was associated with a late breeding season and reduced breeding success. For the Isle of May, Aebischer & Wanless (1992) noted a significant correlation between the start of the shag breeding season and two main environmental factors; breeding tended to start early when abundance of herring *Clupea harengus* in adjacent waters during February was high, but tended to be delayed when there were many days of easterly winds during March. The timing of breeding in 1993 did not fit this relationship, however, and other, unknown factors were evidently involved (Harris & Calladine 1993).

Although it had been feared that the *Braer* oil-spill in Shetland might have a major impact on shag numbers there, surveys suggested that effects were fairly localised. Effects on breeding success had also been a possibility, e.g. through sub-lethal effects on adults or effects on fish stocks, but 1993

proved to be a good year for production of shag chicks in Shetland (above average for recent years).

Another largescale mortality incident occurred during February-March 1994, when corpses of thousands of guillemots and hundreds of shags came ashore along the east coast of Scotland. In the Moray Firth alone, 835 dead shags were found, with most ring-recoveries coming from the Firth of Forth (Swann 1994a). Counts at colonies in 1994 will help assess the full impact.

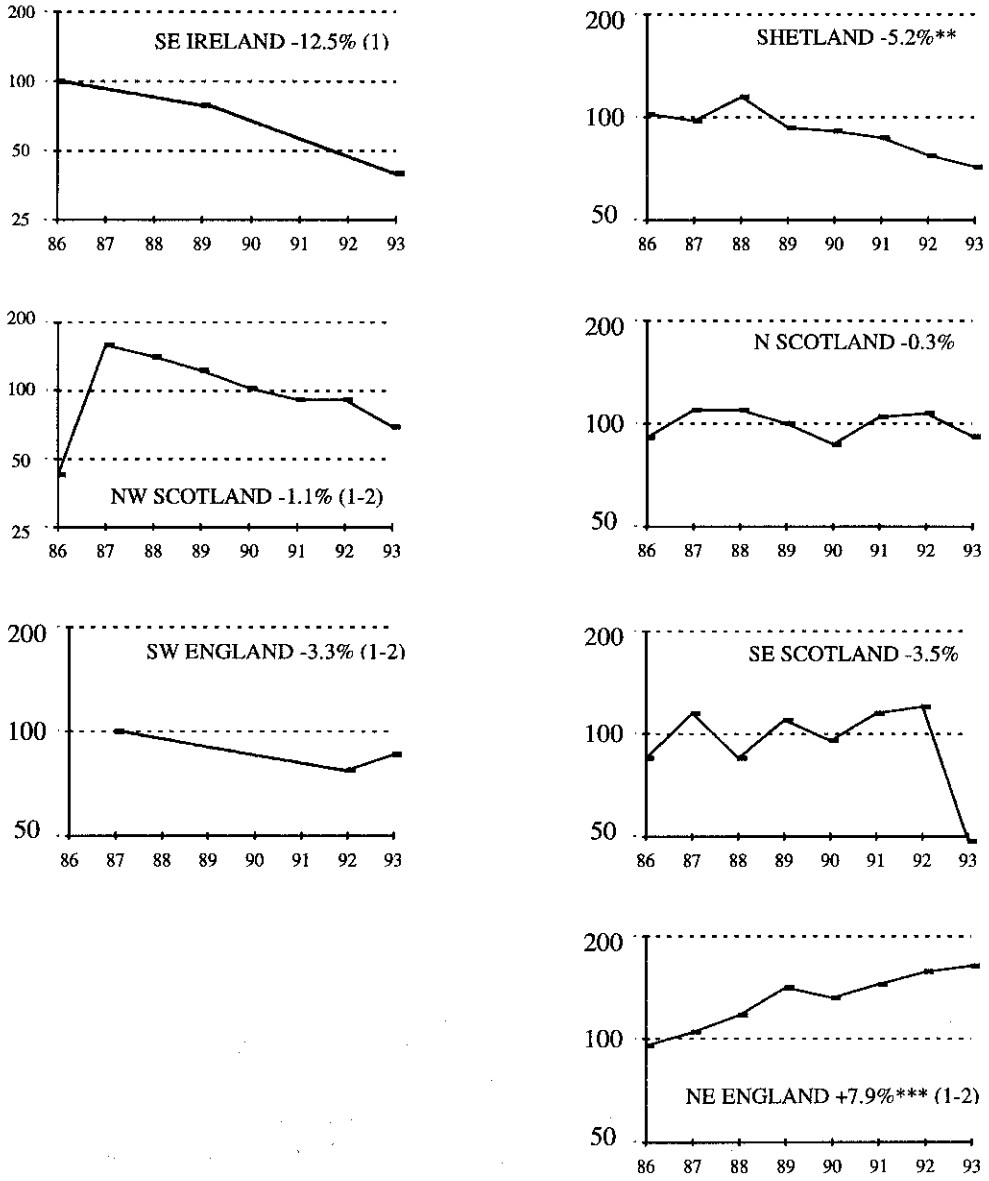

Figure 2.8.1 **Population indices for breeding shags, 1986-93 (apparently occupied nests in late May/June).** Average annual rates of change are calculated by regression of log of index against year (significant trends: * P<0.05; ** P<0.01; *** P<0.001). Number of colonies counted in each region in each year = 3+ (unless 1 or 2 indicated)

Table 2.8.1 **Population changes at monitored shag colonies, 1992-93** (apparently occupied nests in May-June). Superscript = number of colonies with 10+ AONs counted in 1992; counts with a reported inaccuracy of >±5%, and regional samples <100 AONs, are excluded

	NW Scotland	Shetland	N Scotland	SE Scotland	NE England	SW England
1992	1034	1027	343	3389	1871	127
1993	792	823	294	1364	1948	142
% change	-23.4^{3}	-19.9^{9}	-14.3^{3}	-59.7^{8}	$+4.1^{1}$	$+11.8^{1}$

Table 2.8.2 **Shag breeding success, 1986-93**: number of chicks fledged per active nest (where eggs or apparent incubation recorded). For 1992 & 1993, productivity is presented as mean & standard error if based on three or more study-plots (equivalent to mean & half-range for two plots); n = number of nests (plots).
* indicates coverage of most visible parts of colony

Colony	**1986-91 fledged/nest**			**1992 fledged/nest**			**1993 fledged/nest**		
	yrs	**mean**	s.e.	n	**mean**	s.e.	n	**mean**	s.e.
Colonsay (Argyll & Bute)	5	**1.65**	0.11	15(2)	**1.8**	0.05		-	
Canna (Lochaber)	**6**	**1.54**	0.16	45	**0.93**			**1.14**	
Hermaness, Unst (Shetland)	3	**0.59**	0.27	90	**1.45**		92	**1.98**	
Kettlaness (Shetland)		-		19(2)	**1.58**		11(2)	**1.09**	
Noness (Shetland)		-			-		30(3)	**1.43**	
Troswick Ness (Shetland)		-		12(2)	**1.42**		13(2)	**1.46**	
Westerwick (Shetland)		-		29(1)	**1.86**		39(1)	**1.74**	
Sumburgh Head (Shetland)	4	**1.04**	0.17	111(6)	**1.22**	0.13	96(8)	**1.58**	
Fair Isle (Shetland)	6	**1.26**	0.08	74	**1.65**		72	**1.81**	
North Sutor (Ross & Crom.)				36	**1.58**		61	**1.74**	
Isle of May (NE Fife)	6	**0.82**	0.13	181(14)	**0.87**	0.13	80(13)	**0.21**	0.10
St Abb's Hd (Berwickshire)	2	**1.28**	0.52	145(7)	**1.84**	0.10	72	**1.40**	
Farne Isds (N'humberland)	5	**1.28**	0.15	238(9)	**1.56**	0.10	206(8)	**0.77**	0.17
Berry Head (Devon)	1	**1.42**		4(*)	**2.75**			-	
Annet (Scilly)							142(*)	**1.22+**	
Guernsey (Channel Isds)	3	**1.08**	0.16	53(9)	**1.60+**			-	
Bardsey (Gwynedd)	2	**1.79**	0.03		-			-	
Calf of Man (Isle of Man)	1	**2.01**		84(3)	**1.77**	0.07		-	

2.9 Arctic skua *Stercorarius parasiticus*

Dave Suddaby

Breeding numbers (table & figure 2.9.1)

Numbers at regularly monitored colonies in Shetland decreased by 8.7% overall between 1992 and 1993. On Foula, the total fell from 159 apparently occupied territories (AOTS) in 1992 to 144 in 1993, but there was little change on Fair Isle. At ten monitored colonies elsewhere in Shetland, overall numbers fell from 194 AOTs in 1992 to 171 in 1993, a reversal of the increase between 1991 and 1992. Numbers also decreased on Papa Westray, Orkney, from 151 AOTs in 1992 to 126 in 1993 (-16%) and Lewis (Western Isles) from 36 AOTs in 1992 to 19-24 AOTs in 1993.

The Fair Isle and Foula populations have shown no significant trend over the period 1986-93, although Foula had shown a marked decline up to 1990. Detailed trends elsewhere in Shetland are less well known, but there was little net change in the total population between full surveys in 1985/86 and 1992 (-1.4%, or -1.8% including Fair Isle and Foula). Total numbers in Orkney had likewise shown little change between 1982 and 1992 (+2.1%) (Meek *et al.* 1994).

Breeding success (table 2.9.2)

At monitored colonies in Shetland, other than Foula and Fair Isle, mean clutch size (1.85) and hatching success (78%) was slightly lower than in 1992, but there was little change in Orkney (mean clutch size = 1.87; hatching success = 68%). Fairly low hatching success on Noss, Shetland (50%) and Hoy, Orkney (43%) was attributed to continual pressure from neighbouring great skuas.

Productivity figures in Shetland were similar to 1992, ranging from 0.76-1.17 chicks/territory, with an average of 1.08 for colonies other than Foula and Fair Isle. This is well above the 1986-91 average of 0.23. Average productivity in Orkney (0.41 chicks/territory) was lower than in 1992, and below average for recent years, with all monitored colonies being affected, to varying degrees, by predation from great skuas and gulls. Predation was most notable on Hoy (where the study population failed totally) and Papa Westray.

Limited information from Lewis suggested a poor breeding season at the main colony there.

Discussion

Numbers at regularly monitored colonies in Shetland decreased by 8.7% between 1992 and 1993, returning to near 1991 levels (following an increase of 11.7% in 1992). Very few arctic skua chicks were reared in Shetland during 1988-90, and Furness (1988) pointed out that populations of this species would be highly vulnerable to prolonged periods of breeding failure. Success improved markedly in 1990 (Walsh *et al.* 1992) but a shortfall in numbers of recruits reared during 1988-89 (and expected to breed for the first time in 1992-93) may now be having an effect. Studies of ringed adults on Foula suggest that the rate of recruitment to that colony has been fairly low in recent years (Furness 1993).

Reversals in trends in 1993 were also noted on Orkney and Lewis. Reasons for these changes are unclear.

Sandeel abundance in inshore waters of Shetland was moderately high in 1993, similar to 1992 levels (Wright 1994), and this was reflected in initially high adult attendance at arctic skua colonies in Shetland and generally good breeding success. However, for reasons that are not clear, a period

of acute food shortage was noted from about 4 July onwards in most of Shetland, and from 12 July on Foula (Furness 1993), associated with low adult attendance. Some chicks at colonies in Shetland were noted to have lost weight rapidly from the beginning of July, and instances of chicks starving to death were recorded on Mousa and at Dalsetter. Weight-loss was also noted in some chicks at Orkney colonies in the same period, but the relative abundance of sandeels in Orkney waters was not known.

Due to low adult attendance during July, some colonies, e.g. Foula, Lumbister, Noss and Hoy, suffered chick predation by great skuas and, to a lesser extent, great black-backed gulls. Post-fledging mortality as a result of attacks from great skuas was noted in Shetland at Hermaness, and on Yell, Fetlar, Noss and Foula.

Table 2.9.1 **Population changes at monitored arctic skua colonies in Shetland, 1992-93** (apparently occupied territories in late May/June). Superscript = number of colonies counted in both years

	Foula	Fair Isle	other Shetland	total Shetland
1992	159	109	194	462
1993	144	107	171	422
% change	-9.4	-1.8	-11.8^{10}	-8.7^{12}

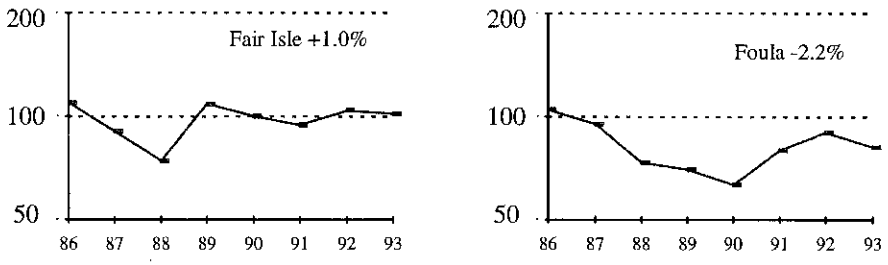

Figure 2.8.1 **Population indices for breeding arctic skuas on Foula and Fair Isle , Shetland, 1986-93 (apparently occupied territories).** Average annual rates of change are calculated by regression of log of index against year (neither trend is significant)

Table 2.9.4 **Arctic skua breeding success, 1986-93**: number of chicks fledged per apparently occupied territory (AOT)

Colony	1986-1991 fledged per AOT			1992 fledged per AOT		1993 fledged per AOT	
	years	mean	s.e.	n	mean	n	mean
Handa	4	**1.18**	0.06		-		-
SHETLAND							
Unst (2 colonies)	4	**0.25**	0.12	43	**0.95**	39	**0.93**
Fetlar (2 colonies)	5	**0.20**	0.16	25	**1.60**	21	**1.14**
Yell (2 colonies)	4	**0.37**	0.18	28	**1.54**	24	**1.08**
Papa Stour	4	**0.13**	0.12		-	-	-
Noss	6	**0.36**	0.11	17	**1.18**	14	**0.86**
Mousa	3	**0.25**	0.25	25	**0.68**	23	**1.17**
Mainland (3 colonies)	4	**0.18**	0.11	40	**0.95**	37	**1.03**
SHETLAND mean ±s.e. excluding Foula and Fair Isle	5	**0.23**	0.11	178(11)	**1.13±0.12**	158(11)	**1.08±0.06**
Foula	5	**0.40**	0.20	159	**1.07**	144	**c1.05**
Fair Isle	4	**0.63**	0.29	109	***c*1.20**	107	**0.76-0.93**
ORKNEY							
North Hill, Papa Westray	3	**0.44**	0.18	151	**0.79**	126	**0.44**
Westray	2	**0.41**	0.01	33	**0.51**	33	**0.73**
Rousay	3	**0.58**	0.15	30	**0.65**	29	**0.48**
Flotta	2	**0.89**	0.06	24	**0.75**	-	-
Lushan Basin, Mainland	3	**0.66**	0.10	22	**1.09**	23	**0.52**
Hoy	2	**0.04**	0.04	20	**0.20**	15	**0.0**
ORKNEY mean±s.e.	3	**0.49**	0.06	28(6)	**0.66±0.12**	226(5)	**0.41±0.12**

2.10 Great skua *Stercorarius skua*

Dave Suddaby

Breeding numbers

In Shetland, excluding Foula and Fair Isle, numbers at eight monitored colonies increased slightly in 1993 (+3%). A notable increase continued at one colony, Noss Hill, from 20 apparently occupied territories (AOTs) in 1991 to 30 in 1992 and 36 in 1993. The breeding season was not protracted as in 1992. On Fair Isle, numbers decreased by 8.2%, from 110 AOTs in 1992 to 101 AOTs in 1993 after an increase of 39% in 1992. On Foula, breeding and non-breeding populations continued to decline, although a full breeding census was not made. This is still by far the largest great skua colony in the North Atlantic, despite a significant decline from 2495 AOTs in 1986 to 2174 in 1992.

