

SEABIRD 18



SEABIRD GROUP – No. 18 : 1996

SEABIRD 18

Edited by
S. Wanless

Produced by
The Seabird Group

CONTENTS

| | |
|--|----|
| Obituary: George Dunnet | 3 |
| Biometrics of Kittiwakes <i>Rissa tridactyla</i> wrecked in Shetland in 1993. By Douglas N. Weir, Andrew C. Kitchener and Robert Y. McGowan | 5 |
| Recent changes in the size of colonies of the Mediterranean Shag <i>Phalacrocorax aristotelis desmarestii</i> in Corsica, western Mediterranean. By Isabelle Guyot and Jean-Claude Thibault | 10 |
| Arctic Terns <i>Sterna paradisaea</i> in the central northern North Sea in July: offshore staging area for failed breeders? By Kees (C.J.) Camphuysen and Chris J.N. Winter ... | 20 |
| Factors affecting the timing of nocturnal returns to land by the Madeiran Storm Petrel <i>Oceanodroma castro</i> during the breeding cycle on Selvagem Grande Island. By J.-L. Mougín, P. Defos du Rau, C. Jouanin, M.-C. Mougín, F. Roux and M. Segonzac | 26 |
| The status of the North Atlantic Gannet <i>Morus bassanus</i> after 50 years in Norway. By Robert T. Barrett and Alv Ottar Folkestad | 30 |
| An analysis of biometrics of oil contaminated Common Guillemots <i>Uria aalge</i> in south-west Britain 1980-94. By J.M. Stratford and K.E. Partridge | 38 |
| Observations of movements of North Atlantic Gannets <i>Morus bassanus</i> from Cape St Vincent, Portugal. By Frank Walker | 44 |
| Book Reviews | 49 |
| The Seabird Group | 52 |
| Notice to Contributors .. | 54 |

OBITUARY

GEORGE MACKENZIE DUNNET (1928 - 1995) AND THE SEABIRD GROUP

George Dunnet was always a quiet man, so it was a surprise to find his untimely death followed by such enthusiastic obituaries (see especially those by his successor as Regius Professor Paul Racey in *The Independent* for 25 September, and Morton Boyd in *The Scotsman* for 5 October). Although George played a crucial role in the formation of the Seabird Group, few mention it, however, while I have tried to put this right in *British Birds*, it may also be useful to consider the connection in more detail here.

The world-wide activities of the Royal Naval Bird-watching Society in the 1950s revealed a sad lack of co-ordination in work on seabirds, which seemed best dealt with on a regional basis. Since I had been impressed by the meetings held by a Vertebrate Ecologists' Group promoted by David Jenkins where George Dunnet played a leading role in northern Scotland, in 1960 I proposed to a number of academics working on seabirds that we hold similar meetings. There was a favourable response, but nobody offered to do the work, so the initiative lapsed until the amateurs attending the annual Bird Observatories' Conference at Oxford who had taken to watching seabirds when the onset of west winds meant few landbirds were available revived the proposal in 1965. There were initial difficulties, however, since most of the active people whose names are often now well-known were then obscure young firebrands, and national ornithological bodies such as the British Ornithologists' Union, British Trust for Ornithology, and Royal Society for the Protection of Birds, whose facilities we wished to use, had recently had the wildfowl highjacked by Peter Scott, and declined to tolerate more piracy.

That was the 1960s, however, when for a little while anything became possible, as the country recovered from World War II, and people sought new things to do. Soon the unexpectedly well-disposed executives of our unsuspecting National Societies were persuaded to agree at a meeting of their transient Joint Liaison Committee to support us if they could all have representatives on our committee, and then to nominate some of our best friends to represent them. The Honorary Secretary of the BOU, Sir Hugh Elliot, was particularly helpful in proposing George Dunnet, a man with a first class honours degree and PhD followed by international experience and charge of a new field research station at Aberdeen, who had already been working for fifteen years on the Fulmar, as the BOU Representative, and agreeing to pay his expenses to come from Aberdeen to attend our meetings.

Since as it happened George was already a member of the preliminary Steering Committee this was granted with great joy, and he was immediately elected Chairman. He proved a great success, prepared to turn out anywhere, at any time, to suit other peoples' convenience, and pretend he enjoyed it. He unobtrusively maintained excellent law and order, had always read all his papers, and while full of ideas of his own did not try to promote them over alternatives. We managed to hang on to him for three years, so that by the time he resigned to spend a sabbatical year in New Zealand the Group was well established and in receipt of a large grant from the superfluous funds subscribed to help the birds affected by oil from the *Torrey Canyon* to carry out the first national seabird breeding census, 'Operation Seafarer'. We looked around for another Chairman tough enough to push it through, and there, sitting in the back row at the Annual General Meeting waiting to be asked, was now the grim grey Godfather of Ornithology, Stanley Cramp himself.

By the time George returned from New Zealand oil had been discovered in the North Sea, and following the performance of the Group when there was a sensational mortality of contaminated auks in the Irish Sea in the autumn of 1969 it had been awarded another large grant to find out how seabirds were distributed out at sea around the north of Scotland. We therefore asked if George could provide a base, and despite a growing workload in the Aberdeen Zoology Department and

acting as general environmental adviser to the crucial first stages of the development of the North Sea oil industry he found time to organise not only departmental facilities but also vital liaison with the Department of Agriculture and Fisheries for Scotland's Aberdeen Marine Laboratory and fishery research and patrol vessels, and then a summary of the results of work on seabirds (NERC Publ. C 18).

George therefore provided the crucial peg upon which the work of the first pioneering decade of the Seabird Group was hung. First he provided it with a respectable administration, and then facilities to start work at sea on an unprecedented scale. If anything had happened to anyone else the Group would probably have survived, but it is doubtful if it could have done much without George. Afterwards he became increasingly overloaded with a variety of other commitments, and while he remained Chairman and organised administrative support for the Shetland Oil Terminal Environmental Advisory Group (SOTEAG), maintained his own work on Fulmars in Orkney (the ringing records from 1950 to 1987 are deposited in the Aberdeen University Library), and remained friendly towards other enterprises, he no longer had time to maintain such a close interest in them. We were very lucky to secure the services of such an outstanding figure in the national conservation movement, and have now all lost a very good friend.

W.R.P. Bourne

Biometrics of Kittiwakes *Rissa tridactyla* wrecked in Shetland in 1993

Douglas N. Weir, Andrew C. Kitchener and Robert Y. McGowan

INTRODUCTION

In January 1993, prolonged and violent westerly storms led to coincidental wrecks in Shetland of the oil tanker *Braer* and of pelagic gulls of two species, Kittiwakes *Rissa tridactyla* and Iceland Gulls *Larus glaucoideus*. The Iceland Gulls were mainly thin adult females, from both Greenland and Baffin I.; these normally winter north of a line roughly from the Westmann Is., Iceland, to Cape Farewell, Greenland, to Cape Cod, Massachusetts (Weir *et al.* 1995 & in prep.). The possible origins of Kittiwakes associated with the Iceland Gulls were therefore of interest and we report our mainly morphometric investigation of a sample of those found dead.

METHODS

About 1400 dead seabirds were collected and frozen in Shetland in ca six weeks after the *Braer* oil spill on 6 January 1993 (Osborn 1994). They were sent for examination by a consortium of the Natural History Department of the National Museums of Scotland (NMS), the Royal (Dick) School of Veterinary Medicine of Edinburgh University and the Applied Ornithology Unit of Glasgow University Zoology Department. At the NMS, we selected the freshest and least damaged 64 of the 144 Kittiwakes (44%) for examination and preservation. We assumed that the 64 were a representative sample but found that, in some respects, they probably were not (see below).

Kittiwakes were aged from plumage (Cramp & Simmons 1983). Extent of plumage covered in oil was assessed by eye. All were dissected to determine sex, gross pathology and condition which was assessed by scoring subcutaneous and body cavity fat deposits by eye on scales of 0 (none) to 3 (heavy).

Measurements (mm) were made of flat, straightened wing, exposed culmen and bill depth at gonys. We also measured the linear extent of wingtip melanism on the inner webs along the shafts on P 8-10 combined (Sluys 1982). Wing length of a sample was measured again, seven months after specimen preparation. This allowed comparison of wing measurements with samples of live or freshly dead birds and with museum material. In half the specimens, re-measurement of wings disclosed that one or more of the outermost primaries, P 8-10, was not full-grown. This was not noted in initial examination when most birds were heavily oiled. Therefore wing measurements of birds not preserved were excluded from the sample because they might have been moulting.

Kittiwake wing and bill lengths increase with age (Pennington *et al.* 1994). Our sample was almost 90% adult (below) and we excluded the only first-winter bird. We compared measurements in the Shetland sample with NMS winter and summer adult skins from Britain, and with summer adults from a wide range of Atlantic and peri-atlantic breeding areas. These were from samples of both live or fresh birds and of museum material reported in the literature (Sluys 1982, Barrett *et al.* 1985, Pennington *et al.* 1994). P 10 in almost all of the Shetland sample was fresh and not worn but tips would have been worn in summer adults which were close to moulting and this would slightly reduce wing lengths.

RESULTS

Of the 64 Kittiwakes, one (2%) was first-winter, six (9%) were second-winter and 57 (89%) were third-winter or older, i.e. adult. Sex ratio was 24 males: 22 females. A further 18 could not be sexed but their small size suggested that they were mainly females (see also below). Sixty

Kittiwakes (94%) were oiled, most of them heavily, but pathology indicated that most were severely dehydrated and in poor condition, which could also have contributed to deaths (S. McOrist, pers. comm.). Mean fat scores for 60 were subcutaneous fat 0.8 and body cavity fat 0.3. Only five birds (8%) scored 3 for both deposits and 28 (46%) scored 0 for both.

Fresh wing length of 60 birds was measured but only 36 could be preserved, and 18 of these (50%) had not completed primary moult. Therefore lengths of the 24 specimens not preserved could not be used (see Methods). Specimen wings shrank by a mean of 2.9% of length in seven months (range 0.5-4.0%, $n = 17$).

TABLE I: MEASUREMENTS (mm) OF KITTIWAKES FROM A WINTER 1993 WRECK IN SHETLAND

| | <i>Fresh wing</i> | | | | | <i>Dry wing</i> | | | |
|-------------------------|-------------------|-------------|-------------|--------------|-------------------------|-----------------|-------------|--------------|--|
| | <i>n</i> | <i>Mean</i> | <i>s.e.</i> | <i>range</i> | <i>n</i> | <i>Mean</i> | <i>s.e.</i> | <i>range</i> | |
| Males | 5 | 323.4 | 3.27 | 320-336 | 5 | 314.8 | 2.38 | 310-323 | |
| Females | 10 | 314.0 | 2.25 | 306-327 | 10 | 305.8 | 2.39 | 298-320 | |
| Unsexed | 5 | 301.8 | 3.13 | 291-310 | Not reliable (see text) | | | | |
| <i>Wingtip melanism</i> | | | | | | | | | |
| | <i>n</i> | <i>Mean</i> | <i>s.e.</i> | <i>range</i> | | | | | |
| Males, no moult | 5 | 176.0 | n.a. | 161-201 | | | | | |
| Males, moult | 9 | 166.8 | 4.11 | 142-187 | | | | | |
| Females, no moult | 11 | 166.5 | 3.70 | 152-189 | | | | | |
| Females, moult | 3 | 150.3 | 4.85 | 145-160 | | | | | |
| Unsexed, no moult | 2 | 163.0 | 5.92 | 157-169 | | | | | |
| Unsexed, moult | 4 | 157.5 | 6.12 | 144-171 | | | | | |
| <i>Exposed culmen</i> | | | | | | | | | |
| | <i>n</i> | <i>Mean</i> | <i>s.e.</i> | <i>range</i> | | <i>Mean</i> | <i>s.e.</i> | <i>range</i> | |
| All Males | 22 | 36.34 | 0.29 | 34.0-39.0 | 22 | 10.93 | 0.12 | 9.8-11.9 | |
| All Females | 21 | 34.73 | 0.42 | 31.5-38.5 | 21 | 10.48 | 0.13 | 8.9-11.1 | |
| All Unsexed | 18 | 33.71 | 0.41 | 29.0-36.5 | 18 | 10.54 | 0.13 | 9.3-11.3 | |

NOTES 1. Female means < male means for wing, culmen $p < 0.05$.

2. Unsexed means < male means for wing, culmen $p < 0.01$.

3. Omissions; unreliable data, standard error for set in which data were not normally distributed (see also text)

Measurements of the Shetland sample are given (Table I). Standard errors are large but data are normally distributed in all sets but one. Bill measurements of moulting and non-moulting birds did not differ and were combined. The extent of wingtip melanism was suggested to be less, although not significantly, in moulting birds. All the samples were very small and inferences from the data are only suggestive.

Mean wing and culmen are significantly shorter in unsexed birds than in males. Most unsexed birds may have been female but they might include birds from populations where size is smaller (see Discussion). Smaller birds tended to be more decayed so that they could less often be sexed. Thus 32% of males could not be preserved, compared with 47% of females and 43% of unsexed birds. Feather slippage due to decay probably caused the preserved wings of four birds to 'grow' in seven months; they were three of five unsexed birds and one of 31 sexed birds.

Bill measurements of Shetland samples (above) were larger than those of Irish Sea adults (Pennington *et al.* 1994) but smaller than those of adults from north Norway (Barrett *et al.* 1985). There are 14 earlier NMS skins of non-moulting adults from Britain in October-March. Sex ratio was about equal. Mean dry wing length of all was 313.1mm. The corresponding average of male and female means combined in the Shetland material was 316.8mm. No standard error could be put on either but the mean for earlier specimens was substantially smaller.

TABLE II. FRESH WING LENGTHS (mm) OF NON-MOULTING MALE AND FEMALE KITTIWAKES FROM THE WINTER 1993 SHETLAND WRECK, COMPARED WITH UNSEXED, LIVE SUMMER ADULTS FROM THE BRITISH IS. AND NORTH NORWAY INCLUDING SVALBARD. COMPARATIVE BRITISH DATA FROM PENNINGTON ET AL. (1994), NORWEGIAN DATA FROM BARRETT ET AL. (1985)

| Location | latitude | mean length | 95% C.I. | range | (n) |
|-----------------------------|----------|-------------|----------|---------|--------|
| Dover | 51°N | 308.7 | | | (18) |
| Liverpool Bay | 53 | 304.6 | 1.29 | 281-323 | (146) |
| Tyne & Wear | 55 | 307.7 | | | (45) |
| Grampian | 57 | 314.4 | | | (33) |
| Fair Isle | 59 | 313.7 | | | (25) |
| Shetland wreck male | 59 | 323.4 | 6.41 | 320-336 | (5) |
| female | | 314.0 | 6.41 | 306-327 | (10) |
| Sexes combined ¹ | | 318.7 | | 306-336 | |
| Sexes combined ² | | 316.8 | | 291-336 | |
| Røst | 67 | 316.1 | 1.3 | | (114) |
| Anda | 69 | 318.1 | 3.0 | | (28) |
| Hillesøy | 70 | 317.2 | 2.1 | | (30+) |
| Hornøy | 70 | 318.2 | 1.0 | | (252+) |
| Hopen | 77 | 321.6 | 1.3 | | (112+) |

1. sexed birds only.

2. assumes that five unsexed birds were all females; the probability that all five were males was negligible (Table I and text).

Mean fresh wing lengths of non-moulting birds in the Shetland sample were compared with those of live or fresh summer adults from Britain and north Norway (Table II). The Shetland values are larger than any from Britain and are most similar to the north of Norway. Wingtip wear would have been greater in the comparative material (see Methods), though the effect of this on comparisons was probably slight.

The standard errors of means for wing length in single sex Shetland samples were greater than those of the comparative, combined sex samples in Table II. This also was true for a combined sex sample of only six NMS skins of summer adults from Scotland (not shown). Therefore the large standard errors of the Shetland means were not due to small samples alone and indicate that the sample comprised individuals from more than one population.

Only one of 144 Kittiwakes found in Shetland was ringed; it was in year 29, from the Farne Is., northeast England, and was the oldest Kittiwake known (Osborn 1994). Fresh wing length of this unsexed bird was 309mm. If it was full-winged, this was below the mean for the females of the Shetland sample.

Eighteen of 36 specimens preserved from Shetland (50%) were still in wing moult in January-February (above). This compared with five of 19 (26%) in earlier NMS skins of winter adults from Britain. Moulting birds were significantly fewer in the latter ($\chi^2 = 6.81$, $p < 0.01$).

TABLE III. RANKING OF MEAN DRY WING LENGTH (mm) AND EXTENT OF WINGTIP MELANISM (mm) IN SUMMER ADULT SAMPLES OF KITTIWAKES AND IN MOULTING AND NON-MOULTING BIRDS FROM THE 1993 SHETLAND WINTER WRECK. COMPARATIVE DATA FROM SLUYS (1982, FIG. 1).

| Wing length | | | | | | Wingtip melanism | | | | | |
|-------------|-------|------|------------|-------|------|------------------|-------|------|------------|-------|------|
| males | | | females | | | males | | | females | | |
| Location | mean | (n) | Location | mean | (n) | Location | mean | (n) | Location | mean | (n) |
| BEA | 322.8 | (10) | BEA | 312.6 | (8) | SVA | 180.5 | (22) | BRI | 167.8 | (5) |
| SVA | 321.4 | (22) | EGR | 308.3 | (9) | BRI | 178.4 | (7) | BEA | 166.8 | (8) |
| <u>SHN</u> | 314.8 | (5) | SVA | 307.6 | (8) | EGR | 178.4 | (13) | FAR | 166.7 | (3) |
| ICE | 314.2 | (20) | FAR | 306.7 | (3) | NOR | 176.0 | (8) | <u>SHN</u> | 166.5 | (11) |
| EGR | 313.9 | (13) | ICE | 306.0 | (6) | <u>SHN</u> | 176.0 | (5) | SVA | 165.0 | (8) |
| WGR | 311.1 | (11) | <u>SHN</u> | 305.8 | (10) | BEA | 175.6 | (10) | EGR | 156.0 | (9) |
| | | | | | | ICE | 172.4 | (20) | ICE | 154.5 | (6) |
| NOR | 310.9 | (8) | WGR | 303.1 | (7) | FAR | 171.3 | (4) | WGR | 151.7 | (7) |
| BRI | 308.4 | (7) | BRI | 302.4 | (5) | <u>SHM</u> | 166.8 | (9) | <u>SHM</u> | 150.3 | (3) |
| FAR | 307.8 | (4) | | | | WGR | 156.3 | (11) | | | |

Locations: BEA Bear Is., SVA Svalbard, SHN Shetland non-moulting, ICE Iceland, EGR east Greenland, WGR west Greenland, SHM Shetland moulting, NOR Norway, BRI British Is., FAR Faroe Is. Samples from Sluys (1982) omitted are two males from Jan Mayen I., two females from Norway and symbols denoting long wings for Kola Peninsula birds.

Mean dry wing length and extent of wingtip melanism in the birds from Shetland were compared with those of summer adults from a range of breeding areas (Table III). There were inconsistencies, generally small samples and no standard errors in the comparative data, which suggested geographical clines only of wing length increasing with increasing latitude, and decreasing with increasing longitude (Sluys 1982). Mean wingtip melanism values for moulting Shetland birds most resemble those of West Greenland birds. Wing lengths of moulting Shetland birds were not known but late moult was consistent with W. Greenland origin (Freuchen & Salomonsen 1957). Non-moulting birds are most like those from Iceland in wing length but males and females most resemble those from different areas in their wingtip melanism. Shetland birds overall least resemble those from the High Arctic east of Greenland, and those from Britain and Ireland. The Shetland sample is heterogeneous, there are inconsistencies in the comparative data, and both Shetland and comparative samples are statistically inadequate. Therefore a close fit between the Shetland sample and specific areas was not expected.

DISCUSSION

Like the Iceland Gulls in the same wreck, the Kittiwakes tended to be thin adults, and a similarly high proportion may have been female. This suggested that both species might have been storm-driven from the same wintering area, which was outlined for adult Iceland Gulls (see Introduction). Many adult Kittiwakes from a range of Nearctic and Palearctic populations winter in that area, with Arctic birds tending to winter furthest north (Salomonsen 1967, 1979, Sluys 1982, Cramp & Simmons 1983, Powers 1983, Brown 1986). This was consistent with the Shetland sample.

The origins suggested for many of the Kittiwakes from Shetland in winter 1993 are in marked contrast to those of 116 ringed elsewhere, which were recovered in Britain and Ireland up to 1991 (Mead & Clark 1993). Most (62%) were from Russia, Norway or France, with only five from Iceland and one from Greenland. It is relevant that a second west Greenland bird was recovered in Shetland in a later winter (Osborn 1994). However, the origins of recoveries depend on ringing effort and differences in this between countries must be reflected in the data.

The Iceland Gull wreck associated with the Kittiwakes was a rare event (Weir *et al.* 1995). Kittiwake wrecks are said to be well-known (Cramp & Simmons 1983) but the only study cited there was of a few wrecks of relatively few, mainly younger, birds in Finland (Pullainen 1962). We found no published evidence to suggest that the Shetland wreck was other than exceptional.

ACKNOWLEDGEMENTS

The authors are most grateful to Martin Heubeck and the Shetland Wildlife Response Co-ordinating Committee for organising the collection and delivery of corpses, and to Scottish Natural Heritage and the National Museums of Scotland for providing grants to cover the costs of processing the dead birds killed by oil from the *Braer*. We also thank Christian Salvesen plc, P&O, A&J Beveridge Ltd, Lever Bros. and Baroid (UK) Ltd for providing additional resources and materials. We further thank Dr S McOrist for pathology reports. Finally, we thank two anonymous referees for their suggestions on improving the manuscript.

SUMMARY

We examined 64 of 144 dead Kittiwakes from a January-February 1993 wreck in Shetland. Up to 94% had been oiled before death, 46% had no fat, up to 70% were female and 89% were adult. Half were still in wing moult, most of them males. Moult and measurements suggested, from very limited data, that most were from 60°-70°N, possibly from Norway to west Greenland. Few can have been British, although a 29-year-old ringed bird was. The Kittiwakes may have been storm-driven from the northwest Atlantic.

REFERENCES

- BARRETT, R.T., FIELDER, R., ANKER-NEILSEN, T. and RIKARSEN, F. 1985. Measurements and weight changes of Norwegian adult Puffins *Fratercula arctica* and Kittiwakes *Rissa tridactyla* during the breeding season. *Ring and Migration* 6: 102-112.
- BROWN, R.G.B. 1986. *Revised atlas of eastern Canadian seabirds. 1. Shipboard surveys by R.G.B. Brown*. Can. Wildl. Serv., CW 66-44/1986 E., Ottawa.
- CRAMP, S. and SIMMONS, K.E.L. (eds.) 1983. *The Birds of the Western Palearctic, Vol. 3*. Oxford Univ. Press, Oxford.
- FREUCHEN, P. and SALOMONSEN, F. 1957. *The Arctic Year*. Cape, London.
- MEAD, C.J. and CLARK, J.A. 1993. Report on bird ringing in Britain and Ireland for 1991. *Ring and Migration* 14: 1-72.
- OSBORN, K. (ed.) 1994. *Shetland Bird Report 1993*. Shetland Bird Club, Lerwick.
- PENNINGTON, M.G., BAINBRIDGE, I.P. and FEARON, P. 1994. Biometrics and primary moult of non-breeding Kittiwakes *Rissa tridactyla* in Liverpool Bay, England. *Ring and Migration* 15: 33-39.
- POWERS, K.D. 1983. Pelagic distribution of marine birds off the northeastern United States. *NOAA Tech. Memo. NMFS-F/NEC-17*. NE Fish. Cent., Woods Hole, Mass.
- PULLAINEN, E. 1962. The invasions of the Kittiwake *Rissa tridactyla* into Finland in February and March 1959 and 1962. *Ornis Fennica* 38: 81-95.
- SALOMONSEN, F. 1967. *Fuglene på Grønland*. Rhodos, Copenhagen. (in Danish and English).
- 1979. Thirteenth preliminary list of recoveries abroad of birds ringed in Greenland. *Dansk. Orn. Foren. Tidsskr.* 73: 191-206.
- SLUYS, R. 1982. Geographical variation of the Kittiwake *Rissa tridactyla*. *Le Gerfaut* 72: 221-230.
- WEIR, D.N., MCGOWAN, R.Y., KITCHENER, A.C., MCORIST, S., ZONFRILLO, B. and HEUBECK, M. 1995. Iceland Gulls from the 'Braer' disaster, Shetland 1993. *Brit. Birds* 88: 15-25.

D. N. Weir, A. C. Kitchener and R. Y. McGowan, Natural History Dept., National Museums of Scotland, Chambers St., Edinburgh EH1 1JF, UK.

Recent changes in the size of colonies of the Mediterranean Shag *Phalacrocorax aristotelis desmarestii* in Corsica, western Mediterranean

Isabelle Guyot and Jean-Claude Thibault

INTRODUCTION

Relationships between the spatial distribution and the size of seabird breeding colonies suggest that seabird numbers may be limited by intraspecific competition for food around colonies during the breeding season, whether in tropical, temperate, or cold waters (Ashmole 1971, Furness & Birkhead 1984). Cormorant and Shag (*Phalacrocoracidae*) numbers can fluctuate over short periods of time, and both species change colony-sites regularly, often in close relation with the fluctuating numbers of some fish species (e.g. Cooper 1980). For these reasons, even a long-unattended breeding-site can rapidly become a large colony. For conservation, this underlines the importance of protecting and managing potential breeding-sites for future use. During the 1980s, the overall number of Mediterranean Shags *Phalacrocorax aristotelis desmarestii* was estimated at less than 10,000 pairs of which *ca.* 7,000 pairs were in the western Mediterranean islands, mainly in the Balearics and on Sardinia and Corsica (Guyot 1993). The aim of this paper is to present results of censuses of breeding Mediterranean Shags over a 17-year period in Corsica, and to show changes in distribution and colony size both for the overall population and five geographic areas.

METHODS

On the island of Corsica (42°N, 9°E), Mediterranean Shags breed on rocky islets surrounding the mainland and on cliffs along the west coast (Guyot 1985). Fig. 1 shows the location of the main colony-sites used by Shags between 1978 and 1994. All are isolated islets or archipelagoes, except on the west coast where Shags breed in isolated pairs or in small groups on inaccessible cliffs, and on only one island (Gargalo, = 6 on Fig. 1). Colony-sites have been grouped into five geographic areas: North (Finocchiarola I.), West (all coastal sites from Calvi to Cargèse), South-west (Lava I., Sanguinaires I., Piana I.), South (Bruzzi I., Tonnara I. and Lavezzi I.) and South-east (Cerbicale Is.). Guyot *et al.* (1985) have provided historical information about Shag surveys in Corsica, and the physical characteristics of islets surrounding Corsica are given in Guyot (1989).

To census, we landed on islet colony-sites; on the West coast, censusing was conducted from a boat. Isolated nests or groups of nests were mapped during each census. In the West area where most nests sites are inaccessible, we included all nests attended by adults or where young could be seen. For the other areas we included only active nests i.e. those with eggs or young. Studies elsewhere have shown that in some years even former breeders may refrain from breeding (Aebischer 1986, Aebischer & Wanless 1992), suggesting that in some cases nest counts may substantially underestimate the breeding population. In addition there are problems in using a single nest count to estimate population size for colonial breeders, since even the peak count usually underestimates the breeding population, especially when there is a large spread of laying dates and/or breeding success is poor (Harris & Forbes 1987, Green & Hirons 1988). The breeding season of the Mediterranean Shag varies from year to year in timing and duration, and laying can occur from November to May (Guyot 1985). In this paper we have used only censuses conducted in February, the month during which at least 90% of nests contain eggs or chicks (I. Guyot & J.-C.