At study plots on Hoy, Orkney, no change in numbers was noted. In contrast, on Hirta, St. Kilda, a record total of 107-112 AOTs was counted, with 95 nests found in 1993 representing a 79% increase compared to 53 nests in 1992. Although some of this increase was apparently real, increased survey effort may have been the major factor. Also in the Western Isles, numbers at the main Lewis colony fell from 18 AOTs in 1992 to 10-12 in 1993, while on North Rona 15-18 AOTs were found in 1993, perhaps little changed from 14 AOTs in 1986 (Murray & Love 1993).

Breeding success (table 2.10.1)

At monitored colonies in Shetland, excluding Foula and Fair Isle, mean clutch size (1.87) and hatching success (76%) were similar to 1992 figures, but average productivity increased from 0.67 chicks fledged/territory in 1992 to 0.83 in 1993. On Fair Isle, average productivity also increased to between 0.99 and 1.19 fledged/territory, the highest figure there since monitoring began (Jenks *et al.* 1993). On Foula, average productivity was similar to 1992 at *c*0.5 fledged/territory. On Hoy, Orkney, average productivity fell from 0.55 fledged/territory in 1992 to 0.35 in 1993; this decrease was largely the result of cannibalism.

At the main colony on Lewis (Western Isles) average productivity was high at *c*1.5 fledged/territory. On Hirta, St Kilda, 107 chicks were ringed (others were probably missed) and it was evidently a successful season.

Discussion

On Foula, the continued decrease in numbers reflects a decrease in the number of potential recruits; adult mortality was high during the period of poor sandeel availability in the mid/late 1980s, apparently leading to high recruitment rates which virtually exhausted the supply of potential recruits. Given that few chicks have fledged from Foula in recent years, recruitment rates are likely to remain low and further population declines seem inevitable (Furness 1993). Nevertheless, great skua populations in the northern isles are currently at a high level: a full survey in 1992 recorded a 22% increase in Orkney since 1982 and a 10% increase in Shetland since 1985/86 (Meek *et al.* 1992, Walsh *et al.* 1993).

On the basis of 1993 figures, St Kilda may now hold the largest great skua colony in the west of Scotland (unless the Handa population has increased from 92 AOTs in 1991). Assessing population changes of skuas using nest-counts is difficult, as changes in intensity of survey effort can markedly affect figures. This was well shown on St Kilda in 1993, and is one of the main reasons why counts of AOTs are the preferred method for skua censusing (Furness 1982).

The increase in average productivity in Shetland, apart from Foula, was due to much-reduced predation of chicks by neighbouring great skuas, especially at Mousa and the two Mainland study-colonies. On Foula, availability of food (predominantly sandeels) appeared to be good during early chick-rearing, and adult attendance was high up to 12 July. Conditions deteriorated after this date and adult attendance decreased to very low levels, resulting in heavy predation of chicks. About 30% of chicks which had survived up to 12 July were killed over the following 18 days by other adults (Furness 1993). In addition to predation of younger chicks, post-fledging mortality as a result of attacks from other great skuas was noted in Shetland on Unst, Fetlar, Noss, and Foula.

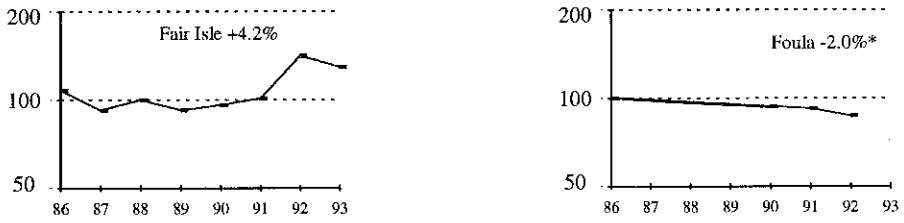

Figure 2.8.1 **Population indices for breeding great skuas on Foula and Fair Isle , Shetland, 1986-93 (apparently occupied territories).** Average annual rates of change are calculated by regression of log of index against year (significant trend: * P<0.05)

Table 2.10.1 **Great skua breeding success, 1986-93**: number of chicks fledged per apparently occupied territory (AOT)

Colony	1986-1991 fledged per AOT			1992 fledged per AOT		1993 fledged per AOT	
	yrs	mean	se	n	mean	n	mean
Handa (Sutherland)	3	**1.21**	0.03		-		-
SHETLAND							
Hermaness	4	**≤0.84**	0.01	44	**1.07**	43	**0.98**
Fetlar (1-2 colonies)	3	**0.35**	0.19	25	**1.12**	58	**0.83**
Mainland (2-4 colonies)	1	**0.18**		58	**0.28**	53	**0.64**
Yell (1 colony)	1	**0.93**		23	**0.96**	23	**0.74**
Mousa		-			-	10	**0.90**
Noss	4	**≤0.38**	0.12	51	**0.69**	52	**0.86**
SHETLAND mean±s.e. excluding Foula and Fair Isle	4	**≤0.52**	0.15	201(7)	**0.67±0.15**	239(8)	**0.83±0.08**
Fair Isle	3	**0.73**	0.12	110	**0.5-0.8**	101	**0.99-1.19**
Foula	5	**0.39**	0.14	2174	**0.4-0.5**		***c*0.5**
ORKNEY							
NW Hoy	3	**0.76**	0.14	32	**0.50**	32	**0.38**
S Hoy	1	**0.83**		33	**0.65**	30	**0.37**
E Hoy	1	**1.08**		26	**0.50**	31	**0.29**
*HOY mean±s.e.	1	**0.80**		91(3)	**0.55±0.05**	93(3)	**0.34±0.03**

2.11-2.15 Black-headed gull *Larus ridibundus* / common gull *L. canus* / lesser black-backed gull *L. fuscus* / herring gull *L. argentatus* / great black-backed gull *L. marinus*

Fuller summaries for these species will be given in next year's report. Among the most notable results for 1993 was almost total breeding failure by black-headed and common gulls at study colonies in the west of Scotland. For both species there, less than 0.15 chicks fledged per pair overall; predation by mink *Mustela vison* was recorded at virtually every colony (cf. accounts for common and arctic terns, and Craik 1993). Lesser black-backed gulls again had a poor season on Skomer (Dyfed), with only 0.1-0.2 chicks fledged/pair, lower than in 1992. Nevertheless, counts of this species at major colonies in Wales, NW England and SE Scotland indicated continued rapid population increase. Recent trends for herring gulls suggest that most regional populations are roughly stable or are decreasing. A survey of gulls breeding inland in NW Ireland in 1992-93 indicated that total numbers had declined by *c*38% since 1977-78, including a 32-38% decrease by lesser black-backed, black-headed and common gulls, a 52% decrease by great black-backed gulls, and a 93% decrease by herring gulls (Whilde *et al.* 1993).

A survey of roof-nesting gulls in Britain and Ireland is being organised by Durham University in 1994; the last full survey was in 1976.

2.16 Kittiwake *Rissa tridactyla*

Breeding numbers (table 2.16.1, figures 2.16.1)

Based on sample populations, all monitored regions in Scotland and England showed a decrease in numbers between 1992 and 1993 (although sample sizes were small in some regions). Most notable were a 19% decline in Shetland, a 16% decline in SE England and a 20% decline in SW England (mainly the small Isle of Scilly population). In contrast, monitored populations in Wales showed a 10% increase, while those in SE Ireland showed little changed little compared to 1992.

In the longer term, few regions show any significant trend over the period 1986-93, suggesting broadly stable numbers. One exception is SE Ireland, with a significant decline over this period (levelling out in 1993). In Shetland, detailed trends are difficult to assess quantitatively, because different lengths of coast may be counted in consecutive years, but, a significant decline is evident since 1981 if counts from recent three-year periods are pooled. In SW England, breeding numbers in the Isles of Scilly have fallen from 584 nests in 1987 to *c*305 in 1992 and 262 in 1993 (Robinson 1993) but overall trends for the region are unclear.

Breeding success (table 2.16.2, figure 2.16.2)

Overall productivity was only moderately high, with 54 colonies averaging 0.63 (±s.e. 0.05) chicks fledged/nest. This is similar to 1991 levels, but significantly lower than in 1992 (average change -0.15 ±0.05 chicks nest, $t_{46} = 2.92$, $P<0.01$). Most of the reduction in success involved colonies along the North Sea coast, from Shetland southwards, where average productivity declined significantly to 0.74 (±0.07) chicks/nest at 31 colonies (average change -0.29 ±0.07, $t_{26} = 4.00$, $P<0.001$). Kittiwakes in NE and SE Scotland were the least successful overall, averaging only 0.22 (+0.07) chicks/nest at six colonies (an average reduction by 0.86 ±0.15 chicks/nest, $t_3 = 5.85$, $P<0.001$). Those on the Isle of May (NE Fife) had their worst recorded season, with only 0.07 chicks fledged/nest. Reduced success was evident at virtually every colony north of Humberside, but birds in Orkney, N Scotland and NE England were nevertheless quite successful, on average fledging 0.9-1.0 chicks/nest. In Shetland, success was moderately high overall (0.67 ±0.16 chicks/nest), but very variable: the Kettla Ness colony failed totally as a result of predation by great skuas, but Sumburgh Head was one of the most successful colonies anywhere (1.24 chicks/nest).

Kittiwakes on the west coast of Scotland showed little overall change, averaging 0.60 (±0.05) chicks/nest, with Handa (Sutherland) again the most successful colony (1.27/nest). Productivity remained low at 'southwestern' colonies from the Isle of Man south to SW England and SE Ireland: an average of 0.43 (±0.06) chicks fledged/nest, only slightly higher than in 1992. The least successful colonies were Bardsey, Gwynedd (0.04 chicks/nest) and Start Point, Devon (total failure), although local disturbance (sand-blasting of a lighthouse) was believed responsible for the latter. Productivity was moderately high at colonies in SW Ireland, but remained rather low (0.47/nest) at Inishmore (Galway) in NW Ireland.

Regional and annual variations in kittiwake success are summarised in figure 2.16.2 for the period 1986-93. Of the broad regions shown, only colonies on the coasts of NE and SE Scotland, and NE to SE England, have shown any significant trend (significant declines in productivity over the period).

Discussion

The broad-scale reductions in breeding success and numbers at colonies along the North Sea coast in 1993 might suggest that some common factors were operating. Whether reduced breeding success had any common cause with reduced numbers is far from clear, however, and the detailed patterns shown by both parameters were not straightforward. Breeding output at Scottish colonies south of the Moray Firth was only 30-50% that of colonies further north or south, and it may be that food availability was particularly low off NE and SE Scotland. Reductions in breeding numbers, in contrast, were most severe in Shetland (an ongoing decline) and in SE England.

More detailed analysis aimed at examining links between kittiwake breeding success, numbers, survival rates and environmental factors is underway. At colonies where few chicks have been produced in recent years (e.g. in the Isles of Scilly), reduced recruitment may account for some of the declines noted in breeding numbers; possible changes in adult survival rates or in emigration rates from the colonies are usually unclear, however.

Table 2.16.1 **Population changes at monitored kittiwake colonies, 1992-93** (apparently occupied nests in late May/June). Superscript = number of colonies with 10+ AONs counted in 1992; counts with a reported inaccuracy of >±5%, and regional samples <100 AONs, are excluded

	SW Scotland	NW Scotland	Shetland	N Scotland	NE Scotland	SE Scotland
1992	270	1598	3789	4475	576	24868
1993	240	1458	3076	4238	531	23518
% change	-11.1[1]	-8.8[2]	-18.8[9]	-5.3[5]	-7.8[1]	-5.4[6]

	NE England	SE England	SW England	Wales	SE Ireland
1992	7321	2878	431	2600	2980
1993	6899	2413	346	2873	2990
% change	-5.8[2]	-16.2[3]	-19.7[7]	+10.5[3]	+0.3[5]

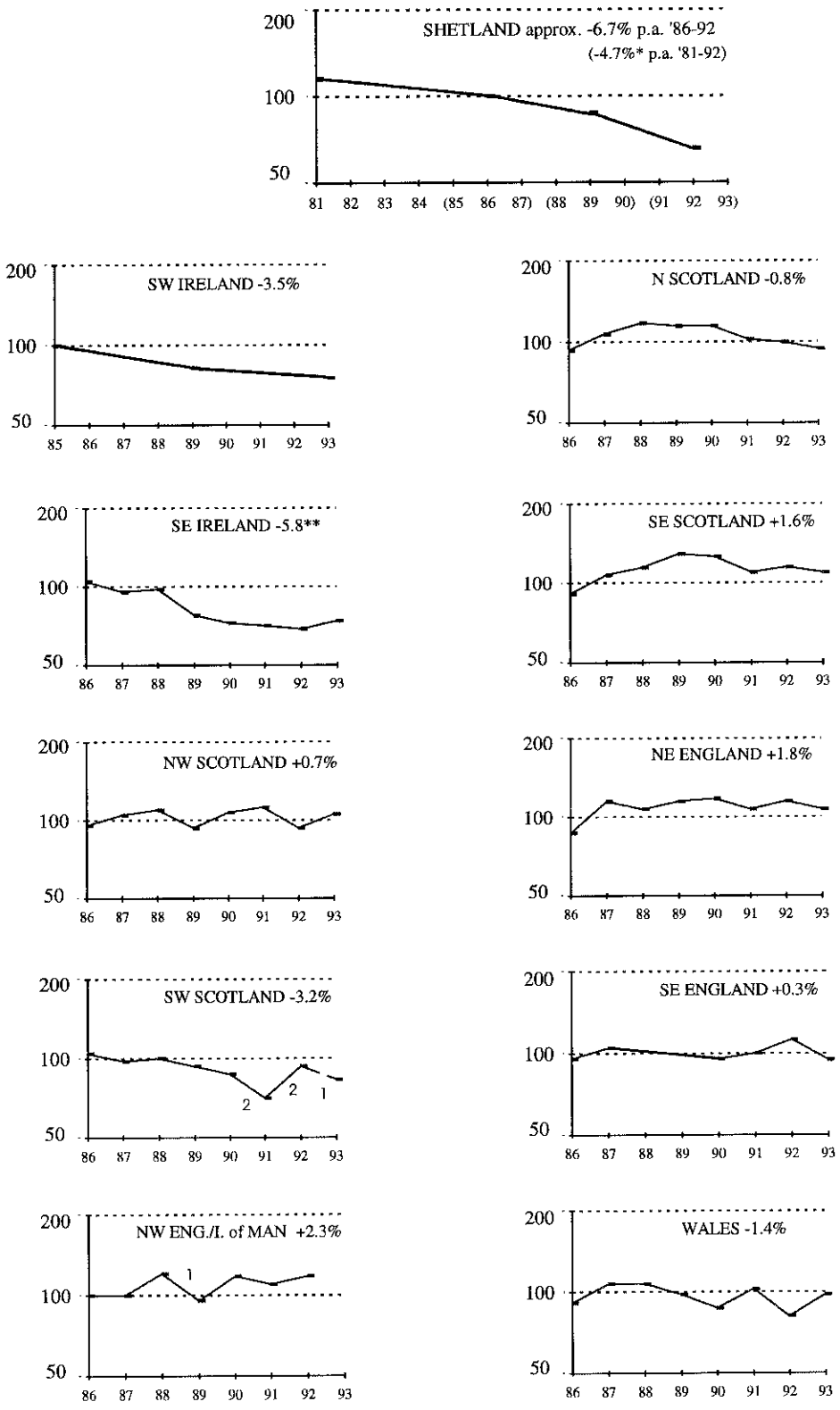

Figure 2.16.1 **Regional population indices for breeding kittiwakes, 1986-93 (occupied nests in June).** Average annual rates of change are calculated by regression of log of index against year (significant trends: * P<0.05; ** P<0.01; *** P<0.001). For Shetland, chain indices are presented for 1981, 1985-87 (average plotted as 1986 index), 1988-90 and 1991-93. For SW Ireland, the period 1985-93 is used. Broken trend lines are based on sample counts of 100-500 AONs. Number of colonies counted in each region in each year = 3+ (unless 1 or 2 indicated)