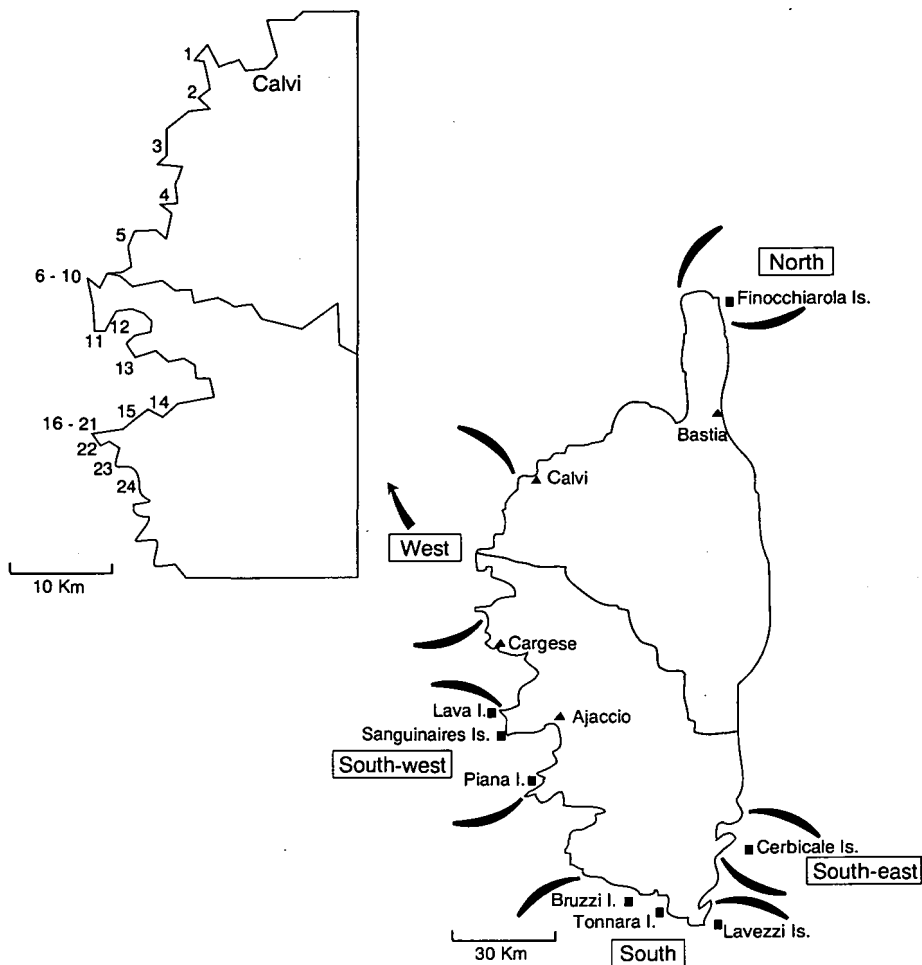


Figure 1. Areas and main Mediterranean Shag colony-sites on Corsica. Numbers indicate the different localities in the West area (see Appendix for identification).

Thibault unpubl. data). Between 1978 and 1994 censuses were obtained regularly for the West coast and Finocchiarola Is. (respectively 15 and 16 censuses for 17 years). Elsewhere censuses were less frequent, although some were obtained for all colony-sites from 1978 to 1985 and from 1993 to 1994.

We use throughout the terminology proposed by Kushlan (1986): "census" to count number of colony inhabitants, "colony-site" the site where Shags breed and "colony" the avian assemblage.

Because of the Shag's high survival rate and site fidelity (Potts 1969, Aebischer 1985), annual data from the same site are unlikely to be completely independent. We were cautious when interpreting levels of probability based on statistics that assume independence. Data on counts of

breeding pairs have been log-transformed. Linear regression was used to test significance of trend, Mann-Whitney U-test to compare data for colony-site between years, and Kendall's Coefficient of Concordance to compare variation between colony-sites over a period of several years.

RESULTS

Overall situation on Corsica

Censuses of all the colony-sites grouped in the five areas, from 1978 to 1994 are summarized in the Appendix. The overall number fluctuated from year to year, with an average annual decrease rate of 5% (although linear regression was not significant, $r_4 = -0.72$). Fig. 2 shows trends in each of the five areas. With the exception of the North area which Shags colonized during this period,

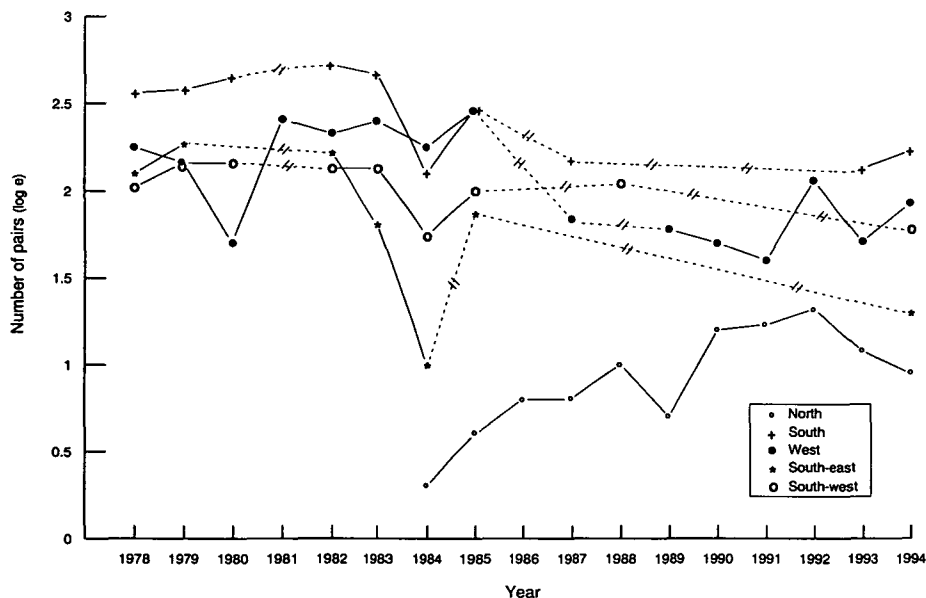


Figure 2. Changes in numbers of breeding Shag pairs in five areas on Corsica from 1978 to 1994 (Small open circle: North area, cross: South area, dot: West area, star: South-east area, open dot: South-west, double bar with broken line: number unknown).

numbers for all areas decreased at an average annual rate of respectively 10% (South-east), 4.5% (South), 5% (West) and 3% (South-west). The rank orders of annual counts over years were not significantly correlated either for all five areas (Kendall's coefficient of concordance, $\tau = 0.25$, $n = 6$, n.s.), or excluding the North area ($\tau = 0.54$, $n = 6$, n.s.).

Although Shag numbers decreased between 1978-81 and 1990-94 in the four main areas (South-east, South, West and South west), this was not associated with a reduction in the number of occupied colony-sites during these periods (Table I). Nevertheless, in the West area there is a significant relationship between the number of pairs and the number of sites occupied ($r_{12} = 0.69$, $p < 0.01$), but such a relationship does not exist among the other areas (Fig. 3), excepted South-west which included no more than three colony-sites.

TABLE I. NUMBERS OF COLONY-SITES OCCUPIED BY MEDITERRANEAN SHAGS IN CORSICA IN 1978-81 AND 1990-94

| | 1978-81 | 1990-94 |
|------------|---------|---------|
| North | 0 | 1 |
| West | 21 | 20 |
| South-west | 1-2 | 3 |
| South | 8 | 9 |
| South-east | 6 | 5 |
| Total | 36-37 | 38 |

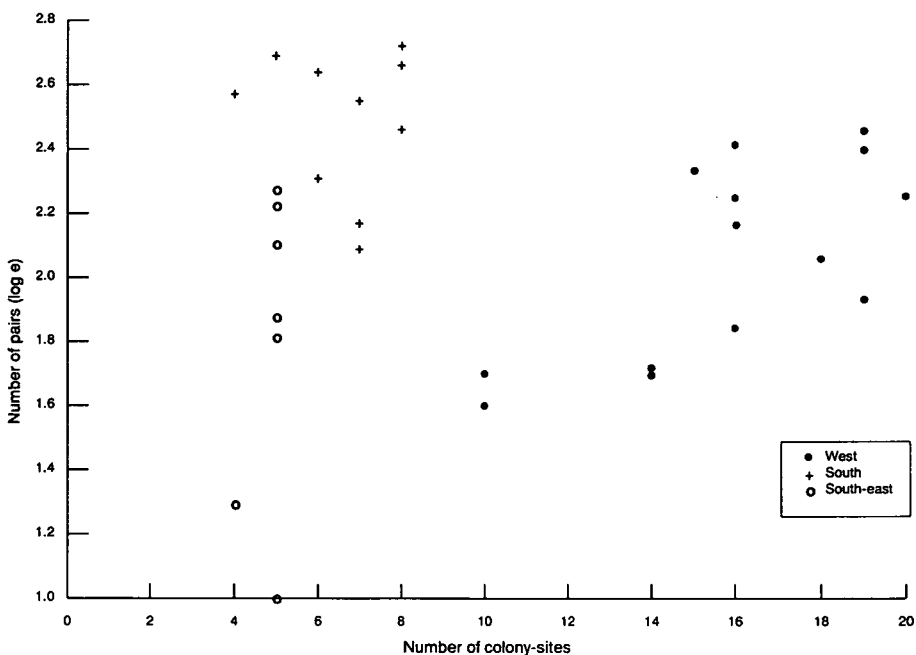


Figure 3. Relationship between number of breeding pairs (log transformed) and number of occupied colony-sites.

*Detailed situation in the five areas**North area*

Shags were first recorded breeding on Finocchiarola Is. (1 colony-site) in 1984 (Appendix). Since then, they have bred regularly, although numbers are low and fluctuate from year to year. The overall increase is significant ($r_g = 0.77$, $p < 0.01$) with an average annual rate of 16%.

West area

Detailed data for the 24 colony-sites are presented in the Appendix. Variations in numbers between 1978 and 1994 (15 counts) are significantly related among the six main colony-sites [1, 4,

6-12, 14-22, 23, 24 (grouped owing to close geographical distribution); $\tau = 0.54$, $p < 0.001$). There was a significant decrease in the overall number for this area between 1978 and 1994 ($r_{13} = -0.51$, $p < 0.05$); three distinct periods may be discerned: 1978-80 (decrease), 1981-85 (maximum number), 1987-94 (marked decrease, followed by stabilization at a low level). Most colony-sites decreased in size between 1981-85 and 1987-94. The three largest showed significant decreases between periods: Capo rosso area (= 14-23) ($U=2$, $n_1=5$, $n_2=7$, $p < 0.05$, Mann-Whitney U-test), Ciuttone ($U=2$, $n_1=5$, $n_2=7$, $p < 0.05$) and Gargalu ($U=0$, $n_1=5$, $n_2=7$, $p < 0.05$). Three colony-sites nearly disappeared (Cavallu, Orchinu and Castel-Arone). But several other smaller sites present different patterns: one did not present any trend (Elpa nera, $r = -0.03$, ns), two were colonized (since 1985 for Senino and 1987 for Revellata).

South-west area

Numbers on the Sanguinaires Is. (1 colony-site) decreased significantly between 1978 and 1994 ($r_s = -0.69$, $p < 0.05$) at an average annual rate of 6%. On Pianu I. (1 colony-site) only three censuses were conducted, no Shags were recorded in 1980, small numbers were present in 1988 and 1994. On Lava (1 colony-site), Shags were discovered in 1989, and counted only in 1992 and 1994.

South area

Numbers of Shag nests were not significantly correlated between the colony-sites of Bruzzi, Tonnara and Lavezzi Is. ($\tau = -0.25$, $n=10$, n.s.), nor among the 8 colony-sites of Lavezzi Is. ($\tau = -0.19$, $n=7$, n.s.) over the period 1978-94.

The decrease on Lavezzi Is. (8 colony-sites) between 1978 and 1994 (average annual rate: 7%) was significant ($r_{10} = -0.78$, $p < 0.01$). Between 1978 and 1980, the main colony-sites (islets A and B) were apparently full up, and Shags colonized several parts of the main island of Lavezzi (Lavezzi 1 and 2, Appendix). After 1986, numbers seemed to remain low, although censuses were not conducted on all islets every year. However since then, the number of main sites (islets A and B) has been very low, and number declines on the main island are resulting in desertion.

The situation was different on other isolated islets of the archipelago of Lavezzi: (i) Ratino and Porraggia showed no significant trend (respectively $r_s = -0.50$, n.s. and $r_{10} = -0.21$, n.s.), (ii) Pianu, where Shags were absent from 1978 to 1983, constituted the main colony-site in 1993-94.

On Bruzzi I. (1 colony-site) numbers fluctuated annually, sometimes dramatically, with 1 pair in 1978 and 40 two years later (Appendix). There was no significant trend between 1980 and 1994 ($r_s = 0.17$, n.s.). Tonnara I. (1 colony-site) was colonized by Shags after 1985 (Appendix).

South-east area

Variation in numbers on Cerbicale Is. between 1978 and 1994 were not significantly related to variations among colony-sites ($\tau = 0.19$, $n=6$, n.s.). Decrease between 1978 and 1994 is significant ($r_s = -0.85$, $p < 0.05$). Between 1978 and 1982, high numbers were noted on one site (Pietricaggiosa, see Appendix). Subsequently there was a general decline in all the colony-sites.

DISCUSSION

While there was no major change in either the distribution or the number of colony-sites of Mediterranean shags in Corsica between 1981-82 and 1993-94, there was a marked decline in the number of nests with the total population decreasing by 55% during the study (Fig. 4). Thus while seven colony-sites held over 100 nests in 1981-82, by 1993-94 only two contained more than 50 nests (Appendix).