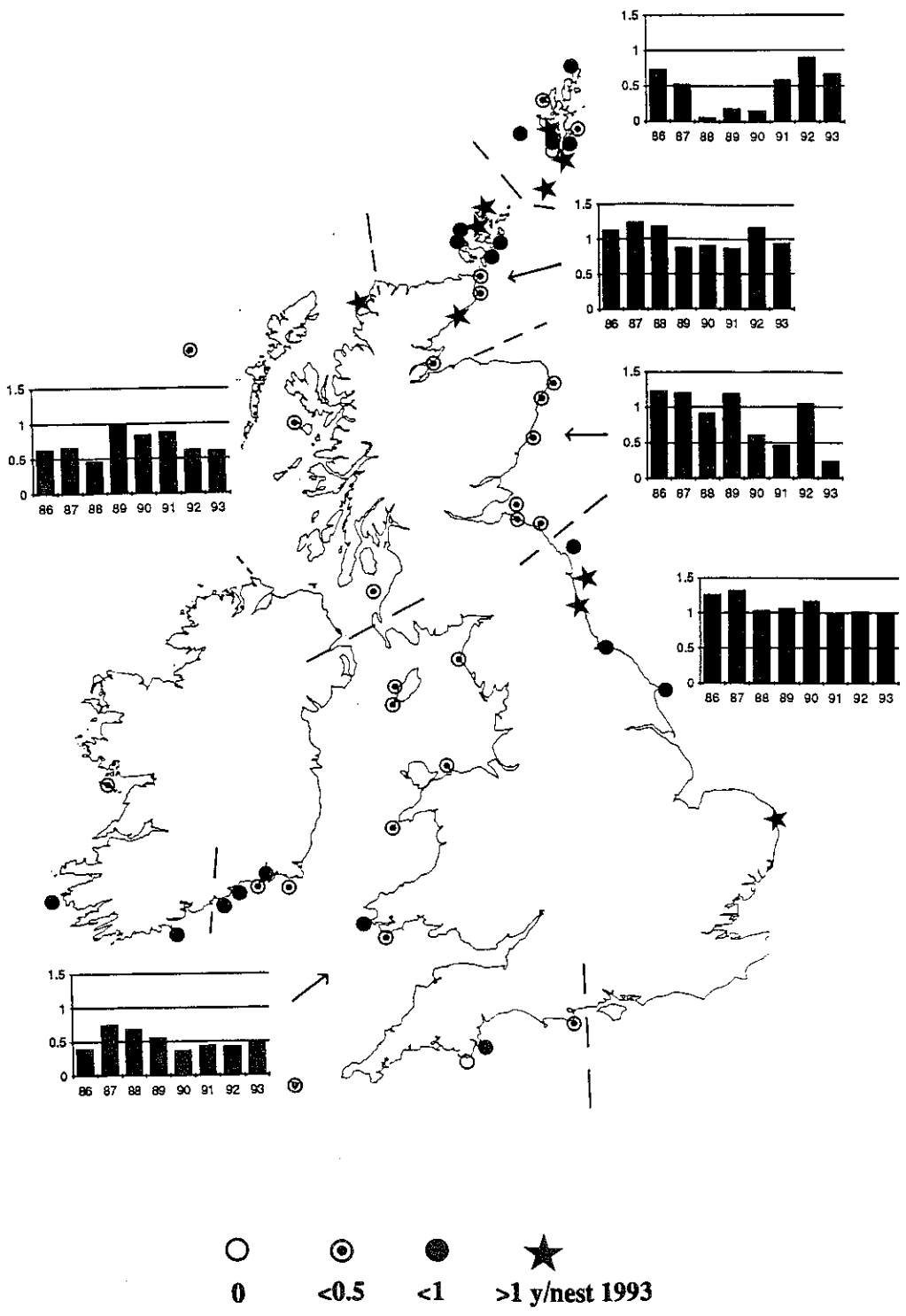

Figure 2.16.2 **Breeding productivity (chicks fledged / well-built nest) at kittiwake colonies during 1986-93, showing regional and annual variation.** Dot symbols represent 1993 figures; histograms show annual averages for sample colonies in each broad region.

Table 2.16.2 **Kittiwake breeding success, 1986-93**: number of chicks fledged per occupied, well-built nest ('apparently occupied nest' or AON). For 1992 and 1993, productivity is expressed as mean & standard error of figures from three or more plots (standard error is equivalent to half-range of figures from two plots); n = number of nests (plots). * indicates coverage of most or all of colony

Colony	**1986-91 fledged/nest**			**1992 fledged/nest**			**1993 fledged/nest**		
	yrs	**mean**	s.e.	n	**mean**	s.e.	n	**mean**	s.e.
Ailsa Craig (Kyle & Carrick)	5	(^)**0.16**	0.05	128(2)	**0.29**	0.06	131(2)	**0.37**	0.25
Tormisdale, Islay (Argyll & Bute)	3	**1.14**	0.09		-			-	
Colonsay (Argyll & Bute)	5	**0.80**	0.08	477(3)	**0.78**	0.04		-	
Canna (Lochaber)	6	**0.55**	0.13	314(2)	**0.42**	0.30	361(2)	**0.42**	0.21
St Kilda (Western Isles)	6	**0.61**	0.08	394(6)	**0.38**	0.05	528(7)	**0.36**	0.07
Eilean Mor, Flannans (W. Isles)	1	**0.39**			-			-	
Eilean Mhuire, Shiants (W. Isles)	1	**0.68**			-			-	
Stac Shuardail, Lewis (W. Isles)	2	**1.12**	0.20		-			-	
Tiumpan Hd, Lewis (Western Isles)	1	**1.04**			-			-	
Cellar Head, Lewis (Western Isles)	2	**0.93**	0.38		-			-	
Spainneavaig, Lewis (Western Isles)	1	**0.88**			-			-	
Handa (Sutherland)	5	**1.24**	0.16	311(5)	**1.22**	0.05	290(5)	**1.27**	0.03
Faraid Head (Sutherland)	2	**1.63**	0.25		-			-	
Hermaness, Unst (Shetland)	3	**0.66**	0.2	166(2)	**1.18**	0.15	128(2)	**0.61**	0.12
Fetlar (Shetland)	1	**0.16**			-			-	
Eshaness (Shetland)	6	**0.6**	0.04	303(2)	**0.81**	0.03	244(2)	**0.04**	0.03
Westerwick (Shetland)	3	**0.39**	0.19	56(*)	**0.55**		49(*)	**1.06**	
Foula (Shetland)	4	**0.61**	0.13		**<1.39**			**<0.92**	
Kettla Ness (Shetland)	3	**0.42**	0.19	88(*)	**0.0**		38(*)	**0.0**	
Noss (Shetland)	3	**0.34**	0.12	181(3)	**0.48**	0.15	409(4)	**0.35**	0.09
Ramna Geo, Burra (Shetland)		-			-		93(*)	**0.79**	
Troswick Ness (Shetland)	3	**0.6**	0.2	89(2)	**0.92**	0.29	73(2)	**0.89**	0.02
Sumburgh Head (Shetland)	5	**0.45**	0.19	161(4)	**1.49**	0.14	133(4)	**1.24**	0.29
Fair Isle (Shetland)	5	**0.68**	0.19	1230(10)	**1.30**	0.04	997(10)	**1.08**	0.06
Fowl Craig, Papa Westray (Orkney)	3	**0.66**	0.05	241(*)	**1.09**		1.39	**1.07**	
Rousay (Orkney)	3	**0.88**	0.04	351(4)	**1.03**	0.02	323	**1.08**	
Costa Head (Orkney)	5	(^)**1.17**	0.10		-			-	
Marwick Head (Orkney)	6	**1.08**	0.05	288(4)	**1.17**	0.06	224(4)	**0.93**	0.03
Row Head (Orkney)	6	(^)**1.11**	0.06	350(4)	**1.02**	0.08	248(4)	**0.90**	0.03

Colony	1986-91 fledged/nest			1992 fledged/nest			1993 fledged/nest		
	yrs	mean	s.e.	n	mean	s.e.	n	mean	s.e.
Mull Head (Orkney)	6	(^)**0.99**	0.06	249(2)	**1.28**	0.10	223(2)	**0.89**	0.03
Gultak (Orkney)	6	(^)**0.85**	0.09	128(2)	**1.40**	0.0	98(2)	**0.61**	0.11
Sandside Head (Caithness)	1	**0.62**	-		-			-	
Skirza Head a (Caithness)	3	**0.69**	0.09	205(1)	**1.27**			-	
Skirza Head b	6	**^1.00**	0.10	205(1)	**^1.28**		179(1)	**^0.90**	
Iresgeo a (Caithness)	3	**0.87**	0.12	264(3)	**1.38**			-	
Iresgeo b	6	**^1.09**	0.10	264(3)	**^1.41**	0.08	251(2)	**^0.95**	0.03
An Dun a (Caithness)	3	**0.91**	0.25	313(2)	**1.33**			-	
An Dun b	6	**^1.17**	0.15	313(2)	**^1.39**	0.10	287(2)	**^1.11**	0.09
North Sutor (Ross & Cromarty)	2	**0.86**	0.02	156(2)	**0.64**	0.22	162(2)	**0.94**	0.10
Covesea (Moray)	3	**0.76**	0.09		-			-	
Bullers of Buchan (Banff & Buchan)	3	**0.91**	0.23		-		289(4)	**0.30**	0.08
Sands of Forvie (Gordon)	3	**0.54**	0.15	148(2)	**1.02**	0.28	136(2)	**0.01**	
Fowlsheugh (Kincardine & Deeside)	5	**1.06**	0.12		-		674(9)	**0.38**	0.03
Isle of May (NE Fife)	6	**0.80**	0.19	1062(15)	**0.61**	0.05	1034(15)	**0.07**	0.03
Dunbar (E Lothian)	5	**1.13**	0.16	379	**1.53**		295	**0.34**	
St Abb's Head (Berwickshire)	5	(^)**0.86**	0.15	1262(3)	**1.03**	0.05	1247(3)	**0.33**	0.15
Farne Islands (Northumberland)	5	**1.05**	0.13	620(11)	**1.08**	0.11	487(9)	**0.73**	0.10
Coquet Island (Northumberland)		-			-		21(*)	**1.28**	
North Shields (Tyne & Wear)	3	**1.30**	0.07		-			-	
Gateshead (Tyne & Wear)	3	**1.17**	0.08	269(*)	**1.18**		284(*)	**1.08**	
Marsden Rock (Tyne & Wear)	1	**0.96**			-			-	
Saltburn (Cleveland)	6	**1.03**	0.04	220(3)	**1.15**	0.05	305(3)	**0.89**	0.05
Bempton (Humberside)	6	**1.19**	0.15	376(6)	**0.93**	0.05	278(6)	**0.93**	0.07
Lowestoft (Suffolk)	6	**1.19**	0.17	203(*)	**1.15**		167(*)	**1.17**	
South Foreland (Kent)	1	**0.88**		122(3)	**0.90**	0.07		-	
Newhaven-Peacehaven (E Sussex)		-		289(5)	**0.74**	0.18		-	
Durlston Hd-St Alban's Hd (Dorset)	1	**^0.21**	-	124(*)	**^0.42**		84(*)	**^0.50**	
Berry Head (Devon)	6	**0.75**	0.11	120(1)	**0.46**	-	62(1)	**0.69**	
Start Point (Devon)				293(*)	**0.41**	0.03	220(3)	**0**	
Trewavas Head (Cornwall)	1	**0.04**	-		-			-	

Colony	1986-91 fledged/nest			1992 fledged/nest			1993 fledged/nest		
	yrs	mean	s.e.	n	mean	s.e.	n	mean	s.e.
Isles of Scilly(^)	1	**0.03**		301(*)	**0.23**		249(*)	**0.22**	
Lundy (Devon)	4	**≤0.58**	0.22		-			-	
Woody Bay (Devon)	1	**0.17**		200(*)	**0.50**			-	
Devil's Truck (W Glamorgan)	1	**^0.16**		66	**^0.48**			-	
Elegug Stacks (Dyfed)	1	**0.12**		255(6)	**0.13**	0.10	252(5)	**0.38**	0.12
Skomer (Dyfed)	6	**0.70**	0.08	1117(3)	**0.47**	0.12	1244(3)	**0.66**	0.09
Bardsey (Gwynedd)	4	**0.62**	0.19		-		52(1)	**0.04**	
Great Ormes Head (Gwynedd)	3	**0.34**	0.09	195	**0.53**		157	**0.34**	
Puffin Island (Gwynedd)	1	**^0.70**			-			-	
Calf of Man (Isle of Man)	6	**0.25**	0.06	158(2)	**0.30**	0.04	139(3)	**0.31**	0.25
Around Peel Hill (Isle of Man)		-		41	**^0.0**		121(3)	**^0.39**	0.22
St Bee's Head (Cumbria)	6	**0.51**	0.18	112(2)	**0.67**	0.02	68(3)	**0.29**	0.03
Rathlin Island (Antrim)	2	**0.63**	0.42		-			-	
Rockabill (Dublin)	2	**^0.68**	0.17		-			-	
Wicklow Head (Wicklow)	1	**^1.36**			-			-	
Great Saltee (Wexford)	2	**^0.39**	0.03	1109(5)	**^0.48**	0.09	1369	**^0.47**	
Dunmore East a (Waterford)	6	**0.59**	0.09	160(1)	**0.41**	-	147(1)	**0.54**	
Dunmore East b	6	**^0.64**	0.08	897(*)	**^0.52**	-	986(*)	**^0.72**	
Portally (Waterford)	6	**^0.57**	0.2	105(*)	**^0.28**	-	102(*)	**^0.39**	
Helvick Head (Waterford)	3	**^0.42**	0.08	383	**^0.59**	-	535	**^0.85**	
Ram Head (Waterford)	3	**^0.53**	0.07	486	**^0.67**	-	517	**^0.70**	
Big Doon (Cork)	1	**^0.33**			-			-	
Old Head of Kinsale (Cork)	1	**^0.59**			-		757	**^0.89**	
Great Skellig (Kerry)		-			-		521	**^0.66**	
Cliffs of Moher (Clare)	1	**<0.44**		451(4)	**^0.82**	0.02		-	
Inishmore, Aran Islands (Galway)	3	**0.24**	0.3	441(*)	**0.53**			**0.47**	

^ = productivity based on comparison of no. of large chicks present in mid July with peak or single late May-mid June count of AONs in study plots. (^) = data for some years or subcolonies are based on latter method.
< = productivity based on late June/early July counts of both AONs and chicks.

a, b = results based on different methods at same colony

2.17 Sandwich tern *Sterna sandvicensis*

Figures are approximate as counts of 'nests' and 'pairs' have been combined to obtain overall regional estimates.

Breeding numbers (tables 2.17.1-2, figure 2.17.1)

Twenty-eight major colonies have been counted regularly since 1986. Numbers in 1993 were *c*10% lower than in 1992 although as usual there was much regional variation. NE Scotland was one of the regions to show an increase in numbers, from 333 pairs in 1992 to 515 pairs this year (+55%). In SE Scotland, while numbers rose by 58% overall, the colony at Inchmickery declined by 92% from 112 pairs last year to only 9; birds perhaps moved to a second Forth colony, which held 250+ pairs this year (40 in 1992). In NE England, numbers on Coquet and the Farne Islands fell by *c*20% from 4861 pairs in 1992 to *c*3858 pairs. The decline in E England was also steep at 13%, with numbers increasing at Scolt Head in Norfolk, although halving at Foulness/Maplin. In SE England, numbers fell by 29% to *c*364 pairs this year; the largest decline was at Dungeness where numbers fell by 84%. SW England, however, saw an increase from 82 to 120 pairs at Brownsea. Numbers in NW England also fell sharply, by 56%, from 810 pairs in 1992 to 353 pairs, largely because none bred at South Walney this year. NE Ireland colonies, however, showed an increase of 53% on last year's numbers, from 897 to 1372 nests. Numbers in SE and NW Ireland also increased, by *c*11% and 9% respectively.

Taking 1992-93 changes into account, population indices over the period 1986-93 show few obvious trends, the exception being SE Ireland, where there has been a significant increase at the single colony there.

Breeding success (table 2.17.3)

At 18 colonies monitored in both 1992 and 1993, *c*6158 pairs this year fledged up to *c*4224 young, giving a maximal estimate of *c*0.69 fledged young/pair (0.75 for all 20 colonies monitored in 1993). Although relatively high in relation to past years, this represented a drop from the 1992 value of 0.90/pair at these colonies. In NE Scotland, productivity was low, heavy rain and predation by foxes *Vulpes vulpes* accounting for many of the failures at Strathbeg. Here, 515 pairs fledged 41+ young (0.08/pair compared to 0.49 in the previous year). In SE Scotland, however, 250+ pairs at one of the Forth colonies hatched *c*190 young (0.76/pair), indicating that fledging success was lower than in 1992 (1.2 chicks fledged/pair). On Lindisfarne, NE England, all 40+ scrapes were predated by foxes. Colonies in E England fared well with 3400 pairs at three colonies raising *c*2948 young (*c*0.86 young fledged/pair compared to 0.96 in 1992). Productivity was particularly good at Scolt Head, where 853 pairs nested, raising *c*1000 young. This success was thought to be largely a result of a good food supply and reduced predation by foxes. At Blakeney, 3000 pairs raised *c*2600 young (0.86 fledged/pair), again thought to be aided by a plentiful food supply. At Maplin/Foulness, success continued with 0.91 young fledged per pair compared to *c*0.73 in 1992. In SE England, productivity was similar to 1992 with 1.29 young fledged/pair compared to 1.32 fledged/pair last year. In SW England, 123 pairs at two colonies hatched *c*92 young and productivity was probably slightly lower than in 1992 (0.80 fledged/pair). At the Anglesey colony, 168+ young fledged from 564 nests (0.3+ fledged/pair). In NW England, terns fared well at Foulney Island (where none bred in 1992), with a productivity of 0.85. However, Hodbarrow saw all young (raised by 100 pairs) taken by stoats *Mustela erminea*. In NE Ireland, numbers of young fledged were extremely low due to severe weather, but approximately 200 young were ringed at two colonies in NW Ireland, giving a minimum productivity of 0.84 fledged/pair. At another colony in this region, however, productivity

fell to only 0.19/pair in 1993 from 0.4/pair in 1992.

Discussion

As is often the case, Sandwich tern colonies have shown variable changes in different regions, likely in some cases to reflect movements of birds between different regions. Overall numbers declined in 1993, with particular drops in SE and NW England. Colonies in Ireland, however, have increased, and population in Britain and Ireland as a whole seems reasonably stable. Productivity also fell in 1993, with foxes, stoats and bad weather all contributing to lower breeding success. Interestingly, colonies in SE England had higher productivity, thought to be aided by a plentiful food supply.

These regional variations emphasise the need for long-term monitoring of Sandwich terns at as many colonies as possible throughout Britain and Ireland.

Table 2.17.1 **Numbers of Sandwich tern breeding pairs at regularly-counted colonies in Britain and Ireland, 1986-93.**

Colony	1986	1987	1988	1989	1990	1991	1992	1993
Loch of Strathbeg	493	130	404	239	121	283	304	515
Sands of Forvie	597	1082	664	744	1126	1115	29	0
Inchmickery	416	656	383	272	418	473	112	9
Coquet Island	1049	1586	1616	1164	1203	1736	2131	1469
Farne Islands	3456	2870	3408	3445	2846	2126	2730	2349
Scolt Head	2550	3089	2775	1052	0	320	280	853
Blakeney Point	1000	475	1000	1500	3000	3000	4000	3000
Minsmere	1	0	0	0	5	20	0	0
Havergate	145	200	63	50	60	84	70	125
Foulness/Maplin	98	243	350	300	280	280	548	275
Dungeness	350	3	125	220	240	250	250	40
Rye Harbour	42	155	0	3	25	2	0	90
Pagham Harbour	0	0	0	0	26	2	0	0
Chichester Harbour	12	27	0	15	22	5	27	45
Langstone Harbour	0	3	2	0	0	0	0	0
North West Solent	176	220	305	198	150	151	150	85
Pitts Deep-Hurst	45	50	70	?	25	0	90	103
Brownsea Island	103	25	72	90	64	75	82	120
Anglesey	450	700	1080	830	517	601	500	564
South Walney	45	180	0	0	0	0	450	0
Foulney	400	550	700	770	720	332	0	253
Hodbarrow	0	0	0	50	120	520	360	100
Swan Island	63	74	117	138	130	135	132	*c*64
Green Island	61	286	78	36	59	172	108	*c*721
Strangford Lough	1418	2127	2228	962	1482	879	657	587
Lady`s Island Lake	524	708	412	1317	1395	1469	1129	1254
Lough Swilly	95	102	73	76	109	99	116	119
Mulroy Bay	112	98	225	240	79	76	107	117
Total	13701	15639	16150	13763+	14122	14205	14333	12857

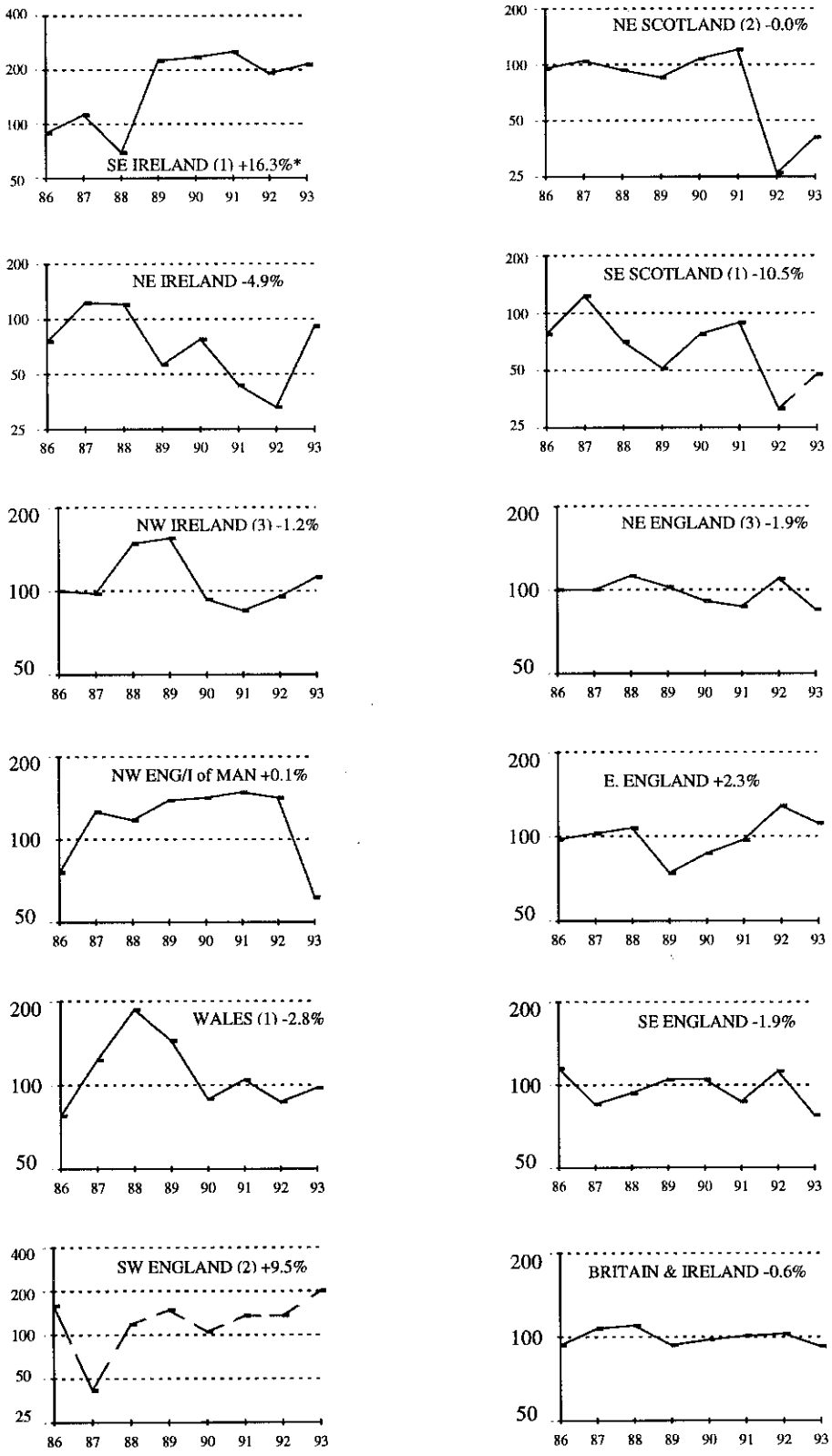

Figure 2.17.1 **Population indices for breeding Sandwich terns, 1986-93 (pairs or apparently occupied nests).** Average annual rates of change are calculated by regression of log of index against year (significant trends: * P<0.05). Broken trend lines are based on sample counts of 20-200 pairs. Number of colonies counted in each region in each year = 3+ (unless 1 or 2 indicated)

Table 2.17.2 **Population changes at monitored Sandwich tern colonies, 1992-1993 (breeding pairs).** Superscript = number of colonies counted in both years (including known colonies not occupied in 1992-93)

	N Scotland	NE Scotland	SE Scotland	NE England	E England	SE England	Wales
1992	230	333	162	4861	4898	517	500
1993	0	515	259	3858	4253	364	564
% change	-100.0[1]	+54.6[2]	+58.9[2]	-20.6[3]	-13.2[5]	-29.6[7]	+12.8[1]

	SW. England	NW England	NE Ireland	SE Ireland	NW Ireland	TOTAL
1992	82	810	897	1129	263	14682
1993	123	353	1372	1254	287	13202
% change	+50.0[1]	-56.4[3]	+52.9[3]	+11.1[1]	+9.1[3]	-10.1[33]

Table 2.17.3 **Sandwich tern breeding success, 1986-93**: estimated number of chicks fledged per breeding pair at sample colonies (superscript ^{n} = number of colonies). Note that the same colonies have not necessarily been monitored in each region each year, and that numbers of pairs given here are sample sizes (and do not necessarily indicate population changes between years). See text for further details (including 1992-93 comparisons for colonies studied in both years)

Region	**1986-91**	**fledged/pair**		**1992**	**fledged/pair**		**1993**	**fledged/pair**	
	years	**mean**	se	prs^{n}	range	**total**	prs^{n}	range	**total**
Orkney	1	**0.63**				-			-
N Scotland	2	**few**		230[1]		**0.35**			-
NE Scotland	6	**0.63**	0.1	304[1]		***c*0.48**	515[1]		**0.08**
SE Scotland		-		40[1]		**1.20**	259[2]	0.0-0.76	**≤0.73**
NE England	6	**0.82**	0.03			-	40[1]		**0.0**
E England	6	**0.63**	0.15	4618[3]	0.57-1.00	**0.96**	4253[4]	0.78-1.17	**0.93**
SE England	6	**0.77**	0.10	277[2]	0.55-1.4+	**1.32+**	175[3]	1.12-1.4	**1.29**
SW England	3	**0.89**	0.27	82[1]		**0.80**	123[2]	0.0-0.76	**≤0.76**
Wales	3	**0.64**	0.08			-	564[1]		**0.3**
NW England	6	**0.53**	0.16	810[2]	0.0-0.31	**0.17**	353[2]	0.0-0.85	**0.61**
SE Ireland	2	**0.65**	0.09	1129[1]		***c*1.00**	1254[1]		***c*0.40**
NW Ireland		-		40[1]		***c*0.40**	287[3]	0.2-1.01	**0.72**
TOTAL	6	**0.68**	0.07	7530[13]	0.0-1.4+	**0.85**	7424[20]	0.0-1.4	**≤0.75**

2.18 Roseate tern *Sterna dougallii*

Figures are approximate as counts of 'nests' and 'pairs' have been combined to obtain overall regional estimates.

Breeding numbers (table 2.18.1)

Breeding numbers continued to increase in 1993, the British and Irish population rising to *c*578 pairs, an encouraging 11% increase overall on the 1992 figure. Most of the British and Irish population now breeds in Ireland, where Rockabill, the main stronghold, held 427 nests, an increase of *c*13% on 1992. The other important Irish colony, at Lady's Island Lake, remained steady at 76 nests.

Colonies in Wales fared slightly better this year than in 1992, with 21 nests counted at two colonies. In SE Scotland, none bred at Inchmickery for the fourth year in succession, but there were 17 pairs at another Forth Estuary colony. In NE England, Coquet Island continued to hold good numbers of breeding birds with at least 30 pairs, while the Farne Islands held 3 pairs. There were at least four pairs on the Isles of Scilly.

Breeding success (table 2.18.1)

The colony on Rockabill raised good numbers of young again this year, with a figure of 1.68 young fledged per nest, approaching the 1992 figure of 1.72. No young were fledged in NE Ireland. At the two colonies in Wales, 21 nests produced 36 young (1.71 fledged/nest). In NE England, breeding pairs on Coquet Island fledged 1.16/nest while, in SE Scotland, the breeding colony in the Forth fledged 0.82 young/pair, a slight improvement on the 0.7 fledged/pair in 1992. The three breeding pairs on the Farne Islands fledged six young (2.0/pair), while in Scilly it is thought that two young fledged from four pairs (0.5 young/pair).

Discussion

The Republic of Ireland remains the stronghold of the breeding population in these islands, and also one of the main breeding sites of the entire European population. All remaining British and Irish colonies seem to have continued their relatively good breeding success this year; wardening and the provision of nest-boxes are likely to have helped.

In France, 80-85 pairs bred, with an estimated one chick fledged/pair. There was no complete survey in the Azores in 1993, but there appeared to be a major decline, with less than 400 pairs counted. Productivity was similar to previous years with about one chick fledged/pair.

Table 2.18.1 **Roseate tern numbers (breeding pairs) at major colonies** (those holding 20+ pairs in at least one year) during 1986-93, and breeding success (chicks fledged/pair) in 1993

Colony	1986	1987	1988	1989	1990	1991	1992	1993	Chicks per pair in 1993
Inchmickery (Edinburgh)	18	20	21	5	0	0	0	0	0.0
Forth colony B	-	2	12	-	15	23	17	17	0.82
Farne Islands (Northumberland)	9	14	21	12	4	3	4	3	2.0
Coquet Island (")	20	17	21	25	23	20	29	*c*30	1.16
Anglesey site A (Gwynedd)	200	40	45	70	35	1	0	16	1.75
Anglesey site B (")	0	21	0	19	7	0	0	0	0.0
Larne Lough (Antrim)	21	25	23	37	19	4	3	0	0.0
Carlingford Lough (Down)	34	40	7	25	3	0	0	0	0.0
Rockabill (Dublin)	177	250	332	194	321	366	378	427	1.68
Lady's Island Lake (Wexford)	0	8	0	76	60	56	76	76	0.79
TOTAL*	490	450	480	470	490	450	520	578	1.49*

*Annual totals, and overall productivity in 1993, include other regularly-counted, small colonies

2.19 Common tern *Sterna hirundo*

Figures are approximate as counts of 'nests' and 'pairs' have been combined to obtain overall regional estimates.

Breeding numbers (table & figure 2.19.1)

Coverage of colonies of this species and arctic tern is less complete than for other tern species, and assessments of population change thus need to be treated with caution.

At seven colonies in N Scotland, breeding numbers rose by 105%, from 261 pairs in 1992 to 536 pairs this year. This increase was largely due to the dramatic rise at Nigg Oil terminal from 171 to 384 pairs this year. At three colonies in NE Scotland, numbers rose from 129 pairs in 1992 to 312 pairs while six monitored colonies in SE Scotland also saw an increase in numbers from 580 pairs in 1992 to 1179 in 1993. Leith Docks, in particular, saw a large rise from 185 pairs in 1992 to 694 pairs this year. In NE England, numbers fell by *c*10% to 1049 pairs at five colonies in 1993 compared to 1173 pairs in 1992. Numbers at four colonies in E England fell slightly, from 647 pairs in 1992 to 613 pairs this year. Numbers in SE England were also fairly stable, with 603 pairs at 7 colonies compared with 639 in 1992, but in SW England numbers fell by 30% at 4 colonies to 257 in 1993. In Wales, 483 pairs at 6 colonies in 1992 fell to 415 nests this year. NW England saw numbers fall at four colonies from 91 pairs in 1992 to 62 pairs this year but numbers at six colonies in NE Ireland rose from 1080 to 1296 this year. On Rockabill, SE Ireland, numbers remained similar to 1992 with 279 pairs.