Most colony-sites were affected by a sharp decrease, but no information collected allows us to know if birds permanently left Corsica. We did not witness a massive shift between colony-sites, although several examples of colonization of new sites do suggest that shifts occurred on a smaller scale: (i) in the West area, on Revellata after 1985 (corresponding to decrease in numbers on

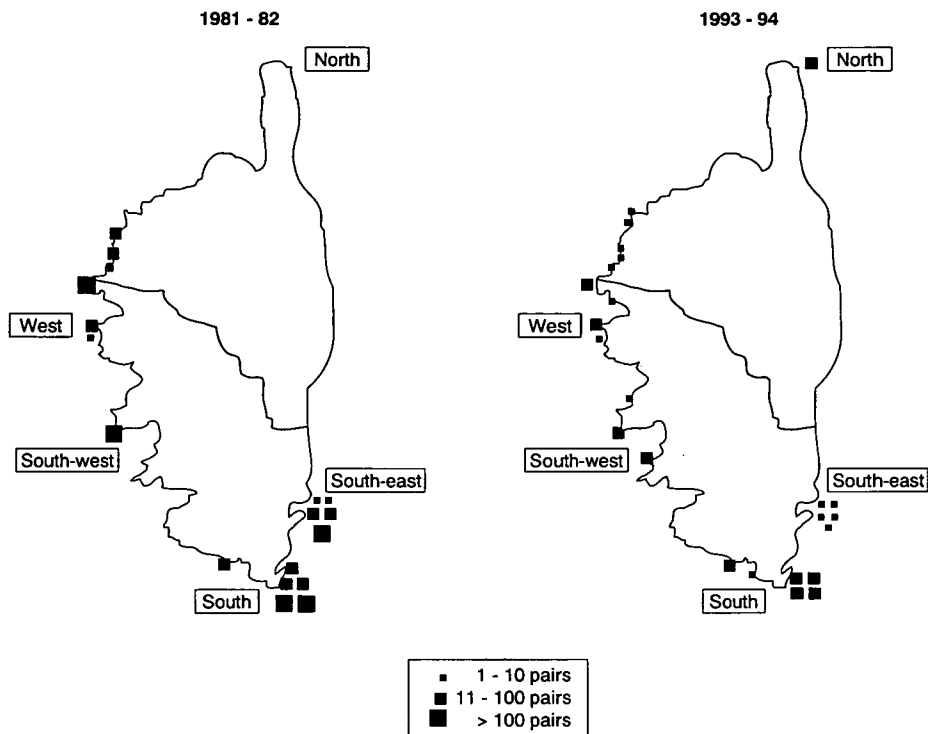


Figure 4. Changes in distribution and size of colonies of Mediterranean Shag on Corsica, between 1981-82 and 1993-94.

Cavallu) and Seninu after 1984 (Appendix), (ii) on Tonnara I., colonized after 1985 by at least some birds from Lavezzi Is., as indicated by observations of several Shags with colour rings (distance between the two colony-sites: 18 km., I. Guyot unpubl. data), (iii) Piana I. became the main colony-site in the Lavezzi archipelago, and (iv) colonization of isolated islets, such as Bruzzi I. after 1978, Piana I. (South-west area) after 1980 and Finocchiarola I. after 1983. Colonization of new but small sites, suggests that wider distribution has compensated for a decrease in number.

What therefore are the reasons for this rapid decrease? Adult mortality is apparently not a cause, as revealed by ringing studies, nor are pesticides, heavy metal poisoning or oil contamination to blame (I. Guyot & J.-C. Thibault unpubl. data). The Shag is moreover a protected species and poaching is rare. Nearly all colony-sites in Corsica are protected (natural reserve or other protection) and birds are not especially disturbed during breeding. As for competition with other species, another fish feeding species, the Yellow-legged Gull *Larus cachinnans*, increased in number during the 1980's with an average annual growth rate of 7% (I. Guyot & J.-C. Thibault unpubl. data). However it should be noted that during this period in the West area, the distribution of Yellow-legged Gulls was limited, and increases were restricted to a few sites. In contrast Mediterranean Shag numbers decreased on most colony-sites, and shags have colonized islets (Piana of Lavezzi, Tonnara) where gull numbers were very high. We therefore suggest that

changes in Shag feeding conditions have caused the observed population changes.

In Shags and Cormorants, reduced food availability before and during breeding is believed to cause decline in numbers, as documented for the Shag on the Isle of May (Aebischer 1986, Aebischer & Wanless 1992). Shags have a small capacity for foraging far from their colony-site (Schreiber & Clapp 1987), and a decline in feeding resources cannot be offset by longer travel; either birds simply do not breed or they move to a nearby colony-site for better food availability. No data exist on distance in feeding travel for breeding Mediterranean Shag, but in the North Sea, radio-tracking techniques indicate a mean foraging range of 7 km (Wanless *et al.* 1991). Analysis of pellets and regurgitation from chicks during the 1980's in Corsica, when Shag numbers were high, has shown that sandeels (Ammodytidae) were the predominant prey item, whereas outside the breeding season birds were dispersed largely along the coasts of Corsica and Northern Sardinia (I. Guyot unpubl. data), and fed mainly on *Posidonia* grass fishes (Guyot 1985). In the Mediterranean, sandeels show high inter-annual fluctuations (Tortonèse 1975), in contrast with *Posidonia* grass fishes which show less annual variation, although they are less abundant than the former during the Shag breeding season (Francour 1994). Seasonal abundance of sandeels provides food for a large number of Shags, but the lower production of *Posidonia* grass fishes constrains birds to breed in smaller numbers, well spread out along the coast. Several declining populations may be explained by the disappearance of seabirds from important feeding areas (Gargalo I. and Foccolara shoal: distance 5 km, Lavezzi A and B and Tour de Lavezzi shoal: <2km), suggesting that fish have vanished locally.

Consequently, we suggest that year-to-year fluctuations on all colony-sites, changes in colony size and shift between colony-sites may reflect modifications in food availability, such as a decrease in sandeels. Due to the lack of data on fluctuation of sandeels in this part of the Mediterranean, it is unknown whether their number decrease corresponds to a change in their biological cycle or to a long-term decline.

ACKNOWLEDGEMENTS

Many people helped with the fieldwork but particular thanks are due to the staff of Corsican Nature Reserves (François Arrighi, Charles-Henri Bianconi, Alain Camoin, Jean-Michel Culioli, Jean-Marie Dominici, Franck Finelli, Roger Miniconi, Jean-Pierre Panzani, Paul Peschet and Félix Santarelli). Nicolas Aebischer, Vincent Bretagnolle, and the Editor Sarah Wanless improved the manuscript with their comments and advice. Patricia Howlett improved the English. Gratitude is expressed here to all.

SUMMARY

Censuses of Shag colony-sites were conducted in Corsica from 1978 to 1994. No significant change was noticed in the overall distribution, but between 1981-82 and 1993-94, the decrease was 52 to 80% according to areas, whereas decrease of the overall population was 55%. Several new colony-sites were colonized during this period. It is suggested that year-to-year fluctuations on all colony-sites, changes in colony size and shift between colony-sites reflect modifications in food availability.

REFERENCES

- AEBISCHER, N.J. 1985. Aspects of the biology of the Shag *Phalacrocorax aristotelis*. Unpubl. PhD thesis, University of Durham.
- AEBISCHER, N.J. 1986. Retrospective investigation of an ecological disaster in the Shag, *Phalacrocorax aristotelis*: a general method based on long-term marking. *J. Anim. Ecol.* 55: 613-629.
- AEBISCHER, N. and WANLESS, S. 1992. Relationships between colony site, adult non-breeding and environmental conditions for Shags *Phalacrocorax aristotelis* on the Isle of May, Scotland. *Bird Study* 39: 43-52.
- ASHMOLE, N.P. 1971. Seabird ecology and the marine environment. In *Avian Biology*, vol. 1 (Eds. Farner, D.S., King, J.K. and Parkes, K.C.), pp. 224-286. Academic Press, New York.
- COOPER, J. 1980. Biology of the Bank Cormorant, Part 1: Distribution, population size, movements and conservation. *Ostrich* 52: 208-215.
- FRANCOUR, P. 1994. Pluriannual analysis of the reserve effect on ichthyofauna in the Scandola natural reserve (Corsica, north western Mediterranean). *Oceanol. Acta.* 17: 309-317.

- FURNESS, R.W. and BIRCKHEAD, T.R. 1984. Seabird colony distributions suggest competition for food supplies during the breeding season. *Nature* 311: 655-656.
- GREEN, R.E. and HIRONS, M.G.J. 1988. Effects of nest failure and spread of laying on counts of breeding birds. *Ornis Scand.* 19: 76-78.
- GUYOT, I. 1985. Approche du régime alimentaire des cormorans huppés *Phalacrocorax aristotelis* (Linné, 1761) en Corse par l'analyse des pelotes de réjection. Diplôme d'Etudes Approfondies, Université des Sciences et Techniques du Languedoc, Montpellier.
- GUYOT, I. 1989. Les îlots satellites de la Corse. *Patrimoine naturel et conservation*. AGENC, Bastia.
- GUYOT, I. 1990. Le Cormoran huppé en Corse: biologie et interactions avec la pêche professionnelle. *Travaux Scientifiques Parc Naturel Régional & Réserves Naturelles Corse* 28: 1-40.
- GUYOT, I. 1993. Breeding distribution and numbers of the Shag *Phalacrocorax aristotelis desmarestii* in the Mediterranean. In *Status and Conservation of Seabirds, Proceeding 2nd Mediterranean Seabird Symposium* (Eds. Aguilar, J.S., Monbailliu, X. and Paterson, A.M.), pp. 37-45. Sociedad Española de Ornitología, Madrid.
- GUYOT, I., LAUNAY, G. and VIDAL, P. 1985. Oiseaux de mer nicheurs du Midi de la France et de la Corse: évolution et importance des effectifs. In *Oiseaux marins nicheurs du Midi et de la Corse* (Eds. Thibault, J.-C., Guyot, I. and Cheylan, G.), pp. 31-47. Centre Régional Ornithologique de Provence, Aix-en-Provence
- HARRIS, M.P. and FORBES, R. 1987. The effect of date on counts of nests of Shags *Phalacrocorax aristotelis*. *Bird Study* 34: 187-190.
- KUSHLAN, J.A. 1986. Colonies, Sites, and Surveys: the Terminology of Colonial Waterbird Studies. *Colonial Waterbirds* 9: 119-120.
- POTTS, G.R. 1969. The influence of eruptive movements, age, population size and other factors on the survival of the Shag *Phalacrocorax aristotelis* (L.). *J. Anim. Ecol.* 38: 53-102.
- SCHREIBER, R.W. and CLAPP, R.B. 1987. Pelecaniform feeding ecology. In *Seabirds: feeding, ecology and role in marine ecosystems* (Ed. Croxall J.P.). Cambridge University Press, Cambridge.
- TORTONESE, E. 1975. Osteichthyes (Pesci ossei), parte seconda. *Fauna italia* 11. Calderini, Bologna.
- WANLESS, S., HARRIS, M.P. and MORRIS, J.A. 1991. Foraging range and feeding locations of Shags *Phalacrocorax aristotelis* during chick rearing. *Ibis* 133: 30-36.

Isabelle Guyot, Agence pour la Gestion des Espaces Naturels de Corse, 3 rue Luce de Casabianca, F-20200 Bastia, Corsica.
Jean-Claude Thibault, Parc Naturel Régional de la Corse, B.P. 417, F-20184 Ajaccio cedex, Corsica.

APPENDIX. CENSUSES OF MEDITERRANEAN SHAG NESTS ON CORSICA BETWEEN 1978 AND 1994. THE LOCATION OF THE FIVE AREAS AND THE COLONY-SITES ARE SHOWN IN FIGURE 1.

18

| Area | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 |
|----------------------------|---------|---------|------|---------|---------|---------|---------|---------|------|------|------|------|------|-------|------|------|------|
| <i>Colony-site</i> | | | | | | | | | | | | | | | | | |
| North | | | | | | | | | | | | | | | | | |
| Finocchiarola Is. | ? | 0 | 0 | 0 | 0 | 0 | 2 | 2-6 | 6 | 6 | 10 | 5 | 16 | 17 | 21 | 12 | 9 |
| West | | | | | | | | | | | | | | | | | |
| Revellata (1) | ? | 0 | 0 | ? | 0 | ? | 0 | 0 | | 3 | | 4-6 | 3 | ? | 10 | 7 | 6 |
| Nichiaretu (2) | ? | ? | ? | ? | ? | ? | ? | ? | | ? | | 1-3 | ? | ? | 3 | 2 | 3 |
| Cavallu (3) | 5 | ? | 4 | c.40 | 8-15 | 8-12 | >1 | 20-30 | | 5 | | 7-9 | 0 | 0 | 4 | 3 | 1 |
| Ciuttone (4) | 15-23 | 19 | 16 | 35-36 | >23 | 33-37 | >35 | 14-17 | | 2 | | 7-10 | 18 | 4-7 | 18 | 14 | 6 |
| Elpa nera (5) | 3-5 | 9 | 3 | 8-9 | 0 | 5 | >10 | 4-7 | | 1 | | 4 | 3 | >3 | 12 | 3 | 6 |
| Punta palazzu (6) | 2-3 | 8 | 3 | 5-6 | >6 | >7-8 | ? | 3-4 | | 2 | | 6 | 3 | 4 | 2 | 0 | 2 |
| Cala di l'oru (7) | 3 | 2 | 0 | 6 | 7-8 | 9 | 1 | 2-3 | | 0 | | 0 | ? | 0 | 1 | 1 | 1 |
| Gargalu I. (8) | 40-60 | 37-42 | 15 | 100-110 | >100 | >95 | 55-85 | c.165 | | 26 | | 17 | >17 | >7 | 14 | 3 | 22 |
| A sulana (9) | 5 | 4 | 3 | 4 | 3-4 | 5 | 3-7 | 1 | | 0 | | 2 | 0 | 2 | 1 | 1 | 1 |
| Gattaghia (10) | 6-7 | 10 | 7 | 19-20 | 10-12 | 5-6 | 8-9 | 7-13 | | 0 | | 2-3 | 2 | 1 | 2 | 2 | 2 |
| Punta scandola (11) | 4-5 | 3 | 1 | 1 | 1 | 1? | 3 | 3 | | 1 | | 2 | ? | 1 | 0 | 0 | 3 |
| Ficaja (12) | 4 | 14 | 4 | 10 | >9 | 15-18 | c.6 | 5 | | 2 | | 0 | 0 | 0 | 1 | 0 | 1 |
| Seninu (13) | 0 | 0 | 1 | 0 | 0 | ? | 0 | 4-5 | | 1 | | 3? | 5 | 4-5 | 14 | 5 | 3 |
| Punta piana (14) | 0 | 0 | 0 | 2 | 6-8 | >4 | 5-8 | 2 | | 4 | | ‡ | ‡ | ‡ | 1 | 0 | 2 |
| Guardiola (15) | 6-7 | 16 | 1 | 4 | 5-11 | 14-15 | 7-13 | 8-13 | | 2 | | ‡ | ‡ | ‡ | 2 | 2 | 1 |
| Éboulis de Piana (16) | 22-25 | 3 | 1 | 2 | 7-14 | >10-14 | >4 | 4-8 | | 1 | | ‡ | ‡ | ‡ | 14 | 10 | 5 |
| Turghio-San Pelegrino (17) | 3 | 0 | 1 | 5 | 5-8 | >4-5 | c.10 | 10-12 | | 3 | | ? | >5 | 3-7 | 5 | 1 | 12 |
| Passage (18) | 7 | 4 | 0 | 0 | c.7 | 2 | 3-4 | 2-4 | | 1 | | ‡ | ‡ | ‡ | 1 | 0 | 1 |
| Sbiro (19) | 6 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | | 0 | | ‡ | ‡ | ‡ | 0 | 0 | 0 |
| Terre face 39 (20) | 7 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | | ‡ | ‡ | ‡ | 0 | 0 | 0 |
| Ilot pointu (21) | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | | ‡ | ‡ | ‡ | 0 | 0 | 0 |
| Cala genovese (22) | 5 | 3 | 1 | ? | 3-4 | 1-2 | 3-5 | 2-3 | | 0 | | ‡ | ‡ | ‡ | 0 | 0 | 0 |
| Castel-Arone (23) | 9 | 4 | 0 | 5-6 | ? | 5-6 | 0 | 1? | | 1 | | ? | 0 | 0 | 0 | 0 | 1 |
| Orchinu (24) | 1 | 0 | ? | 9 | ? | 11-13 | 3-6 | 11-15 | | 5 | | ? | 0 | 0 | 0 | 1 | ? |
| Total | 160-200 | 140-150 | c.50 | 255-270 | 200-230 | 235-260 | 160-200 | 270-310 | ? | c.70 | ? | c.60 | c.50 | 30-50 | 105 | c.52 | c.80 |