Monitored populations in SE and SW England have decreased significantly over the period 1986-93, but no consistent trend is evident for England and Wales as a whole. Elsewhere, the only significant trend has been an increase in SE Ireland.

Breeding success (table 2.19.2)

Overall productivity remained rather low in Scotland this year at approximately 0.51 fledged/pair, similar to the recent average. Predation was a factor at many colonies, with American mink *Mustela vison* the main problem on the west coast. In England, colonies were more successful, with *c*0.82 fledged/pair overall, although there was marked regional variation. Monitored colonies in NE England averaged a maximum of *c*2.45 young/pair. This very high figure largely reflects the success of 79 pairs, from which 211 young were ringed, at the ICI Wilton site. In E England, productivity at five annually-monitored colonies rose slightly from 1992 levels, to *c*0.72 young fledged/pair, although SE England saw a slight decline from 1.31 fledged/pair at four colonies in 1992 to 0.98 this year. The monitored colony in SW England saw a reduction in productivity, with only *c*0.8 young hatched/pair (compared to 1.18 fledged/pair in 1992). In Wales, rats were responsible for taking many chicks at Shotton, contributing to the mean fledged/nest of 1.22 (still high) compared to 1.45 last year. Predation (by stoats, gulls and oystercatchers *Haematopus ostralegus*) continues to be a problem at several NW England colonies. Overall productivity there was 0.15 fledged/pair (slightly lower than the 0.21 fledged/pair at the same colonies in 1992).

Discussion

As in most years, 1993 saw distinct regional variations in population trends in Britain and Ireland. Reversing the trend of the last two years, monitored colonies along the east coast of Scotland

an increase in breeding numbers. Numbers in England, however, declined by 12% between 1992 and 1993 and at Welsh colonies, by 14%, to slightly below recent averages. Numbers at Irish colonies either increased or remained relatively stable.

Breeding success at Scottish colonies remained rather low this year, with predation a serious problem at colonies on the west coast. Productivity rose slightly at English colonies. At artificial sites throughout Britain, e.g., ICI Wilton, success was again high, although (despite improved protection against disturbance and predation, compared to 'natural' sites) predation accounted for moderate losses of chicks at some. Food shortages were again quoted as a factor in reduced productivity at some colonies.

Table 2.19.1 **Population changes at monitored common tern colonies, 1992-1993** (breeding pairs). Superscript = number of colonies counted in both years (including known colonies not occupied in 1992-93)

	N Scotland	NE Scotland	SE Scotland	NE England	E England	SE England	SW England
1992	261	129	580	1173	647	639	365
1993	536	312	1179	1049	613	603	257
% change	-105.4^{7}	$+141.9^{3}$	$+103.3^{6}$	-10.6^{5}	-5.2^{4}	-5.6^{7}	-29.6^{4}

	NW England	ENGLAND	WALES	ENGLAND / WALES	NE Ireland	SE Ireland
1992	91	2932	483	3415	1080	268
1993	62	2580	415	2995	1296	279
% change	-31.9^{4}	-12.0^{21}	-14.1^{6}	-12.3^{27}	$+20.0^{6}$	$+4.1^{1}$

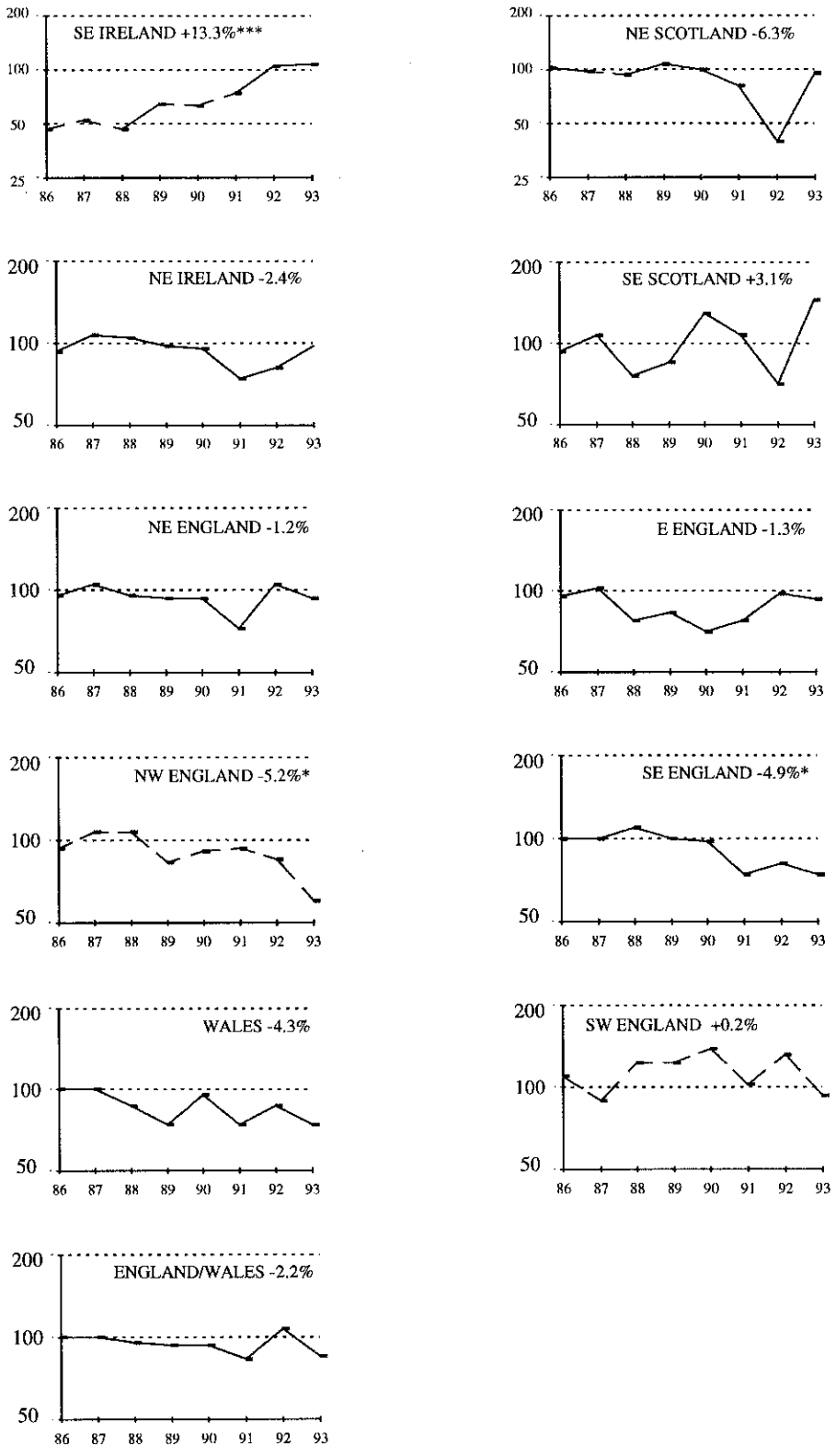

Figure 2.19.1 **Regional population indices for breeding common terns, 1986-93 (pairs or apparently occupied nests).** Average annual rates of change are calculated by regression of log of index against year (significant trends: * P<0.05; *** P<0.001). Broken trend lines are based on sample counts of 50-200 pairs. Number of colonies counted in each region in each year = 3+ (unless 1 or 2 indicated)

Table 2.19.2 **Common tern breeding success, 1986-93**: estimated number of chicks fledged per breeding pair at sample colonies (superscript ^{n} = number of colonies). Note that the same colonies have not necessarily been monitored in each region each year, and that numbers of pairs given here are sample sizes (and do not necessarily indicate population changes between years)

Region	**1986-91**	**fledged/pair**		**1992**	**fledged/pair**		**1993**	**fledged/pair**	
	years	**mean**	se	prs^{n}	range	**total**	prs^{n}	range	**total**
SW Scotland	4	**0.55**	0.13	1186^{11}	0.0.71	**0.47**	795^{6}	0.0-0.74	**0.57**
NW Scotland	4	**0.22**	0.02	376^{9}	0.0-1.08	**0.73**	579^{7}	0.0-1.03	**0.48**
Shetland	4	**0.08**	0.04			-			-
N Scotland	3	**0.46**	0.17	621^{5}	0.50-1.20	**0.69**	506^{4}	0.0-1.0	**0.45**
NE Scotland	6	**0.39**	0.17	102^{2}	0.20-0.46	**0.33**	276^{4}	0.0-0.8	**0.46**
SE Scotland	6	**0.70**	0.21	$c409^{4}$	0.40-0.64	***c*0.54**	383^{5}	0.1-0.9	**0.45**
SCOTLAND	6	**0.50**	0.13	2694^{31}	0.0-1.20	**0.56**	2539^{26}	0.0-1.03	**0.50**
NE England	5	**0.74**	0.05	882^{2}	0.0-0.91	**0.87**	97^{3}	1.2-3.0	**≤2.45**
E England	6	**0.52**	0.07	647^{4}	0.05-1.20	**0.59**	869^{7}	0.0-1.1	**0.65**
SE England	6	**0.75**	0.16	488^{6}	0.0-1.60	**1.01**	277^{3}	0.1-1.5	**0.98**
SW England	4	**0.65**	0.15	365^{4}	0.37-1.20	**0.74**	130^{1}		**≤0.8**
NW England	4	**0.09**	0.09	153^{5}	0.0-0.40	**0.14**	67^{3}	0.0-0.19	**0.15**
ENGLAND	6	**0.64**	0.06	2535^{21}	0.0-1.60	**0.76**	1440^{17}	0.0-3.0	**0.82**
Wales	3	**0.17**	0.27	357^{5}	0.17-1.60	**1.45**	415^{6}	0.43-2.0	**1.17**
SE Ireland	1	***c*1.37**		601^{2}	0.20-1.79	***c*0.91**	279^{1}		**≤2.34**

2.20 Arctic tern *Sterna paradisaea*

Figures are approximate as counts of 'nests' and 'pairs' have been combined to obtain overall regional estimates.

Breeding numbers (tables 2.20.1-2, figure 2.20.1)

Coverage of colonies of this species and common tern is less complete than for other tern species, and assessments of population change thus need to be treated with caution.

On Shetland, numbers of adults at 53 colonies counted in both 1992 and 1993 fell only slightly, from 4305 to 4242 individuals (-1.5%), whereas on Orkney, numbers at 33 colonies declined from 8949 to 7212 (-19%). Although the number of colonies counted is only a fraction of the total, the results do suggest that there may have been a big decline in Orkney. In N Scotland, breeding numbers increased slightly at seven monitored colonies, from 357 pairs in 1992 to 398 pairs this year (+11%). In NE Scotland, numbers at five colonies declined from 593 pairs to 505 pairs (-15%). However, numbers at six colonies in SE Scotland rose slightly from 531 pairs in 1992 to *c*560 pairs in 1993. Colonies in NE England appeared relatively stable, with 4009 pairs at two colonies in 1992 and 3810 pairs this year (-5%). Wales showed a decline of 16% at four monitored sites, from 1113 breeding pairs in 1992 to 935 this year. Two colonies in NE Ireland saw an increase, by 47% to 246 pairs. Interestingly, 23 pairs nested this year on Rockabill (SE Ireland), the highest numbers recorded there since 1969.

Recent population trends are poorly known except for a few regions. No consistent trends have been seen for SE Scotland or NE England, but breeding numbers have increased significantly in Wales, and decreased significantly in NE Ireland, over the period 1986-93.

Breeding success (table 2.20.3)

At colonies studied in detail, overall productivity (expressed as chicks fledged/apparently incubating adult) decreased to 0.39 in Shetland and less than 0.25 in Orkney in 1993. Colonies throughout the northern isles suffered from prolonged periods of cold and wet weather, and also lost eggs and chicks to predators, including skuas, common gulls, cats and a stoat. On Fair Isle, only 50 chicks fledged from 808 nests, 0.06 fledged/nest. Elsewhere in Scotland, productivity was even lower than in 1992. In N Scotland, 211 chicks fledged from 398 pairs at four colonies (0.53 young/pair compared to 0.84 in 1992). The colony at Nigg Oil Terminal fared particularly badly, 213 pairs raising no more than 16 young (0.08/pair); predation by cats may have been responsible (Swann 1994) In NE Scotland, 330 pairs at four colonies raised a maximum of 29 young (0.09 /pair) where 0.4 young/pair had fledged in 1992. Two monitored colonies in SE Scotland appear to have fared very badly, with 539 pairs known to have raised only 43 young (0.07/pair, compared to 0.4 in 1992). Food shortages and bad weather were thought to be underlying factors. Monitored colonies in both NW and SW Scotland had low productivity, raising only 0.13-0.18 young/pair, mainly due to severe predation by American mink, as in 1992.

NW England also saw a big fall in productivity, with 20 pairs at one colony fledging only eight young (0.4/pair) compared to 54 young produced by 60 pairs in 1992 (0.9/pair). Colonies in Wales, however, fared well, fledging 730 young from 795 nests (0.9/nest) at three monitored colonies. This was much improved on the figure of 0.41 at these colonies in 1992. At one Anglesey colony, in particular, productivity rose from 0.21 fledged/pair in 1992 to 1.39 this year. In Ireland, 23 pairs on Rockabill raised up to of 18 young (0.78/pair), perhaps the resumption of regular breeding at this

this location.

Discussion

Despite much regional variation, breeding numbers overall appear to have declined in the northern isles and in Wales, while remaining relatively stable in NE England and SE Scotland.

In most regions, mean breeding success has been lower this year than in 1992. Reasons put forward for this include food shortage, bad weather and predation. Productivity was highest at colonies in Wales and SE Ireland.

Table 2.20. 1 **Numbers of arctic terns (individuals) recorded at sample colonies in Shetland and Orkney which were surveyed in both 1992 and 1993**

Colony location	**1992**	**1993**	**% change**
SHETLAND			
Fetlar	2609	2100	-19
N. Mainland	85	153	+80
W. Mainland	77	53	-31
S. Mainland	130	167	+28
Central Mainland	45	48	+4
Noss	220	200	-9
Mousa	1100	1500	+36
Unst	39	21	-46
TOTAL SHETLAND	4305	4242	-1.5
ORKNEY			
N. Ronaldsay	1024	555	-46
Westray	2337	1389	-41
Papa Westray	4810	3765	-22
Mainland	418	300	-28
S. Ronaldsay	10	3	-70
Rousay	350	1200	+243
TOTAL ORKNEY	8949	7212	-19

Table 2.20.2 **Population changes at monitored arctic tern colonies. 1992-93** (breeding pairs). Superscript = number of colonies counted in both years (including known colonies not occupied in 1992-93). Regional samples < 100 pairs in 1992 are excluded

	Shetland	Orkney	N Scotland	NE Scotland	SE Scotland	NE England	Wales	NE Ireland
1992	4305*	8949*	357	593	531	4009	c1113	167
1993	4242*	7212*	398	505	560	3810	c935	246
% change	-1.5^{53}	-19.4^{30+}	$+11.5^{7}$	-14.8^{5}	$+5.5^{3}$	-5.0^{2}	-16.0^{4}	$+47.3^{2}$

* Counts of individual adults, Shetland and Orkney (cf. table 2.20.1).