SEABIRD

| | | | | | | | | | | | | | | | | | |
|----------------------------|---------|---------|---------|-------|---------|---------|---------|-------|-------|-------|--------|-----|----|----|-----|---------|---------|
| South-west | | | | | | | | | | | | | | | | | |
| Lava I. | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? | ? | x | ? | ? | 8 | x | 4-5 |
| Sanguinaires Is. | 80-130 | 130-160 | 130-160 | ? | 120-150 | 120-150 | c.55 | c.100 | ? | ? | 80-110 | ? | ? | ? | ? | ? | 33-50 |
| Piana I. | ? | ? | 0 | ? | ? | ? | ? | ? | ? | ? | 12-16 | ? | ? | ? | ? | ? | 20 |
| Total | 80-130 | 130-160 | 130-160 | ? | 120-150 | 120-150 | c.55 | c.100 | ? | ? | 92-126 | ? | ? | ? | ? | ? | 57-75 |
| South | | | | | | | | | | | | | | | | | |
| Bruzzi I. | 1 | ? | 40 | c.60 | c.25 | c.15 | c.25 | 25 | ? | 60 | ? | ? | ? | ? | ? | 34 | 55 |
| Tonnara I. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ? | 30 | ? | 17 | ? | ? | ? | 10-13 | 5-10 |
| Lavezzi 1 (Lavezzi Is.) | 2-3 | ? | 2-5 | c.25 | c.50 | c.30 | c.25 | 25 | 25-30 | 21 | 27 | 11 | 3 | 3 | 0 | 3 | 1 |
| Lavezzi 2 | 0 | 0 | 0 | <10 | c.60 | c.10 | ? | c.35 | ? | 1 | ? | <5 | 0 | 2 | <5 | 0 | 0 |
| Islet A | c.150 | c.150 | c.150 | c.150 | >150 | <150 | <50 | >50 | ? | 25 | ? | <10 | <5 | <5 | <5 | <5 | 5 |
| Islet B | c.190 | c.190 | c.190 | ? | >180 | <180 | <50 | >45 | ? | ? | ? | <10 | <5 | <5 | <5 | <5 | 10 |
| Ratino | 8-12 | ? | 15 | ? | 25 | c.8 | 5 | c.30 | 25-30 | ? | ? | ? | ? | ? | ? | 33 | 22-27 |
| Porraccia | 25-30 | 25-30 | c.50 | c.50 | c.50 | c.20 | 1-2 | c.30 | 50-65 | 30-32 | ? | ? | ? | ? | ? | 19 | 16-22 |
| Sperduto | 1-3 | 1-3 | 1-3 | c.10 | c.10 | c.10 | >5 | 5 | c.10 | 8 | ? | ? | ? | ? | ? | ? | ? |
| Piana | 0 | 0 | 0 | 0 | 0 | ? | ? | ? | >5 | ? | ? | ? | ? | ? | ? | 20-50 | 56-65 |
| Total | c.380 | c.380 | c.450 | ? | c.550 | <420 | <160 | >245 | ? | c.175 | ? | ? | ? | ? | ? | 129-174 | 170-195 |
| South-east (Cerbicale Is.) | | | | | | | | | | | | | | | | | |
| Forana | ? | 6 | ? | ? | 4-10 | 6 | ? | ? | 35 | ? | ? | ? | ? | ? | ? | ? | 2-5 |
| Piana | 10-20 | 50 | ? | ? | <5 | c.15 | ? | ? | 10-15 | ? | ? | ? | ? | ? | ? | ? | 6-10 |
| Pietricaggiosa | 65-85 | c.100 | ? | ? | c.125 | 30-35 | 1 | ? | 13 | ? | ? | ? | ? | ? | ? | ? | 5-7 |
| Vacca | 10-15 | 5-6 | ? | ? | c.20 | 1 | 0 | ? | 8 | ? | ? | ? | ? | ? | ? | ? | 0 |
| Toro | 5-10 | 30 | ? | ? | ? | ? | <10 | ? | 1 | ? | ? | ? | ? | ? | 1-3 | ? | 1-3 |
| Total | 90-130 | c.190 | ? | ? | >160 | 50-80 | c.10 | ? | 70-80 | ? | ? | ? | ? | ? | ? | ? | 14-25 |
| Total count | 710-840 | 840-880 | ? | ? | c.1,000 | 825-910 | 385-425 | ? | ? | ? | ? | ? | ? | ? | ? | ? | 320-375 |

Note

Numbers in brackets correspond to those shown on Fig. 1.

c. = estimated mean number, ? = presence and number unknown, x = present, but number unknown, ‡ = grouped data, < = maximum number, > = minimum number.

Range indicates effective count and estimated number.

Arctic Terns *Sterna paradisaea* in the central northern North Sea in July: offshore staging area for failed breeders?

Kees (C.J.) Camphuysen & Chris J.N. Winter

INTRODUCTION

Arctic Terns *Sterna paradisaea* are by far the most pelagic species of tern in the North Sea, with frequent sightings at considerable distances from the coast, but the largest numbers are normally found close inshore (Nørrevang 1960, Tasker *et al.* 1987, Stone *et al.* 1995). In one study, breeding Arctic Terns spent on average only 50 minutes away from the nest on feeding trips, indicating inshore foraging (Pearson 1968). During extensive ship-based seabird surveys conducted between 1979 and 1993, some offshore dispersal in July of small numbers of Arctic Terns became apparent (Stone *et al.* 1995), but during surveys in July 1995 substantial numbers of offshore terns were discovered in the northwestern North Sea. The observations are described and discussed in the light of prompt colony desertion of nesting Arctic Terns (Bullock & Gomersall 1981, Bourne & Saunders 1992).

METHODS

The distribution of seabirds at sea was assessed onboard the fishery research vessel *Tridens* during an acoustic survey for herring *Clupea harengus* from 4 to 21 July 1995. Broad coverage of the North Sea was achieved between 54°N and 59°N latitude, 2°W-2°E longitude, and the transects were steamed in a zig-zag course from north to south (Fig. 1). Counts presented are in the form of numbers per kilometre travelled (n/km) obtained from a 180° scan ahead of the ship, or densities (birds per km²) taken from a 300 m wide band-transect which was performed simultaneously (Tasker *et al.* 1984). Estimates of total numbers within the study area were roughly estimated from mean densities per quarter ICES square (15' latitude x 30' longitude). For all recorded flocks of terns, the distance to the nearest land was calculated and the water depth was recorded. Arctic Terns were aged by plumage, while notes were made on the behaviour. Attempts were made to identify prey visible in the beak of the terns.

RESULTS

Arctic Terns were observed both offshore and inshore within the study area (Fig. 1). However, north of 56°N latitude terns mainly occurred far offshore whilst in the south most terns were concentrated around one of the most important breeding colonies, the Farne Islands (55°38'N, 1°36'W). In the north, all terns were adults and formed comparatively large flocks (Table I), whereas in the south virtually all sightings comprised solitary terns or small groups, eagerly foraging and either feeding recently fledged juveniles or carrying fish towards land. On the basis of differences in overall distribution, flock size, behaviour, age composition and co-occurrences with other seabirds, the 'northerly' and 'southerly' terns were treated as two different 'populations', the characteristics of which are described below.

North of 56°N

In the north, Arctic Terns were widespread, but occurred mainly at over 75 km from the nearest coast (Fig. 2) in waters over 90m in depth (Table II). The terns were seen in flocks of up to 57 individuals and exhibited a variety of aerial courtship displays. Most flocks (58%, n = 19) were restless, frequently settling and swimming in tight packs followed by different flight patterns.

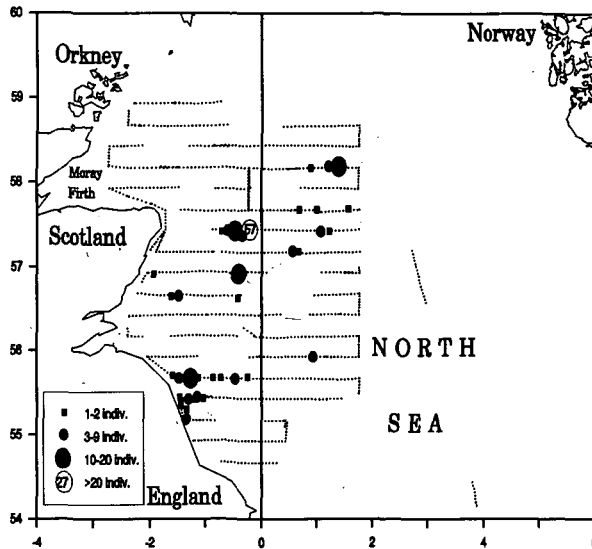


Figure 1. Ten-minute counts (small dots) conducted between 4 July and 21 July 1995 onboard RV Tridens and sightings of Arctic Terns in the northern North Sea.

TABLE I. FREQUENCY DISTRIBUTION (N) OF FLOCK SIZE IN ARCTIC TERNS OBSERVED NORTH AND SOUTH OF 56°N

| Flock size | N of 56°N | S of 56°N |
|--------------------|-----------|-----------|
| 1 | 5 | 18 |
| 2 | 5 | 11 |
| 3 | 1 | 3 |
| 4 | 2 | 5 |
| 8 | 1 | |
| 9 | 1 | 1 |
| 12 | 1 | 1 |
| 14 | 1 | |
| 19 | 1 | |
| 57 | 1 | |
| Number of birds | 145 | 90 |
| Number of flocks | 19 | 39 |
| Average flock size | 7.6 | 2.3 |

Substantial flocks of terns (>5 individuals) occurred significantly more frequently in the north than in the south ($\chi^2 = 7.13$, $df = 1$, $p < 0.01$). Aerial displays included terns chasing others in a rather aggressive motion, and courtship displays (low flight and high flight; Cullen 1960). Feeding terns were occasionally observed (4 flocks; 21% of all terns, $n = 145$), but there were no observations of flocks of terns steadily moving in one particular direction (indicative of migrant birds). Terns carrying fish and flying towards land were not seen. The total number of Arctic Terns to the north of 56°N was estimated at 10,500 individuals.

Arctic Tern distribution in the north did not overlap with that of the Kittiwake *Rissa tridactyla*, another abundant surface feeding seabird in this part of the North Sea (Fig. 2). Kittiwakes occurred mainly within 75 km from land, actively feeding on sandeels *Ammodytes* spp. where these fish formed dense balls near the surface (direct observations in the field, sandeel balls were not visible in the acoustic survey results). The coastal zone was very rich in piscivorous seabirds and marine mammals (most notably Kittiwake, Herring Gull *Larus argentatus*, Guillemot *Uria aalge*, Razorbill *Alca torda*, Minke Whale *Balaenoptera acutorostrata*, Harbour Porpoise *Phocoena*

TABLE II. OBSERVED AND EXPECTED NUMBERS OF ARCTIC TERNS IN RELATION TO WATER DEPTH (M) NORTH AND SOUTH OF 56°N. EXPECTED NUMBERS ARE BASED ON OBSERVER EFFORT IN EACH OF THE DEPTH CATEGORIES AND THE TOTAL NUMBER OF TERNS OBSERVED.

| Water depth (m) | North of 56°N | | South of 56°N | |
|--------------------|---------------|-----|---------------|-----|
| | Obs | Exp | Obs | Exp |
| <50 | 0 | 1 | | |
| 50-60 | 0 | 6 | 5 | 4 |
| 60-70 | 9 | 13 | 29 | 13 |
| 70-80 | 1 | 20 | 12 | 35 |
| 80-90 | 18 | 22 | 32 | 27 |
| 90-100 | 96 | 33 | 12 | 8 |
| 100-110 | 3 | 13 | 0 | 2 |
| 110-120 | 0 | 15 | | |
| 120-130 | 12 | 7 | | |
| 130-140 | 0 | 6 | | |
| 140-150 | 4 | 5 | | |
| 150-160 | 2 | 3 | | |
| Totals | 145 | 145 | 90 | 90 |

phocoena and Grey Seal *Halichoerus grypus*). Arctic Terns were rare in these coastal waters, but rather stayed offshore in waters where low densities of the other piscivorous seabirds were found (Table III). This offshore zone was apparently poor in shoaling fish, either near the surface (direct observations) or further down the water column (acoustic survey results; pelagic catches comprised small amounts of herring, sprat *Sprattus sprattus* and Norway pout *Trisopterus esmarckii*; A. Corten pers. comm.).