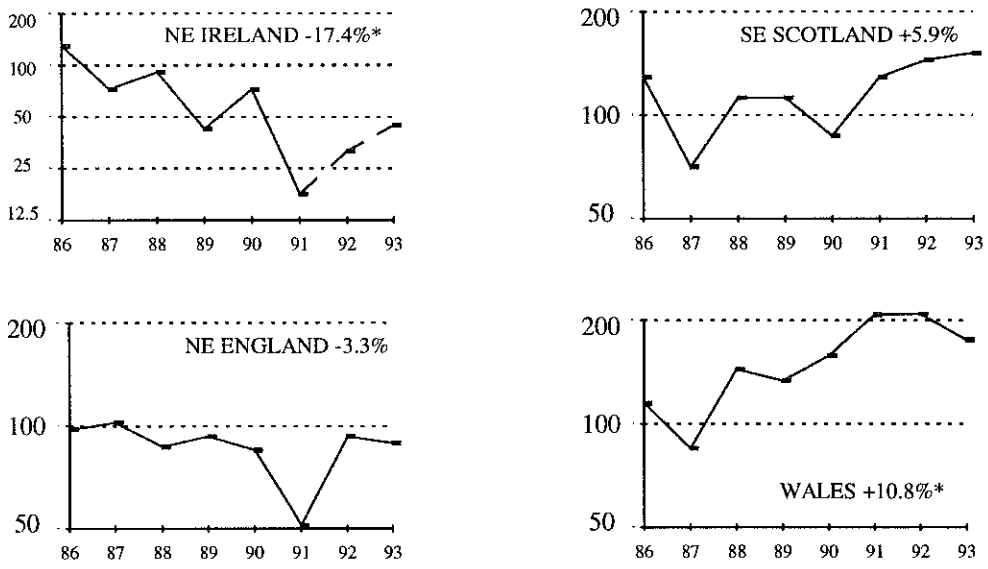

Figure 2.20.1 **Regional population indices for breeding arctic terns, 1986-93 (occupied nests or sites in May/June).** Average annual rates of change are calculated by regression of log of index against year (significant trends: * P<0.05). Broken trend lines are based on samples counts of 100-200 pairs. Number of colonies counted in each region in each year = 3+ (unless 1 or 2 indicated)

Table 2.20.3 **Arctic tern breeding success, 1986-93**: estimated number of chicks fledged per breeding pair at sample colonies (superscript ^{n} = number of colonies). Note that the same colonies have not necessarily been monitored in each region each year, and that numbers of pairs given here are sample sizes (and do not necessarily indicate population changes between years). See text for further details (including 1992-93 comparisons for colonies studied in both years)

Region	**1986-91**	**fledged/pair**		**1992**	**fledged/pair**		**1993**	**fledged/pair**	
	yrs	**mean**	se	prs^{n}	range	**total**	prs^{n}	range	**total**
SW Scotland	5	**0.45**	0.11	212^{11}	0.0-0.86	**0.34**	272^{8}	0.0-0.71	**0.18**
NW Scotland	4	**0.51**	0.22	$39+^{4}$	0.0-1.00	**0.44**	79^{3}	0.07-0.38	**0.13**
Shetland	6	**0.12**	0.11	1342^{22}	0.0-1.40	**0.70**	4242^{53+}		**0.39**
Orkney	3	**0.22**	0.06	3487^{12}	0.0-0.97	**0.57**	$>970^{12}$	0.0-0.45	**≤0.25**
N Scotland	3	**0.31**	0.16	416^{8}	0.0-1.11	**0.75**	398^{4}	0.08-1.16	**0.53**
NE Scotland	5	**0.42**	0.17	448^{2}	0.0-0.38	**0.38**	383^{4}	0.0-0.4	**≤0.08**
SE Scotland	6	**0.21**	0.06	538^{4}	0.0-0.51	**0.46**	562^{6}	0.0-2.0	**0.07**
NE England	2	**0.59**	0.17	749^{3}	0.44-0.54	**0.51**	919^{2}	0.45-0.73	***c*0.65**
Wales	4	**0.74**	0.12	813^{3}	0.21-0.45	**0.41**	935^{4}	0.43-1.39	**0.85**
NW England	4	**0.16**	0.03	61^{2}	0.0-0.90	**0.90**	20^{1}		**0.4**
SE.Ireland	1	***c*0.7**		*c*196^{1}		***c*0.20**	23^{1}		**≤0.78**

2.21 Little tern *Sterna albifrons*

Figures are approximate as counts of 'nests' and 'pairs' have been combined to obtain overall regional estimates.

Breeding numbers (table & figure 2.21.1)

Total numbers at 69 monitored colonies in Britain and Ireland declined by 13.7% in 1993, reversing the increase seen in 1992.

In Scotland the numbers of pairs fell at 14 monitored colonies from 166 to 111, a decline of 33%. In NE England, 178 pairs were counted at seven colonies, where there had been 202 pairs in 1992 (-12%). The population stronghold in E and SE England also showed a decline, by 12%, between 1992 and 1993: in E England, numbers at 22 colonies fell by *c*10.8% to 760 pairs, with a *c*18% reduction at 13 colonies in SE England to 230 pairs. SW England saw numbers at Chesil remaining stable at 50+ pairs compared to 55 pairs in 1992. Numbers in Wales were similarly little changed, with 45 nests at the Gronant colony (52 last year). In NW England, numbers rose slightly on those of 1992, with 64 pairs breeding at seven colonies, compared to 56 pairs last year, an increase of 14%. Little terns returned to Mawbray, Cumbria for the first time since a single pair nested there in 1988. Five colonies in SE Ireland, however, declined by 19%, from 72 pairs in 1992 to *c*58 this year.

Population indices over the period 1986-93 indicate a significant overall decline at British colonies population (based on monitoring of well over half the total population). SE England is the only individual region to show a significant decline over the same period, but numbers in NE and E England are evidently also in decline. In contrast, the small population in SW England has increased significantly from 1986-87 levels.

Breeding success (table 2.21.2)

In Scotland, breeding success at 10 annually-monitored colonies returned to its former lower level, from 0.54 young fledged/pair in 1992 to a maximum of 0.25 this year. Poor success in 1993 was reported to be due to food shortages, high tides and predation by foxes and crows *Corvus corone*. Success at seven monitored colonies in NE England remained relatively stable, with an overall figure of 0.37 fledged/pair compared to the >0.35 fledged/pair in 1992. E England saw productivities fall at monitored colonies from 0.5 fledged/pair last year to *c*0.4/pair this year and in SE England, productivity remained very low at *c*0.15 fledged/pair. At Chesil in SW England, breeding success was much improved on 1992, with 50+ pairs raising 25-30 young (*c*0.5 fledged/pair) compared to only 4 young raised by 55 pairs in 1992 (0.07/pair). Improved success followed more effective protection of the colony from fox predation. NW England, however, did not see the same success, with 55 pairs at six colonies raising 9+ young (0.16+ fledged/pair) compared to the 0.86 fledged per pair in 1992. Predation by weasels *Mustela nivalis*, oystercatchers and gulls was a major problem here. Wales saw a similar reduction in breeding success at Gronant, where 45 nests produced 47 young this year (*c*1.04 fledged/nest), although this figure is still high. In 1992, 1.92 young fledged/pair at this colony, but 25 nests were reported to have been predated by foxes in 1993. Bad weather and predation accounted for extremely poor productivity in SE Ireland this year, with only 0.05 fledged/pair.

Discussion

1993 saw a continuation of the worrying decline in breeding numbers at little tern colonies, and average breeding success was again low (below the annual average of 0.56 chicks fledged/pair recorded during 1969-89: Sears & Avery 1993). Predation has again been the cause of many failures at colonies throughout Britain and Ireland. Foxes, stoats and kestrels *Falco tinnunculus* were the most frequently quoted of these, with human disturbance also giving rise to desertion. Bad weather caused problems at colonies in Ireland in particular. Continued population monitoring at as many colonies as possible will be vital over the next few years to give some idea as to whether survival and recruitment rates are adequate to prevent further declines.

Table 2.21.1 **Population changes at monitored little tern colonies, 1992-1993** (breeding pairs). Superscript = number of colonies counted in both years (including known colonies not occupied in 1992-93). Regional samples <50 pairs are excluded

	Scotland	NE England	E England	SE England	Wales	NW England	BRITAIN	SE Ireland
1992	166	202	852	280	52	56	1735	72
1993	111	178	760	230	45	64	1496	58
% change	-33.1^{14}	-11.9^{7}	-10.8^{25}	-17.8^{13}	-13.5^{1}	$+14.3^{7}$	-13.7^{69}	-19^{5}

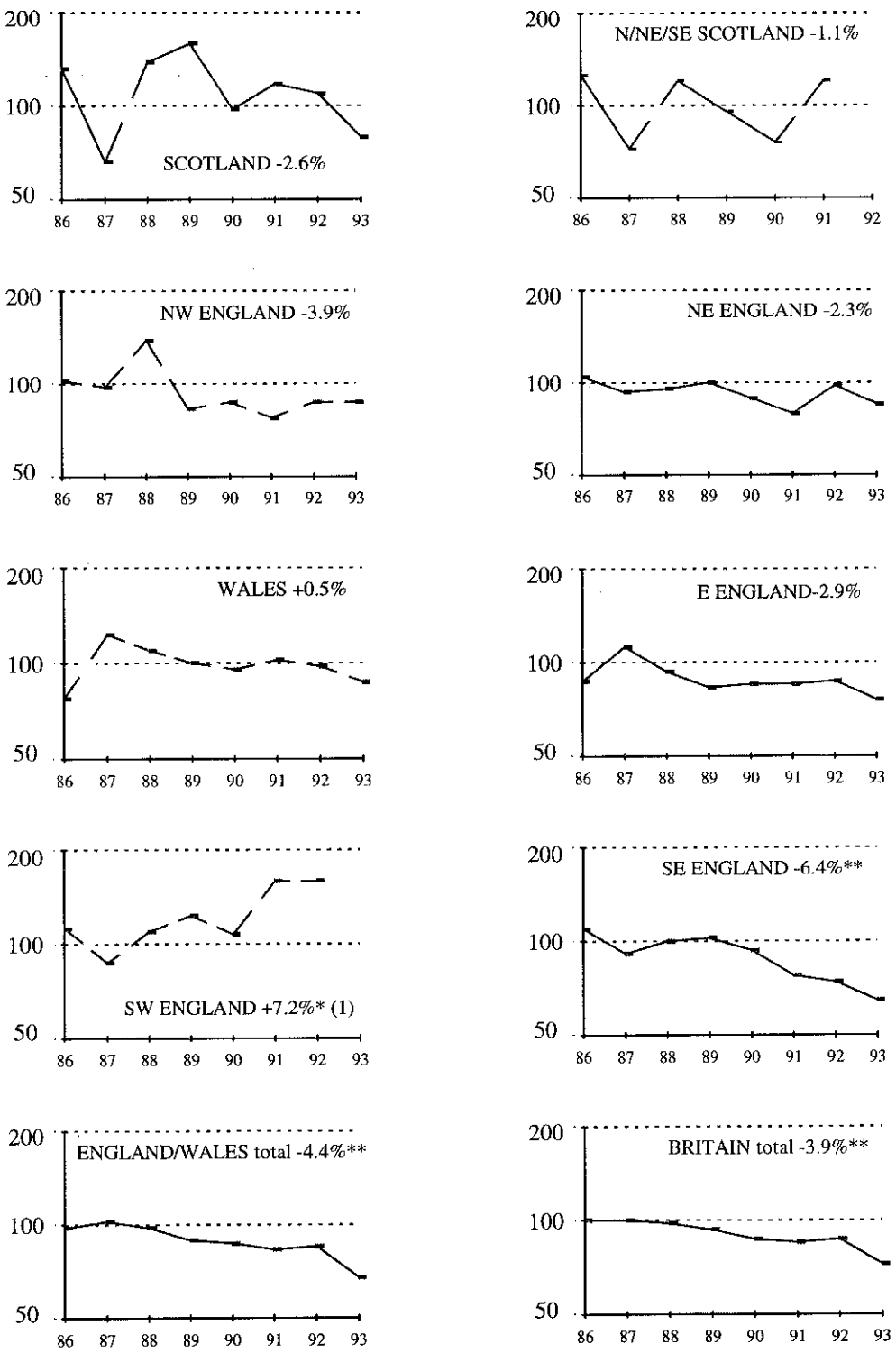

Figure 2.21.1 **Population indices for breeding little terns, 1986-93 (pairs or apparently occupied nests).** Average annual rates of change are calculated by regression of log of index against year (significant trends: * P<0.05; ** P<0.01). Broken trend lines are based on sample counts of 30-100 pairs

Table 2.21.2 **Little tern breeding success, 1992-93**: estimated number of chicks fledged per breeding pair at sample colonies (superscript ^{n} = number of colonies). Note that the same colonies have not necessarily been monitored in each region each year, and that numbers of pairs given here are sample sizes (and do not necessarily indicate population changes between years). See text for further details (including 1992-93 comparisons for colonies studied in both years)

Region	**1986-91**	**fledged/pair**		**1992**	**fledged/pair**		**1993**	**fledged/pair**	
	years	**mean**	se	pairs^{n}	range	**total**	pairs^{n}	range	**total**
SW Scotland	5	**0.30**	0.20	7^{1}		**0.43**	8^{2}	0.0-0.66	**0.25**
NW Scotland	2	**0.41**	0.15			-			-
N Scotland	5	**0.80**	0.40	31^{3}	1.33-1.67	**1.42**	8^{2}	0.71-1.0	**0.75**
NE Scotland	6	**0.23**	0.08	42^{2}	0.0-0.24	**<0.24**	13^{2}		**0.0**
SE Scotland	6	**0.53**	0.20	34^{5}	0.0-0.37	**0.18**	40^{4}	0.0-0.33	**0.22**
SCOTLAND	6	**0.35**	0.10	107^{10}	0.0-1.67	**0.56**	69^{10}	0.0-1.0	**0.25**
NE England	6	**0.63**	0.09	216^{8}	0.0-0.61+	**0.33+**	223^{8}	0.0-2.0	**0.54**
E England	6	**0.55**	0.10	784^{19}	0.0-1.11	**0.50**	755^{21}	0.0-1.22	**0.42**
SE England	6	**0.38**	0.14	288^{14}	0.0-0.60	**0.18**	167^{5}	0.0-0.5	**0.16**
SW England	6	**0.38**	0.08	55^{1}		**0.07**	$50+^{1}$		***c*0.5**
Wales	6	**0.70**	0.24	52^{1}		**>1.92**	45^{1}		**1.04**
NW England	6	**0.43**	0.13	56^{6}	0.0-1.14	**0.86**	55^{6}	0.0-0.66	**0.16**
ENGLAND / WALES	6	**0.52**	0.09	1451^{49}	0.0->1.92	**0.46**	1295^{42}	0.0-1.22	**0.42**
SE Ireland	5	**0.62**	0.27	58^{2}	0.0-0.04	***c*0.03**	58^{4}	0.0-0.06	**0.05**
TOTAL	6	**0.53**	0.09	1659^{63}	0.0-2.00	**0.48***	1422^{54}	0.0-2.0	**0.40**

*The overall mean for 1992 (0.48 chicks/pair) was wrongly given as 0.18/pair in last year's report.

2.22 Guillemot *Uria aalge*

Breeding numbers (table 2.22.1, figures 2.22.1-2)

Population changes since 1992 varied between regions, with little evidence of any broad patterns, although numbers fell in the three regional samples from Shetland (-9%) south to NE Scotland (-13%). Elsewhere, the most notable changes were a 29% increase shown by the NE England sample (mainly the Farne Islands), and a 19% decrease in NW England. Of 21 colonies where replicate counts of adults in study plots were made in both 1992 and 1993, few showed any significant changes in mean numbers: significant decreases at Hermaness and Noss (Shetland), Fowlsheugh (Kincardine & Deeside), and St Bee's Head (Cumbria), and a significant increase at Skirza Head (Caithness). Study plots on St Kilda (Western Isles) also showed a significant decrease (by 8.2%, from the previous counts in 1990).

Longer-term trends, over the period 1986-93, show significant increases in sample populations in N and NE Scotland and in Wales, averaging 2.5-4.0% per year. Trends elsewhere are not significant but generally suggest that populations are either roughly stable or are increasing. A marked decline in Shetland during 1988-90 had been reversed by 1992, and the decrease noted in 1993 largely involved a large sample population at one colony (Hermaness). In Shetland (and elsewhere) year-to-year changes in attendance rates by non-breeders and off-duty breeders may be contributing to changes seen.

Breeding success (table 2.22.2)

Productivity was assessed at 12 colonies in 1993 (compared to 9 in 1992), and breeding output was high overall: an average of 0.72 ($\pm$s.e. 0.03) chicks/pair left the breeding ledges successfully. This represented a slight, but non-significant, drop from 1992 figures (average change -0.07 $\pm$0.05 chicks/pair, $t_7 = 1.46$). Most of the study colonies were on North Sea coasts (average 0.71 +0.05 chicks/pair, also down from 1992 figures: average change -0.10 $\pm$0.07, $t_4 = 1.301$, n.s.).

The majority of individual colonies were successful, in the range 0.70-0.85 chicks/nest (highest on Fair Isle, Shetland). However, productivity was low (for this species) at two northern colonies: only 0.44 chicks/pair on Papa Westray (Orkney) and 0.57 at Sumburgh Head (Shetland). On Papa Westray, the cause of the low success was unknown. At Sumburgh Head, many chicks disappeared during two days of strong northeasterly winds in early/mid June, although the ledges were not exposed to rain or sea-spray (ledges on west-facing cliffs were not affected).

Discussion

Breeding numbers and success evidently remain high at most monitored colonies. Low breeding output at two colonies in 1993 appeared to reflect very local factors; such occasions appear to be rare at British colonies, on the evidence of data available since 1986. Anecdotal reports of poor success are sometimes received, but quantitative assessment of breeding output is time-consuming for this species and casual assessments of 'good' or 'bad' years are difficult to make. Study plots for productivity were established at two new colonies in 1993, and it is hoped that this improved geographical coverage can be maintained.

A major 'wreck' of seabirds occurred along the east coast of Britain (Shetland southwards) in February-March 1994, with tens of thousands of guillemots (the main species) estimated to have died. Most birds were emaciated and had evidently starved, and it appeared to be the largest such

incident since a similar wreck in 1983. Counts at guillemot colonies will assume particular importance in 1994 (and subsequent years), if any impacts on North Sea colonies are to be detected.

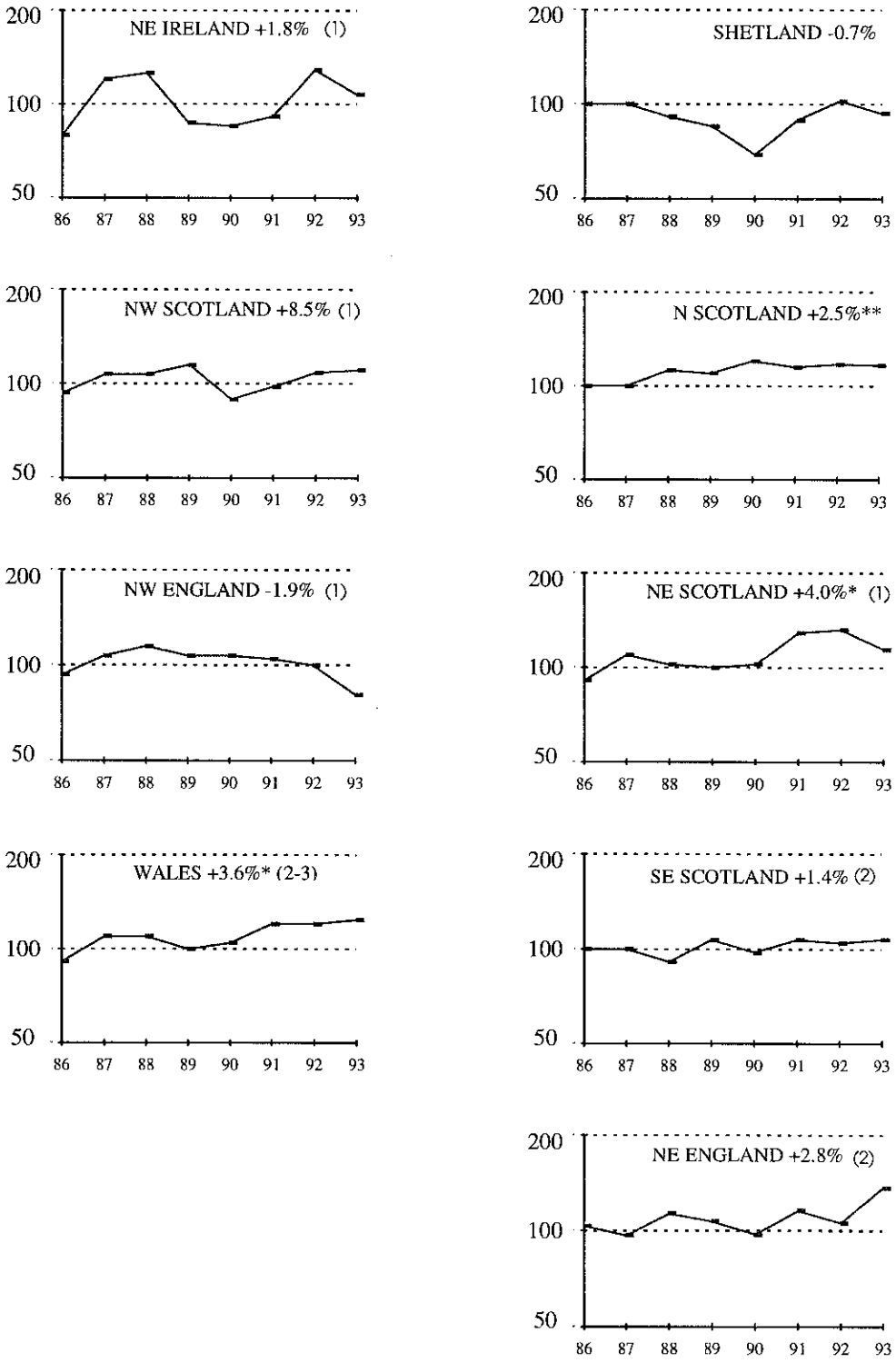

Figure 2.22.1 **Population indices for breeding guillemots, 1986-93 (adults at colonies in June).** Average annual rates of change are calculated by regression of log of index against year (significant trends: * P<0.05; ** P<001). For each region, data are based on 3-10 replicate counts of study plots or whole colonies each year. Number of colonies counted in each region in each year = 3+ (unless 1 or 2 indicated)

Table 2.22.1 **Population changes at monitored guillemot colonies, 1992-93** (adults attending colony in first three weeks of June). Superscript = number of colonies counted in both years. Figures for regions in block capitals are based on the means of 3-10 annual counts of study plots within each colony

	SW Scotland	NW SCOTLAND	SHETLAND	N SCOTLAND	NE SCOTLAND
1992	1149	1676	12823	7719	2756
1993	1499	1706	11708	7596	2384
% change	+30.5[1]	+1.8[1]	-8.7[7]	-1.6[5]	-13.5[1]
	SE SCOTLAND	NE ENGLAND	WALES	NW ENGLAND	NE IRELAND
1992	4419	20570	4935	739	3459
1993	4508	26547	5113	600	2846
% change	+2.0[2]	+29.0[2]	+3.6[2]	-18.8[1]	-17.7[1]

Table 2.22.2 **Guillemot breeding success, 1986-93**: number of chicks 'fledged' per site regularly occupied by a pair or per pair laying.* For 1992 & 1993, productivity is presented as mean & standard error if based on three or more study-plots (equivalent to mean & half-range for two plots); n = number of pairs (plots)

Colony	1986-91 fledged/pair			1992 fledged/pair			1993 fledged/pair		
	yrs	**mean**	s.e.	n	**mean**	s.e.	n	**mean**	s.e.
Hirta, St Kilda (W Isles)	1	**0.64**	-		-				
Handa (Sutherland)	4	**0.69**	0.03	194(4)	**0.76**	0.01	107(2)	**0.74**	0.05
Sumburgh Head (Shetland)	3	**0.63**	0.03	96(1)	**0.75**	-	104(1)	**0.57**	
Fair Isle (Shetland)	5	**0.75**	0.02	141(2)	**0.74**	-	198(2)	**0.85**	0.01
Papa Westray (Orkney)	3	**0.73**	0.18	146(5)	**0.77**	0.03	148	**0.44**	
Marwick Head (Orkney)	6	**0.71**	0.03		-		95	**0.80**	
Row Head (Orkney)	2	**0.79**	0.04		-			-	
Mull Head (Orkney)	3	**0.73**	0.02		-		96	**0.77**	
Iresgeo (Caithness)		-			-		151(2)	**0.70**	0.03
Isle of May (NE Fife)	6	**0.81**	0.01	745(5)	**0.85**	0.01	797(5)	**0.76**	0.03
Farne Islands (Northumberland)	4	**0.74**	0.06		-			-	
Bempton (Humberside)	1	**0.70**	-	188(4)	**0.80**	0.04	148(4)	**0.80**	0.06
Breil Nook (Humberside)		-		146(2)	**0.71**	0.05		-	
Durlston Head (Dorset)		-			-		119(2)	**0.75**	
Berry Head (Devon)	1	**0.73**		68(2)	**0.84**	0.08	70(2)	**0.77**	0.01
Skomer (Dyfed)	3	**0.74**	0.03	169(6)	**0.72**	0.04	198(6)	**0.74**	0.05

*At colonies where monitoring begins in early May, sample is number of sites where egg or apparent incubation recorded; where monitoring begins later in May, sample also includes sites regularly attended by *pairs* (usually failed breeders). Small differences between years or colonies may reflect differences in intensity of monitoring.

2.23 Razorbill *Alca torda*

Breeding numbers (table 2.23.1, figures 2.23.1-2)

Counts of adults at sample colonies suggested increases or little change in breeding numbers between 1992 and 1993 in most regions, although sample numbers fell by 18-20% at single colonies in NE Scotland and NE Ireland. Shetland counts indicated continued recovery from the low numbers recorded at study colonies during 1989-90 (which may have reflected low attendance rates rather than any real population change). Of 14 British colonies where replicate counts of study plots were available for both 1992 and 1993, only a few showed any significant population change: decreases at Troswick Ness (Shetland) and Fowlsheugh (Kincardine & Deeside), increases at Skirza Head (Caithness), the Isle of May (NE Fife) and South Stack, Anglesey (Gwynedd). Regional trends for the period 1986-93 as a whole suggest that most populations are either increasing (significant trends for SE Scotland and Wales) or show no obvious trend.

Breeding success (table 2.23.2)

Data were available for only three colonies in 1993, but included new study plots established on Skomer (Dyfed). Razorbills on Fair Isle (Shetland) and the Isle of May (NE Fife) had a successful season, despite a reduction in productivity on the Isle of May from 0.86 chicks/pair in 1992 to 0.72 in 1993. Productivity was lower on Skomer (0.55 chicks/site), but perhaps moderately good for this species.

Discussion

This remains one of the most difficult seabird species for which to obtain useful information on population changes or breeding success. Numbers of adults visible at colonies can fluctuate markedly, and, where a high proportion of nest-sites is hidden among boulders, it is can be very difficult to monitor population changes accurately or safely. Even at cliff-colonies, monitored population samples are often small, in part because breeding razorbills are generally less abundant, and more widely scattered over cliffs, than guillemots. This also affects selection of plots for assessment of breeding output. Nevertheless, further attempts to improve monitoring of this species should be encouraged.

Table 2.23.1 **Population changes at monitored razorbill colonies, 1992-93** (adults attending colony in first three weeks of June). Superscript = number of colonies counted in both years. Figures for regions in block capitals are based on means of 3-11 annual counts of study plots within each colony

	SW Scotland	SHETLAND	N SCOTLAND	NE SCOTLAND	SE SCOTLAND	WALES	NE IRELAND
1992	172	284	902	221	711	1118	960
1993	303	287	982	180	799	1222	761
% change	+76.2[1]	+1.3[4]	+8.8[5]	-18.5[1]	+2.4[2]	+9.3[2]	-20.7[1]

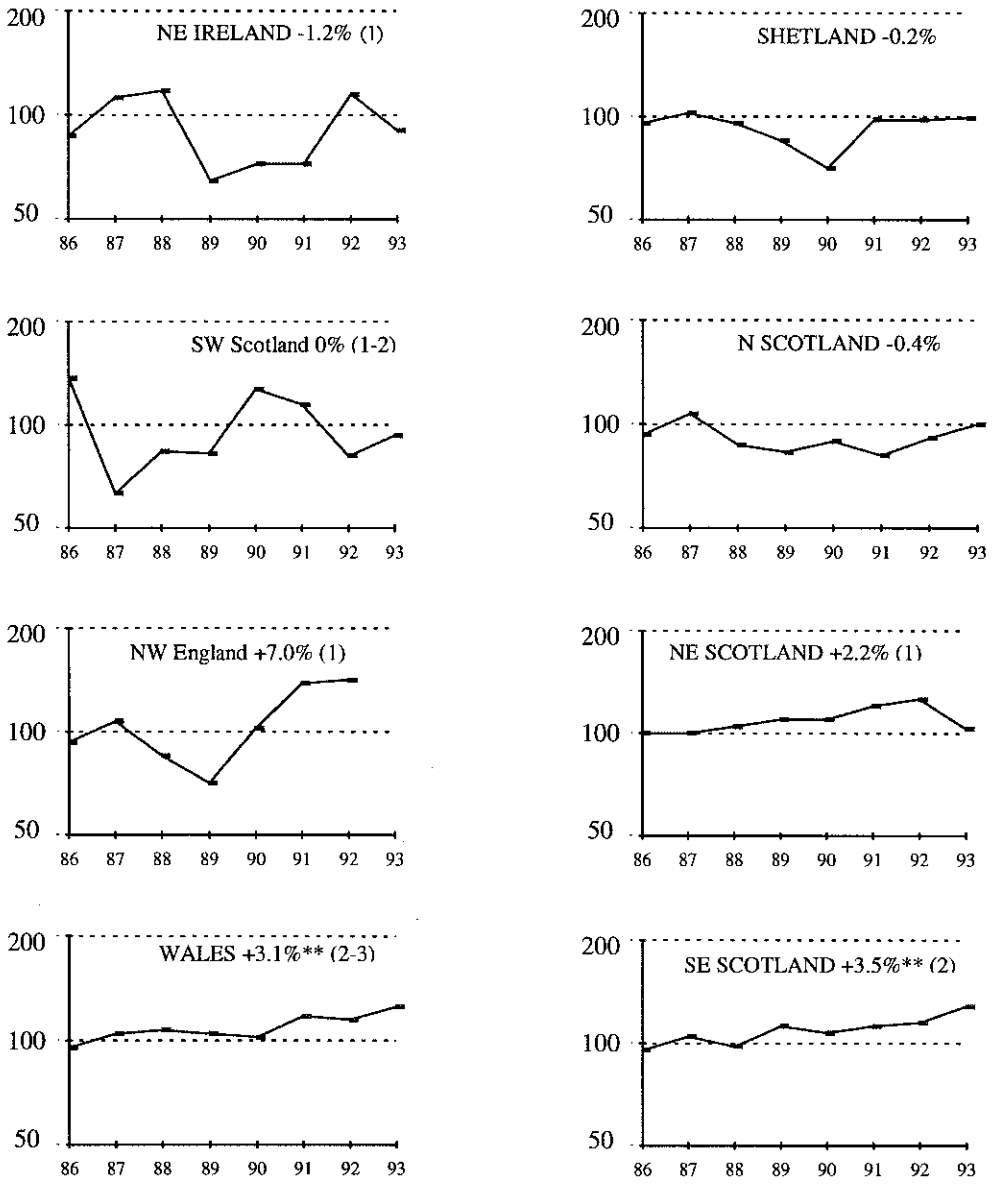

Figure 2.23.1 **Regional population indices for breeding razorbills, 1986-93 (adults at colonies in June).** Average annual rates of change are calculated by regression of log of index against year (significant trends: * P<0.05; *** P<0.001). Region names in capitals indicate indices based on 3-10 counts of study plots per colony each year. Number of colonies counted in each region in each year = 3+ (unless 1 or 2 indicated)