South of 56°N

In the south, Arctic Terns were most commonly observed near the coast (<50 km from the coast; Fig. 2), mainly in waters of 60-90m depth (Table II), and many terns were foraging (17 flocks, 50% of all terns, $n = 90$). Most Arctic Terns were found in a small area around the Farne Islands and 97.8% were adults ($n = 90$). Arctic Terns were not seen to form compact groups, did not settle on the sea for any length of time, and five were seen to return to land carrying fish (sandeels). Aerial displays were never seen, except the begging behaviour of some recently fledged juveniles, and none of the terns spent any time swimming around. Arctic Tern and Kittiwake distribution overlapped completely (Fig. 2) and both species were actively foraging on sandeels in waters rich in seabirds and cetaceans. As in the north, all piscivorous seabirds were more abundant in the coastal zone than offshore (Table III), and feeding aggregations were a typical inshore phenomenon. To the south of 56°N, some 5000 Arctic Terns were estimated to occur.

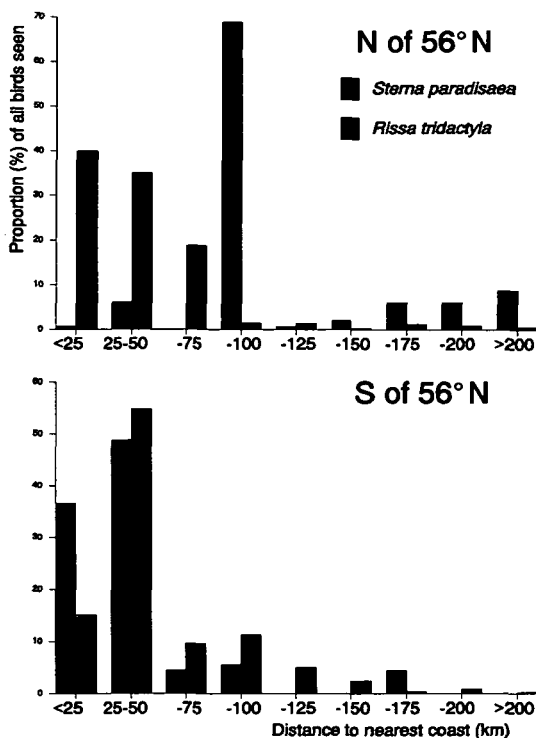


Figure 2. Numbers of Arctic Terns and Kittiwakes observed north and south of 56°N in distance strata away from the nearest coast.

TABLE III. RELATIVE ABUNDANCE OF SOME PISCIVOROUS SEABIRDS NORTH AND SOUTH OF 56°N, WITHIN OR BEYOND 75 KM FROM THE NEAREST COAST. HERRING GULLS, KITTIWAKES, AND THE AUKS ARE EXPRESSED AS DENSITIES (N/KM²), ARCTIC TERNS ARE GIVEN AS NUMBER PER KM TRAVELLED.

| | | < 75 km from the shore | > 75 km from the shore |
|-----------|--------------|------------------------|------------------------|
| N of 56°N | Herring Gull | 0.5 | 0 |
| | Kittiwake | 6.4 | 0.1 |
| | Guillemot | 16.6 | 3.6 |
| | Razorbill | 2.4 | 0.2 |
| | Puffin | 1.3 | 0.1 |
| | Arctic Tern | 0.0 | 0.1 |
| S of 56°N | Herring Gull | 0.1 | 0 |
| | Kittiwake | 7.2 | 0.8 |
| | Guillemot | 10.1 | 2.9 |
| | Razorbill | 1.8 | 0.2 |
| | Puffin | 3.4 | 0.0 |
| | Arctic Tern | 0.1 | 0.0 |

DISCUSSION

Arctic Terns are widespread and common summer visitors to north-west European coasts. The largest North Sea colonies are found on Shetland and Orkney (c. 66,000 pairs; Lloyd *et al.* 1991). Within the study area described here, the most substantial breeding populations are found on the Farne Islands, whereas only small numbers breed along the east coast of Scotland (Buckland *et al.* 1990). In the northern half of the study area, the colonies on Shetland and Orkney are as close as those on the Farne Islands. It is worth mentioning that no Arctic Terns were seen close to Orkney. Arctic Terns nesting in colonies bordering the North Sea have a breeding season extending from May to July inclusive (Langham 1971). Two or three eggs are normally laid from late May to early June, with replacements as late as July (Cramp *et al.* 1974).

The terns in the south were obviously associated with the nearby breeding stations, considering the distance to the colonies and the frequent sightings of adult birds carrying fish towards land. Of the terns in the north it was unlikely that they were (currently) associated with any colony, since the distance to land was too large and none were carrying fish for any length of time. The northern half of the study area was visited in the first half of July, so that recently fledged juveniles (if the adults had been successful breeders) as seen in the south could not yet be expected.

Aerial displays by Arctic Terns performed at sea are not unusual. Camphuysen (1991) described courtship displays of Arctic Terns at great distances from land in the southern North Sea in early June. It was suggested that these might have been terns breeding in the High Arctic (arrivals late June), slowing down the speed of spring migration and establishing or re-affirming the pair-bond on their way north. After such necessary rituals are dealt with, nesting, copulation and egg-laying can commence immediately after arrival. Aerial courtship displays as late as July have been described for Arctic Terns in Massachusetts (Cramp 1985) and are known from Shetland (J. Uttley pers. comm.). Such displays were considered part of mate choice and pair bonding for the following year. The courtship of terns in the central northern North Sea in early July could serve either as a second nesting attempt, or the formation, continuation or re-affirmation of a pair bond for the next season.

Bourne & Saunders (1992) mentioned a report of thousands of Arctic Terns settling and starting to breed on the Pentland Skerries in May 1913, which then suddenly left the island for a month in early June, but returned to lay again in July. The terns suddenly deserted their hatching eggs when feeding conditions deteriorated. Similarly, Bullock & Gomersall (1981) described total colony desertion of eight colonies along the east coast of Shetland between 14-24 June 1980, and numbers of breeding pairs falling by 30-90% at a further 12 colonies. In many cases, adults left behind dead and dying chicks which were well below the expected minimum weights for their age, indicating food shortages. Colony desertion by Arctic Terns was common in the years when reductions in the availability of sandeels around Shetland caused widespread breeding failures, particularly among surface feeding seabirds (Heubeck 1989, J. Uttley pers. comm.). It has been speculated that terns which suddenly abandoned breeding colonies moved out to sea, but without any supporting evidence in the form of sightings. Although the offshore terns could simply have been non-breeders, it is tempting to speculate that the adult Arctic Terns in the northern North Sea are in fact such failed breeders, either awaiting further chances later in the season ('stand-by population'), or awaiting the proper time for their southward migration. A staging area in the central northern North Sea as reported in this paper could potentially support Arctic Terns from Shetland, Orkney, southwest Norway and the east coast of Scotland. The c. 10,000 Arctic Terns, calculated to occur offshore to the north of 56°N, could potentially originate from colonies in northern Shetland which had failed by the beginning of July 1995 after which the adults had simply disappeared (M. Heubeck *in litt.*). One example is the colony on Papa Stour, which had over 2000 breeding pairs in the third week of June, but was virtually deserted by c. 6 July (i.e. >4000 adult terns without young).

It is difficult to understand why, if the offshore concentrations comprise failed breeders

awaiting better chances, these terns move to areas which are apparently not particularly rich in food. Only 50 km further inshore very rich feeding grounds were available, highly suitable for Arctic Terns. Instead, they preferred waters which were poor in surface schooling fish. Prior to the autumn migration, in late July, substantial flocks of Arctic Terns are often seen along the coast of Scotland and north-east England, with post-breeding concentrations of up to 300 individuals in late July/early August (Buckland *et al.* 1990, Jardine *et al.* 1993). Possibly, the energetic requirements for the offshore terns are comparatively low (no chicks to feed, no large distances to travel) leading to a preference for waters in which they avoid competition (Kittiwakes), predation (Great Skuas *Stercorarius skua*) and kleptoparasitism (gulls, Arctic Skuas *S. parasiticus*). Another explanation would be that the adult terns did not feed on fish but preferred zooplankton. Fulmars *Fulmarus glacialis* in the Barents Sea have a diet that is predominately fish if chicks are to be fed, whereas immatures and failed breeders visiting the colonies immediately switch to zooplankton (pers. obs.). It is possible that adult Arctic Terns, which are known to feed on Euphausiids in their wintering quarters, prefer zooplankton to fish.

ACKNOWLEDGEMENTS

We would like to thank captain A. Krijgsman, crew and cruise leader A. Corten of FRV *Tridens* for their co-operation onboard. Martin Heubeck kindly produced information on the 1995 breeding season on Shetland. Jaap van der Meer, Theunis Piersma, John Utley and an anonymous referee improved earlier drafts of this paper.

SUMMARY

The distribution of Arctic Terns in the northwestern North Sea in July 1995 was described from extensive ship-based surveys. Two 'populations' of terns were recognized, an inshore, foraging population around the Farne Islands, and an offshore population in the north. From strip-transect counts, it was estimated that the offshore population numbered approximately 10,500 terns. The offshore terns were frequently engaged in aerial courtship, formed rather large and restless groups, and occurred in waters which were comparatively poor in piscivorous seabirds (including potential competitors) and surface schooling fish. It is speculated that the offshore concentrations of adult Arctic Terns comprised failed breeders, either awaiting further chances later in the season ('stand-by population'), or awaiting the proper time for their southward migration.

REFERENCES

- BOURNE W.R.P. and SAUNDERS D. 1992. Operation Seafarer and Arctic Terns. *Scott. Birds* 16: 205-210.
- BUCKLAND S.T., BELL M.V. and PICOZZI N. 1990. *The birds of North-east Scotland*. North-east Scotland Bird Club, Aberdeen.
- BULLOCK I.D. and GOMERSALL C.H. 1981. The breeding populations of terns in Orkney and Shetland in 1980. *Bird Study* 28: 187-200.
- CAMPHUYSEN C.J. 1991. Baltsvluchten van Noordse Sterns *Sterna paradisaea* op open zee. *Sula* 5: 59-61.
- CRAMP S. (ed.) 1985. *The birds of the Western Palearctic*, vol. IV. Oxford Univ. Press, Oxford.
- CRAMP S., BOURNE W.R.P. and SAUNDERS D. 1974. *The Seabirds of Britain and Ireland*. Collins, London.
- CULLEN J.M. 1960. The aerial display of the Arctic Tern and other species. *Ardea* 48: 1-37.
- HEUBECK M. (ed.) 1989. Seabirds and sandeels: proceedings of a seminar held in Lerwick, Shetland, 15-16th October 1988. Shetland Bird Club, Lerwick.
- JARDINE D., JOHNSTON A., KERR I., MCKEOWN D. and ROSSITER N. 1993. Birds in Northumbria, 1992. *The 1992 Bird Report for Northumberland, Newcastle and North Tyneside*. Northumberland and Tyneside Bird Club, Newcastle.
- LANGHAM N.P.E. 1971. Seasonal movements of British terns in the Atlantic Ocean. *Bird Study* 18: 155-175.
- LLOYD C., TASKER M.L. and PARTRIDGE K. 1991. *The Status of Seabirds in Britain and Ireland*. T. and A.D. Poyser, London.
- NØRREVANG A. 1960. Nogle iagttagelser over traekkende ternen oppørsel. *Dansk Orn. Foren. Tidsskr.* 54: 125-127.
- PEARSON T.H. 1968. The feeding biology of sea-bird species breeding on the Farne Islands, Northumberland. *J. Anim. Ecol.* 37: 521-552.
- STONE C.J., WEBB A., BARTON C., RATCLIFFE N., REED T.C., TASKER M.L., CAMPHUYSEN C.J. and PIENKOWSKI M.W. 1995. *An atlas of seabird distribution in north-west European waters*. Joint Nature Conservation Committee, Peterborough.
- TASKER M.L., JONES P.H., DIXON T.J. and BLAKE B.F. 1984. Counting seabirds at sea from ships: a review of methods employed and a suggestion for a standardized approach. *Auk* 101: 567-577.
- TASKER M.L., WEBB A., HALL A.J., PIENKOWSKI M.W. and LANGSLOW D.R. 1987. *Seabirds in the North Sea*. Nature Conserv. Council, Peterborough.

C.J. Camphuysen and C.J.N. Winter, Netherlands Institute for Sea Research, P.O. Box 59, 1790 AB Den Burg, Texel, The Netherlands.

Factors affecting the timing of nocturnal returns to land by the Madeiran Storm Petrel *Oceanodroma castro* during the breeding cycle on Selvagem Grande Island

J.-L. Mougin, P. Defos du Rau, C. Jouanin, M.-C. Mougin, F. Roux
and M. Segonzac

INTRODUCTION

The Madeiran Storm Petrel *Oceanodroma castro* visits Selvagem Grande Island (30°09' N, 15°52' W) throughout the year and breeds during 9 or 10 months (June to March) with each pair spending approximately 105 days on incubation and chick rearing (Mougin *et al.* 1990). The species is threatened by diurnal predators such as the Yellow-legged Herring Gull *Larus cachinnans* and the Kestrel *Falco tinnunculus* and is strictly nocturnal. Birds are active at the colony only during darkness, when both sexes emit a loud and repeated flight call which is clearly audible over a considerable distance.

METHODS

During various visits to Selvagem Grande Island between May and October from 1980 to 1994, the timing of the first flight call, i.e. of the first return, of the Madeiran Storm Petrel has been noted every night. The flight call is produced equally by both sexes (James & Robertson 1985) and by non-breeding as well as by breeding birds, flying or in the burrows, but the first call of the night is always produced by a relatively distant flying bird which makes it impossible to determine the status of the individual. Breeding birds are present on land from June (first egg) until February-March (last chick) together with non-breeding birds, hence our observations included birds of all status, except in May where no breeding occurs. Previous data given in Mougin *et al.* (1993) are incorporated in this paper together with newly collected ones. All results are given in Madeira winter time. Values are means \pm S.D. Student's t-test and analysis of variance were used for statistical comparisons.

RESULTS

Timing of the first returns

The times of the first return to land varied markedly during the breeding season (Fig. 1). The monthly means became later from May to June, were more or less constant in June and July and became earlier between August and October. An analysis of variance shows very significant differences ($F_5 = 733.2$, $p < 0.01$), but the values provided by June and July ($t = 0.6$, ns) and May and August ($t = 1.7$, ns) are not significantly different. A highly significant correlation exists between the date and the hour of the first return, positive before the summer solstice ($r = 0.875$, $n = 37$, $p < 0.01$) and negative thereafter ($r = -0.939$, $n = 136$, $p < 0.01$). Finally, a very significant positive correlation exists between the hour of sunset and the hour of the first returns for : the whole period studied ($r = 0.989$, $n = 173$, $p < 0.01$) ; the period preceding the solstice ($r = 0.833$, $n = 37$, $p < 0.01$) ; and the period following it ($r = 0.993$, $n = 136$, $p < 0.01$).

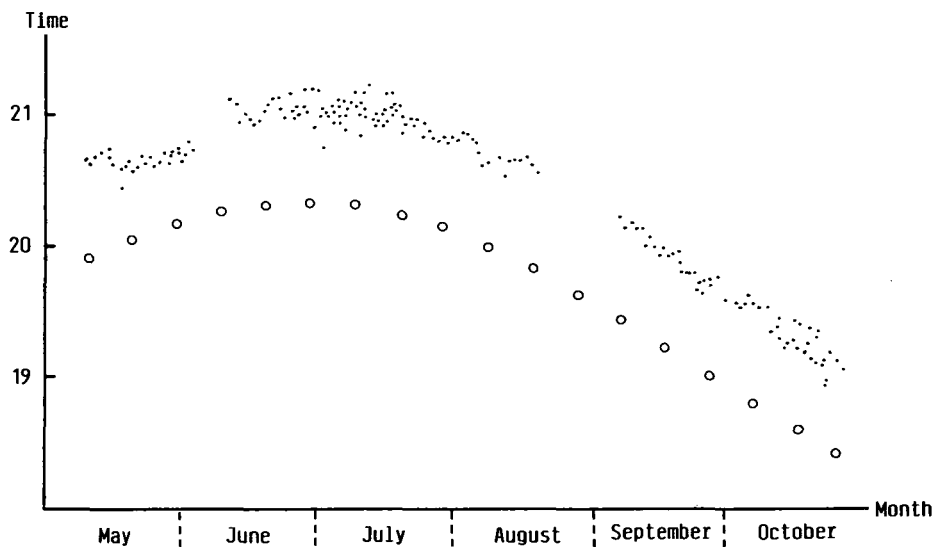


Fig.1. Timing of the first returns to land. Black dots indicate first returns; open circles indicate the time of sunset.

TABLE I. TIMING OF THE FIRST RETURNS TO LAND AND INTERVAL BETWEEN SUNSET AND FIRST RETURNS. MEAN \pm STANDARD DEVIATION, RANGE, SAMPLE SIZE.

| | <i>First returns (h.mins.)</i> | <i>Interval (mins.)</i> |
|-----------|--------------------------------------|------------------------------|
| May | 20.39 \pm 0.04 20.25-20.45 (23) | 36.6 \pm 5.4 25-46 (23) |
| June | 21.01 \pm 0.08 20.40-21.12 (27) | 44.1 \pm 6.3 30-53 (27) |
| July | 21.00 \pm 0.07 20.45-21.15 (54) | 43.7 \pm 5.5 26-57 (54) |
| August | 20.42 \pm 0.06 20.31-20.52 (16) | 42.9 \pm 3.8 33-48 (16) |
| September | 19.55 \pm 0.11 19.35-20.15 (24) | 45.6 \pm 3.5 38-53 (24) |
| October | 19.20 \pm 0.11 18.57-19.39 (29) | 42.7 \pm 5.6 30-54 (29) |

Interval between sunset and the first returns to land

The interval between sunset and the first returns shows a very small but significant increase ($r = 0.235$, $n = 173$, $p < 0.01$) of about 5 min between May and October. Close similarities exist between monthly means ($F_s = 1.69$, ns, Table I), except for May where the interval is significantly shorter than during the other months ($t \geq 3.98$, $p < 0.01$), but by a few minutes only. For the whole period studied, the first returns noted were 42.8 ± 5.8 min after sunset (coefficient of variation 13.6 %), with a range of 33 min (25-57 min, $n = 173$). However the range was only 5 min (40-44 min) for more than a third of records, and 15 min (35-49 min) for three quarters of them. Finally there was no significant correlation between the time of sunset and the interval between sunset and the first returns, either for the period preceding the solstice ($r = 0.286$, $n = 37$, ns), or for the period following it ($r = 0.054$, $n = 136$, ns), and for the whole period ($r = -0.042$, $n = 173$, ns).

Influence of the moon phases

The mean interval between sunset and the first returns to land varies between 41.6 and 44.6 min according to the moon phases (Table II). The shortest interval occurs, paradoxically, during the full moon and the longest during the new moon. Both are significantly different ($t = 2.48$, $p < 0.05$), but only slightly, 3 min.

TABLE II. INTERVAL BETWEEN SUNSET AND FIRST RETURNS TO LAND (MIN) AS A FUNCTION OF MOON PHASES AND LUMINOSITY. MEAN \pm STANDARD DEVIATION, RANGE, SAMPLE SIZE.

| <i>Moon phases</i> | | | |
|---------------------|----------------------|--------------------|---------------------|
| <i>New moon</i> | <i>First quarter</i> | <i>Full moon</i> | <i>Last quarter</i> |
| 44.6 \pm 5.7 | 43.0 \pm 6.0 | 41.6 \pm 5.6 | 41.6 \pm 5.7 |
| 25-57 (50) | 33-55 (39) | 31-53 (36) | 26-50 (45) |
| <i>Luminosity</i> | | | |
| <i>Clear nights</i> | | <i>Dark nights</i> | |
| 43.9 \pm 4.7 | | 43.1 \pm 4.0 | |
| 36-53 (80) | | 34-53 (33) | |

Influence of luminosity

The ambient luminosity, influenced by the phases of the moon as well as its height in the sky and the nebulosity, was noted during 5 study years (1989, 1990, 1992, 1993 and 1994), with nights being classified "clear nights" and "dark nights". No significant difference ($t = 0.94$, ns) was found between them for the interval between sunset and first return to land.

DISCUSSION

The times of the first return to land of the Madeiran Storm Petrel of Selvagem Grande Island vary noticeably during the year, becoming progressively later as the days lengthen, i.e. before the summer solstice, and progressively earlier as the days shorten after the solstice. In contrast, the interval between sunset and the first returns is relatively constant between May and October. Moon phases and luminosity have little or no influence. Thus, between May and October, the first returns always occur after dark, on average 43 min after sunset. Between day variation is slight, with more than 50% of observations falling in a 10 min interval (38-47 min) in spite of the wide diversity of the sample in terms of sex, age, status and date.

A comparison with other breeding localities of the species would have been interesting, but detailed data are lacking. However, in two equatorial localities, Ascension Island (08° S, Allan 1962) and the Galapagos Islands (0°30' S, Harris 1969), the first returns seem to occur about 1 hour after sunset. The difference with Selvagem Grande Island, if real, is too slight to deserve an explanation.

On Selvagem Grande Island, three other species of Procellariiformes: Bulwer's Petrel *Bulweria bulwerii*, Little Shearwater *Puffinus assimilis* and White-faced Storm Petrel *Pelagodroma marina*, come back to land at about the same time as the Madeiran Storm Petrel. In contrast, Cory's Shearwater *Calonectris diomedea* shows a very regular 10 day cycle in the timing of the first returns, which is independent of nebulosity or the phases of the moon, but is correlated with the numbers of birds present, the greater the numbers, the earlier the first returns. A variation of 4 hours during a half-period is possible, the first returns being always diurnal on Selvagem Grande Island although elsewhere the species is strictly nocturnal (Jouanin *et al.* 1989).

SUMMARY

On Selvagem Grande Island, the first returns to land of the Madeiran Storm Petrel *Oceanodroma castro* are observed to occur progressively later up to the summer solstice, when days are lengthening, and then progressively earlier, when they become shorter. The interval between sunset and the first returns (42.8 ± 5.8 min) shows little variation over the whole breeding season. Likewise, the phases of the moon and luminosity have no effect on the interval.

REFERENCES

- ALLAN, R.G. 1962. The Madeiran Storm Petrel *Oceanodroma castro*. *Ibis*, 103b: 274-295.
HARRIS, M.P. 1969. The biology of Storm Petrels in the Galapagos Islands. *Proc. Calif. Acad. Sc.*, 37: 95-166.
JAMES, P.C. and ROBERTSON, H.A. 1985. The calls of male and female Madeiran Storm-Petrels (*Oceanodroma castro*). *Auk*, 102: 391-393.
JOUANIN, C., ROUX, F. and MOUGIN, J.-L. 1989. Cycles d'affluence des Puffins cendrés (*Calonectris diomedea borealis*) à Selvagem Grande. *L'Oiseau et R.F.O.*, 59: 153-168.
MOUGIN, J.-L., JOUANIN, C. and ROUX, F. 1990. Chronologie de la reproduction chez le Pétrel-tempête de Castro *Oceanodroma castro* (Harcourt). *L'Oiseau et R.F.O.*, 60: 136-150.
MOUGIN, J.-L., JOUANIN, C. and ROUX, F. 1993. Les heures des premiers retours à terre du Pétrel-tempête de Castro (*Oceanodroma castro*) à Selvagem Grande (30°09' N, 15°52' W). *L'Oiseau et R.F.O.*, 63: 34-44.

Jean-Louis Mougin, Pierre Defos du Rau, Christian Jouanin, Marie-Claire Mougin and Francis Roux: Muséum National d'Histoire Naturelle, Laboratoire de Zoologie, Mammifères et Oiseaux, 55 rue de Buffon, 75005 Paris, France.

Michel Segonzac, IFREMER/CENTOB, B.P. 70, 29280 Plouzané, France.

The status of the North Atlantic Gannet *Morus bassanus* after 50 years in Norway

Robert T. Barrett and Alv Ottar Folkestad

INTRODUCTION

The breeding distribution of the North Atlantic Gannet *Morus bassanus* is restricted to the North Atlantic with colonies in Canada, Iceland, Great Britain, Ireland, France, the Channel Islands, Norway and the Faeroes. Numbers at most colonies have increased during the 20th century and several new colonies have been established (Gurney 1913, Fisher & Vevers 1943, 1944, Nelson 1978a,b, Wanless 1987). This widespread increase has been attributed to the introduction of the Seabird Protection Act of 1869 (Britain), the official Canadian protection in 1904 and the Icelandic protection of the colony on Eldey in 1940 (Nelson 1978a) which put an end to a heavy 19th-century persecution.

The Gannet was first recorded ashore in Norway in 1946, with four pairs prospecting on the cliffs of Runde (Fig. 1). In 1947, seven nests were documented (Valeur 1947). Although Gannets may have bred in Norway in previous millennia (Montevecchi & Hufthammer 1990), those on Runde were the first to breed in Norway in historical times. During the next 50 years, several new colonies were established and by 1985 the population had reached ca. 2300 pairs in four colonies (Fig. 2, Brun 1967, 1972, 1979, Barrett 1979, 1981, Montevecchi *et al.* 1987). Of these, 1400 pairs (ca. 60%) bred in three colonies north of the Arctic Circle. Prior to the last review of the status of the Gannet in Norway (Montevecchi *et al.* 1987) the population growth in the North Norwegian colonies (13-20% per annum (p.a.)) was well in excess of the intrinsic rate of increase (3-4% p.a.) indicating high levels of immigration (Nelson 1978b, Barrett 1981, Montevecchi *et al.* 1987). On Runde the growth rate was 2.5% p.a. (1979-1985) and of similar magnitude to that of the total North Atlantic population (2% p.a. 1969-1985, Wanless 1987).

This paper documents the establishment of a fifth colony in Norway (in 1987) and its subsequent growth, presents census data collected in all colonies since 1985 (some of which formed part of the decennial world census of Gannets (Wanless 1987)), and presents details of intercolony movements of breeding birds.

METHODS

As in previous censuses, counting methods varied from colony to colony due to differences in their accessibility. These are described in detail in Montevecchi *et al.* (1987) and include direct counts from a distance at Runde and Syltefjord, aerial surveys of Hovsflesa and Skarvklakken, and counts of nests where at least some nest material was present on the ground during ringing visits to Storstappen. The counting unit was nest-site holding pairs, defined as singles and pairs of birds at sites where nest material was observed. Although in aerial photographs of the large Gannet colonies (e.g. Fig. 2 in Gardarsson 1995) it is impossible to detect the presence or absence of nests, it is possible in photographs of Hovsflesa and Skarvklakken, due to the greater detail. Since 1985, counts have been made intermittently at Runde and in the four northern colonies (Table I). Aerial photographs were taken of Hovsflesa and Skarvklakken in 1988, 1991 and 1995, and ground counts of nests were made at Storstappen and Syltefjord between 1986-1993 and in 1995. One ground count of occupied nests on Syltefjord made by visiting German tourists is included in Table I.

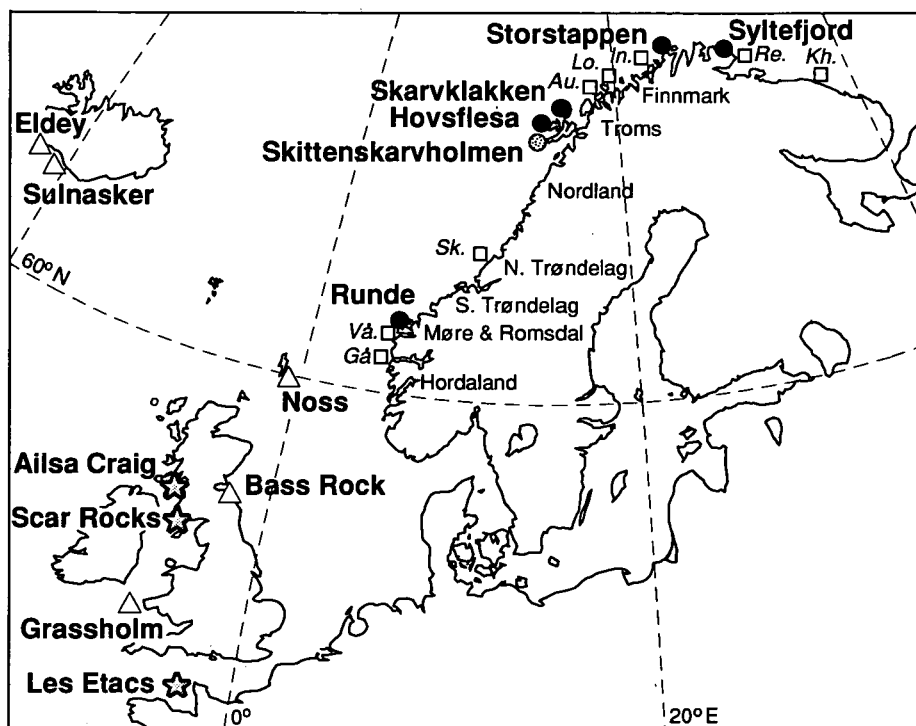


Fig. 1. Distribution of extant (solid circles) and extinct (shaded circle) North Atlantic Gannet colonies in Norway and sites of reported prospecting (open squares). Colonies from which Gannets immigrated to Norway to breed are marked with stars. Colonies at which Gannets were ringed outside Norway and otherwise later recovered in Norway north of 60°N are marked with open triangles.