Table 2.23.2 **Razorbill breeding success, 1986-93**: number of chicks fledged per active site (where egg or apparent incubation recorded, or pair regularly present). For 1991 & 1992, productivity is presented as mean & standard error if based on several study-plots; n = number of pairs (plots)

Colony	1986-91 fledged/pair			1992 fledged/pair			1993 fledged/pair		
	yrs	**mean**	s.e.	n	**mean**	s.e.	n	**mean**	s.e.
Handa (Sutherland)	3	**0.74**	0.06		-			-	
Fair Isle (Shetland)	1	***c*0.60**		69	**≤0.55**	-	77	**≤0.77**	
Isle of May (NE Fife)	6	**0.72**	0.01	105(4)	**0.86**	-	119(4)	**0.72**	0.04
St Abb's Head (Berwickshire)		-		30	**0.83**	-		-	
Skomer (Dyfed)		-			-		104(5)	**0.55**	0.08
Calf of Man (Isle of Man)		-		32	**≤0.69**	-		-	

≤ indicates young not necessarily known to have reached fledging age

2.24 Black guillemot *Cepphus grylle*

Breeding numbers (table & figure 2.24.1)

Following the wreck of the *Braer* oil-tanker near the southern tip of Shetland in January 1993, and the consequent oil spill, a major programme of environmental assessment was undertaken. Black guillemots (tysties) were one of the bird species most immediately affected (with 219 oiled birds found dead), and pre-breeding surveys of adults associated with potential breeding habitat were carried out (Heubeck *et al.* 1993). Surveys covered the coasts of southern Shetland that were directly affected by oil during January ('the *Braer* coast,' from Gulberwick on the E Mainland to Easter Vaila Sound in the W Mainland). In addition, counts were made at established SOTEAG monitoring sites to the north of the *Braer* coast. Comparisons between the highest count obtained for each section in 1993 and in the year of the most recent survey (in some cases, 1982-84) suggested that the breeding population of tysties to the north of the *Braer* coast were unaffected by the oil spill. In affected areas, allowing for differences in survey methodology and likely increases since 1982-84 on some coasts, actual losses of breeding adults caused by the *Braer* oil-spill were likely to have involved *c*70 birds in the southernmost coast of the SE Mainland, *c*370 along the coast between Grutness and Maywick, *c*630 between Clift Sound and the Weisdale Voe Islands and only *c*30 to the west of this, a total of *c*1100 birds. This would represent somewhere in the range 5-10% of the total Shetland breeding population. Assuming that the age structure of oiled birds found was representative of the total mortality, *c*200 immature birds may also have been killed. These totals imply that beached bird surveys in January located only 15-20% of the birds killed.

The regular SOTEAG monitoring sites on the *Braer* coast showed an 11.1% decline from 1992, while monitoring sites in NE/NW Shetland, in contrast, showed a 6.3% increase (Table 2.24.1). Numbers at monitoring sites had increased significantly along both stretches of coast during 1985-89, but this trend was reversed for the *Braer* coast in 1993 (Figure 2.24.1). A separate series of monitoring sites in Yell Sound continued to show a rapid population increase (*c*9% per year during 1985-93). The population trend on Fair Isle (*c*40 km SSW of the *Braer* wreck) was rather variable during 1986-91, but numbers there fell to their lowest recent levels in 1993. Whether this was related to the oil-spill is unclear, but it is possible, as some Fair Isle birds are known to winter around Mainland Shetland (Ewins 1988)

Elsewhere, pre-breeding counts of adults around Papa Westray (Orkney) fell by 30% between 1992 and 1993, to *c*59% of their 1983 levels. The factors behind this are not known, nor are trends elsewhere in Orkney. However, predation by rats *Rattus* apparently kept tystie breeding success low on Papa Westray, at least until recent control measures (Meek 1993a), and it is possible that recruitment and/or fidelity to colonies there has been reduced. In the Isle of Man, sample populations have indicated stable or increasing numbers in recent years, although numbers fell slightly in the main colony in 1993.

Breeding success (table 2.24.2)

Only limited information was available. On Fair Isle, numbers of chicks reared (1.23/pair) were above average for recent years. Success was lower at study colonies around Papa Westray (Orkney), with <0.8 chicks fledged/pair and a continued decline on the Holm of Papay.

Discussion

The vulnerability of this species (resident, and rarely moving far from the vicinity of colonies) to

inshore oil pollution was demonstrated once again in Shetland. Assessing the impact of the *Braer* spill on tysties was greatly aided by the availability of regular monitoring data and of baseline survey results from 1982-84. Total losses were estimated at *c*1300 birds, a similar order of magnitude to mortality caused by the *Esso Bernicia* spill in Yell Sound in December 1978 (when 633 oiled tysties were found and at least 1200 were estimated to have died). Breeding numbers in Yell Sound have subsequently recovered fully and are still increasing, providing some grounds for optimism about tystie populations in southern Shetland.

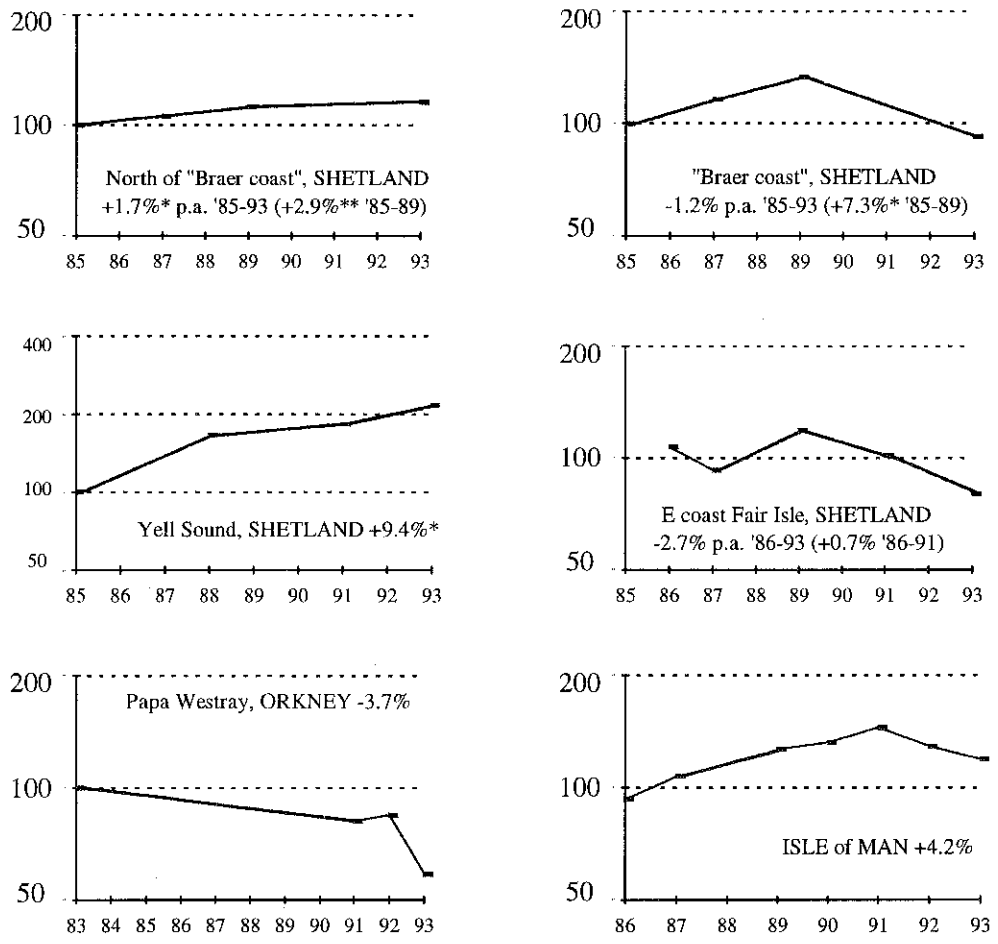

Figure 2.24.1 **Population indices for black guillemots, 1983-93 (adults at colonies in April / early May).** Average annual rates of change are calculated by regression of log of index against year (significant trends: * P<0.05, ** P<0.01). Note variable year-scale. See text for details of Shetland

Table 2.24.1 **Population changes at monitored black guillemot colonies, 1992-93** (adults in breeding habitat in early morning, April/early May). Superscript = number of colonies/lengths of coastline counted in both years. See text for further details on Shetland

	*'*Braer* coast,' SHETLAND	Other coasts, SHETLAND	Papa Westray, ORKNEY	Peel Hill, ISLE OF MAN
1992	565	695	538	135
1993	502	739	374	126
% change	-11.1^{4}	$+6.3^{6}$	-30.5^{2}	-6.7^{1}

*Evidence from other colonies (for which 1992 counts were not available) suggested a more severe decline.

Table 2.24.2 **Black guillemot breeding success, 1986-93**: number of chicks fledged per active site (where egg or apparent incubation recorded)

Colony	**1987-91 mean**			**1992**		**1993**	
	yrs	**yng/site**	s.e.	sites	**yng/site**	sites	**yng/site**
Fair Isle (Shetland)	5	**0.76**	0.09	47	**1.00**	31	**1.23**
N Ronaldsay (Orkney)	1	**0.54**		-	**-**		**-**
Holm of Papa Westray (Orkney)	5	**1.12**	0.09	71	**≤0.91**	68	**≤0.76**
North Hill, P. Westray (Orkney)	1	**≤0.15**		30	**≤0.50**	13	**≤0.54**
Sheep Height, P. Westray (Orkney)	1	**0.0**		12	**≤1.58**	9	**≤0.78**

≤ = based on counts of chicks present in mid July.

2.25 Puffin *Fratercula arctica*

Breeding numbers (figure 2.25.1)

Annual monitoring of study plots on the Isle of May (NE Fife) indicates that numbers of apparently occupied burrows (AOBs) have been stable (or have increased only slowly) during the period 1986-93. The sample count of AOBs increased by 12.8% from 2051 in 1992 to 2313 in 1993, compensating for a short-term decrease in 1990-92. Complete counts of apparently occupied burrows (AOBs) in 1989 and 1992 confirmed a stable population, although a period of rapid increase had been apparent up to 1987 (Harris 1993). Elsewhere, annual counts of study plots have been available only for Fair Isle (Shetland), but problems with erosion and methodology have arisen in recent years and trends there are unclear. Transects on Hermaness (Shetland) were re-counted in 1993 (Williams & Duck 1994), after a gap of several years; no significant trend was shown for the period 1986-93. On North Rona (Western Isles), numbers of AOBs in sample transects showed a 63% increase between 1976 and 1993 (equivalent to *c*2.9% per year), and more limited 1980-93 comparisons supported this increase (Murray & Love 1993).

Elsewhere, several large colonies were re-censused in 1993. The main slopes on Sule Skerry (Orkney) held an estimated 43 380 AOBs, compared to 41 900 in 1986 (suggesting little change) (Blackburn & Budworth). On the Farne Islands (Northumberland), 34 710 AOBs were estimated in 1993, an apparent 32% increase since 1989 (equivalent to a *c*7.1% annual increase, or *c*3.8% per year since 1980). More dramatically, Coquet Island (also Northumberland) held an estimated 13 270 AOBs in 1993, indicating an apparent quadrupling of numbers since 1986 (or an annual rate of increase by *c*22% per year). In Wales, a small colony on Ynysoedd Gwylan, near Bardsey held 386 AOBs in 1993, 36% lower than 1986 counts.

Breeding success (table 2.25.1)

Breeding output was moderately high at four study colonies in 1993, with an average of 0.70 (±s.e. 0.02) chicks fledged per breeding pair, although figures were below average for recent years. Additional monitoring at Hermaness and Sumburgh Head (Shetland) concentrated on survival rates of small chicks and suggested a successful season at those colonies. At Hermaness, 78% of 27 small chicks were estimated to have reach fledging (compared to 56%, 67% and 87% of small chicks in 1990-92, respectively). Sumburgh Head birds were even more successful, with all 26 small chicks in study burrows surviving to fledge (compared to 56%, 77% and 82% in 1990-92). Feral ferrets *Mustela furo* had caused problems at Sumburgh in previous years. No detailed results were available for colonies off NW Scotland, but there were reports that long periods of rain had caused many pairs to fail in the Minch area.

Discussion

Good breeding success in Shetland continued in 1993, with little evidence of major problems with food availability (unlike the period up to 1988). Colonies elsewhere also had a fairly successful season, except perhaps in NW Scotland. Unfortunately, logistical problems prevented detailed work in the latter region (including regular productivity-monitoring and transect counts on Dun, St Kilda). The Shiant and Flannan Islands remain priority colonies for further work; the Shiants, in particular, have not been censused since 1970 (when over 76 000 pairs were estimated). Nevertheless, several major colonies were surveyed in 1993 and notably highlighted rapid population growth at colonies in NE England.

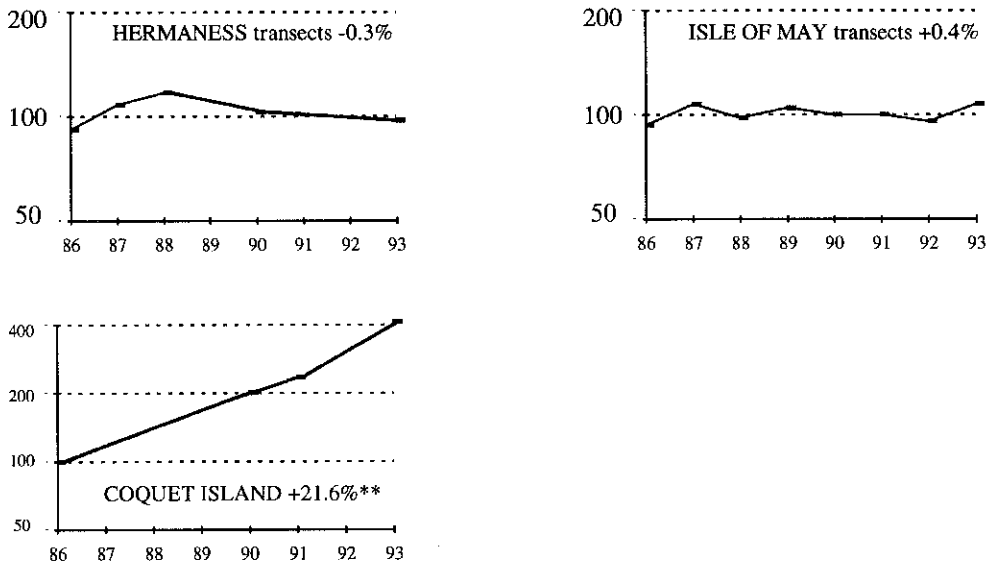

Figure 2.24.1 **Population indices for breeding puffins, 1986-93 (occupied burrows in study plots or whole colonies).** Average annual rates of change are calculated by regression of log of index against year (significant trends: * P<0.05, ** P<0.01)

Table 2.25.1 **Puffin breeding success, 1986-93**: number of chicks fledged per egg or per occupied burrow; n = number of burrows

Colony	unit	**1986-91 mean**				**1992**		**1993**
		yrs	**yng/pair**	s.e.	n	**yng/pair**	n	**yng/pair**
Dun, St Kilda (W Isles)	egg	2	**0.70**	0.02	95	**0.76**		-
Hermaness, Unst (Shetland)*	impression		**variable**			**good**		**moderate-good**
Foula (Shetland)	impression		**variable**			**good**		**good**
Sumburgh Head (Shetland)*	impression		**variable**			**good**		**good**
Fair Isle (Shetland)	egg	5	**0.73**	0.05	97	**0.75**	110	**0.69**
Isle of May (NE Fife)	egg	6	**0.82**	0.04	184	**0.87**	182	**0.70**
Coquet Island (Northumberland)	-		-			-	-	**0.76**
Skomer (Dyfed)	occ. burrow	5	**0.82**	0.03		-	249	**0.67**

* = based on survival of chicks.

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4. REFERENCES

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