TABLE I. CHANGES IN THE BREEDING POPULATION (SITES WITH NEST MATERIAL) OF NORTH ATLANTIC GANNETS IN NORWAY, 1985-1995. (- = NO COUNT)

| Colony | 1985 ¹ | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 |
|--------------|-------------------|------|------|-------------------|------|------|-----------|------|------------------|------|-----------|
| Runde | 872 | - | - | 1184 | - | - | 1327 | 1269 | - | 1439 | 1455 |
| Hovsflesa | 400 | - | - | 558 | - | - | 520-550 | - | - | - | 460-470 |
| Skarvklakken | 704 | - | - | 816 | - | - | 934-951 | - | - | - | 730-760 |
| Storstappen | 0 | - | 1 | - | 9 | 96 | 220 | - | 350-400 | - | 516 |
| Syltefjord | 300 | 290 | - | 309 | 369 | 382 | 444-451 | - | 497 ² | - | 481 |
| Total | 2276 | - | - | 2872 ³ | - | - | 3618-3672 | - | - | - | 3642-3682 |

¹ From Montevecchi *et al.* 1987

² From Pfeifer 1993

³ Assuming c. 5 nests on Storstappen

To determine rates of population change, counts were lognormal transformed and plotted against year. Trends were determined using linear regression analysis, the slope giving the annual percentage rate of population change.

During visits to ring chicks on Skarvklakken, Hovsflesa and Storstappen, ringed adults were caught round the legs using a wire crook on the end of a 4-5 m pole. Data on foreign-ringed Gannets recovered in Norway were supplied by the British, Icelandic and Norwegian ringing centres and local Gannet contacts on the Channel Islands and the Faeroes.

RESULTS

Colony establishment and description of new colony

Runde was the first colony to be established in Norway, probably by birds from Scotland or elsewhere in Britain (Brun 1971, 1972). The second colony was Syltefjord (established 1961), followed by Skittenskarvholmen (1964-65), Skarvklakken (1967), and Hovsflesa (1975) (Fig. 1). These colonies are described in detail in Valeur (1947), Brun (1967, 1970, 1972) and Barrett (1981). All but Skittenskarvholmen are still extant. After reaching a peak of 83-84 nests in the early 1970s, the colony on Skittenskarvholmen declined and was finally abandoned in 1978 (Barrett 1979).

During the 1989/1990 winter a report of a new colony on Storstappen, (71° 08'N, 25° 20'E, Fig. 1) just west of the North Cape was received and confirmed during two visits the following summer. Storstappen is the outermost and largest island in the Gjesværstappan Nature Reserve. It is a steep sided, grass-covered island rising up to 283 m a.s.l. The nature reserve is internationally important as one of the largest seabird colonies in Norway with an estimated 390 000 pairs of Atlantic Puffins *Fratercula arctica*, 7500 pairs of Kittiwakes *Rissa tridactyla*, 4500 pairs of Razorbills *Alca torda* and ca. 500 pairs of Common Guillemots *Uria aalge*. Other species breeding there include Brünnich's Guillemots *U. lomvia*, Shags *Phalacrocorax aristotelis* and Cormorants *P. carbo*. The first Gannet nest was observed by the locals in 1987, and nine nests were counted on the west side of the large stack "Stauran" on the northwest corner of the island in 1989. The nests are on a ca. 30° sloping grassy bank rising 30-40 m a.s.l. which is isolated from the rest of the shoreline by near vertical rock faces which drop on either side and in front. Behind the bank, the grass/rock slope lifts steeply towards the top of the 165 m high stack. Apart from ca. 100 pairs of Kittiwakes which breed on the seaward face and a few Puffins round the edge, there were no other seabirds breeding on the bank prior to the Gannets' arrival. Due to the island's status as a nature reserve, access to the island is forbidden between 15 June and 15 August without special permission from the county governor's office. Storstappen is 18 km west of the North Cape and replaces Syltefjordstauran as the world's northernmost Gannet colony.

TABLE II. MEAN RATES (% p.a.) OF NORTH ATLANTIC GANNET POPULATION CHANGE IN NORWAY. THE NUMBERS OF COUNTS WITHIN EACH DECADE ON WHICH THE REGRESSIONS ARE BASED ARE GIVEN IN BRACKETS. $P < 0.05$ IN ALL CASES EXCEPT THOSE MARKED WITH *.

| Colony | Total | Runde | Syltefjord | Skittenskarv- holmen | Skarv- klakken | Hovsflesa | Storstappen |
|--------------------------|-----------|----------|------------|-------------------------|-------------------|-----------|-------------|
| Year of establishment | | 1946 | 1961 | 1964 | 1967 | 1975 | 1987 |
| 1st decade | +21% (4) | +21% (4) | +35% (8) | +68% (4)* | +46% (6) | +70% (5) | +78% (6) |
| 2nd decade | +26% (3)* | +24% (4) | +18% (5) | (extinct) | +15% (6) | +1% (4)* | |
| 3rd decade | +16% (4) | +10% (5) | +5% (5) | | -2% (3)* | | |
| 4th decade | +7% (3) | +3% (3)* | | | | | |
| 5th decade | +3% (3)* | +3% (5)* | | | | | |

Population changes

Since the first colony was established on Runde, the Norwegian Gannet population in Norway has increased to ca. 3700 pairs at a mean overall rate of 13.9% p.a. (Fig. 2). There has, however, been considerable temporal and spatial variation in the rate of increase. All the colonies increased rapidly (21-78% p.a.) during the first 10-20 years after colonisation, but rates of increase then slowed (Table II). The most rapid growth rate was at Storstappen (78% p.a.), the newest of the colonies, and during the first five years after colonisation (1987-1991), Storstappen increased at a rate of 145% p.a.. Hovsflesa, the second most recently established colony, also more than doubled its population each year during the first five years (1975-1979), increasing at a rate of 124% p.a..

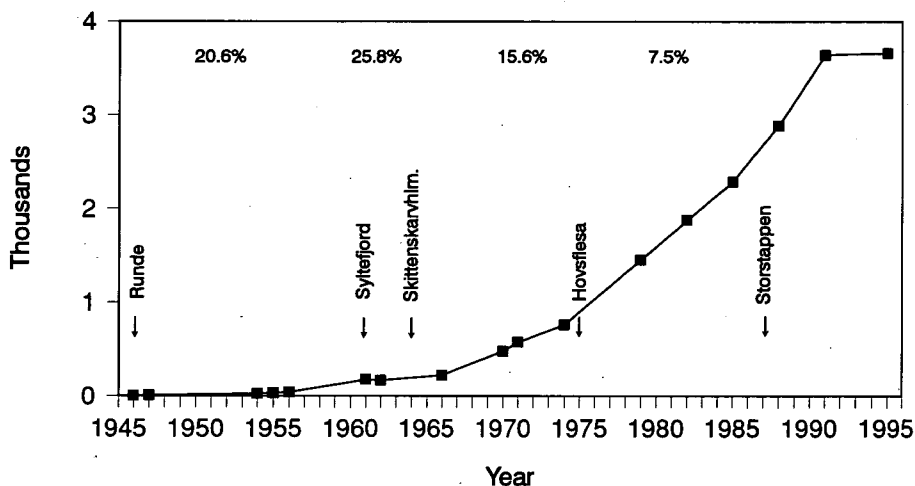


Fig. 2. Numbers of the North Atlantic Gannet on sites with nest material in Norway since their establishment in 1946. Establishment years of each colony are marked with arrows, and the rates of growth per annum during each successive decade (1946-55, 1956-65, etc.) are given in %.

Since the last review of the colony counts made up to and including 1985 (Montevecchi *et al.* 1987), all the colonies continued to flourish until 1991 after which the total population suddenly levelled out (Fig. 2). Since 1991, two colonies, Runde and Syltefjord increased only very slightly while Skarvklakken and Hovsflesa have declined by 21 and 13% respectively (Table I). Only Storstappen has continued its rapid increase. This is the first time declines of this magnitude have been recorded in any Norwegian colony apart from Skittenskarvholmen in the 1970s.

Other potential colonies

Gannets have also been seen on or near land and reported as prospecting or establishing breeding sites at several other locations in Norway in recent years. For example, two pairs in a Shag colony at Sklinna, Nord Trøndelag in 1978 (Fig. 1, Sk.) (Nygård 1980), one individual on a nest on Reinøya, Finnmark all summer 1980 (Fig. 1, Re.) (RTB pers. obs.), nine individuals in a mixed Cormorant and Shag colony plus 17 fishing nearby at Auvær, Troms in 1985 (Fig. 1, Au.) (Montevecchi *et al.* 1987), one individual ashore at Vågsøy in 1988 (Fig. 1, Vå.) and one pair on a nest in a Shag colony on Gåsvær, Sogn and Fjordane in ca. 1990 (Fig. 1, Gå.) (G. Godø, pers. comm.). The Sklinna, Reinøya and Vågsøy sightings are reported as confirmed breeding in the Norwegian Bird Atlas (Gjershaug *et al.* 1994), but the sites have all subsequently been abandoned.

Two other potential breeding sites have also been plotted in the same atlas but subsequent contact with the observers has revealed that one of these, Loppa in 1982 (Fig. 1, Lo.) involved sightings of birds offshore. Because Gannets are frequently seen offshore along the whole Norwegian coast, this should not have been interpreted as a potential breeding attempt. The second record (Ingøy in 1981 (Fig. 1, In.)) could not be checked due to the recent death of the observer.

Intercolony movements

Ninety-nine ringed birds have been controlled on Skarvklakken, Hovsflesa and Storstappen since the early 1970s. Of these, one had an illegible ring, seven were controlled twice and three were controlled three times at intervals of several years.

Of 69 birds ringed as chicks and later controlled in a colony, 37 (54%) were on their natal colony and 32 (46%) had emigrated to another colony. Two of the 37 were subsequently controlled once and one twice, each time still in their natal colony. Among those which moved, three had been ringed in Britain (two on Ailsa Craig and one on Scar Rocks) and one came from the Channel Islands (Les Etacs, Alderney) (Fig. 1). Two Norwegian-ringed birds were controlled on Hovsflesa seven years after their natal colony (Skittenskarvholmen) had been abandoned. Of 32 birds controlled on Storstappen during four visits (1990, 1991, 1993 and 1995), only two had been ringed as chicks there. Twenty-one were ringed as pulli on Skarvklakken, five as pulli on Hovsflesa, one as a pullus on Ailsa Craig, one as a pullus on Les Etacs, and two as adults on Skarvklakken. One of the adults had, in the meantime, been controlled on Hovsflesa. Most of the birds were controlled when they were 4-8 years old (range 2-17 years, Fig. 3). One was only two years old and one three years old and were thus only prospecting (assuming that Gannets aged 4-5 years and older had recruited to the breeding population).

Of 29 controls of birds previously ringed or controlled as adults (i.e. in adult plumage, $n = 27$) or subadults ($n = 2$), 26 (93%) were in the colony where they were ringed/controlled and two (7%) had moved to another colony. The latter two included one adult which first moved from Skarvklakken to Hovsflesa and then to Storstappen and one which moved directly from Skarvklakken to Storstappen. The oldest bird caught was controlled 15 years after being ringed as

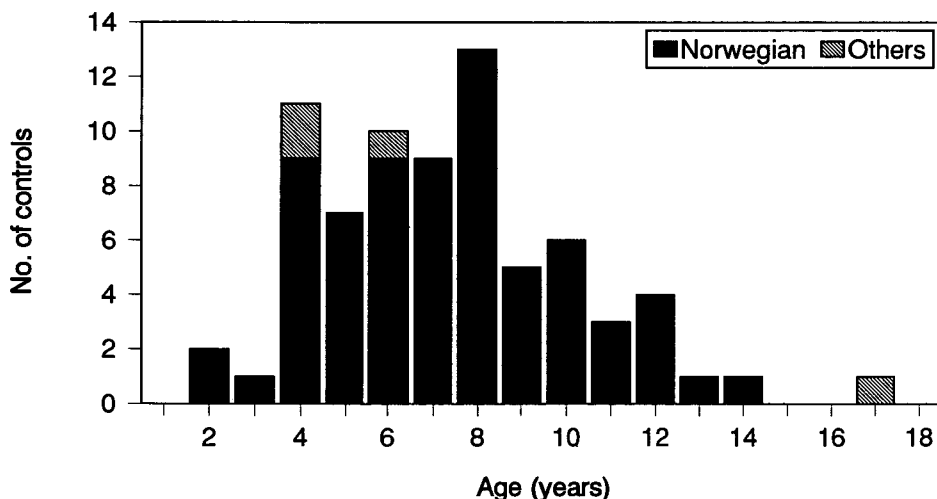


Fig. 3. Ages of North Atlantic Gannets ringed as pulli when they were controlled in North Norwegian breeding colonies.

an adult; i.e. it was at least 19 years old.

As yet, only one Norwegian-ringed bird has been controlled in a colony outside Norway. It was ringed on Hovsflesa as a pullus in 1986 and controlled breeding at Hermaness, Shetland in 1995.

DISCUSSION

The Norwegian population has increased very rapidly since its establishment in 1946. Rates of increase were 21-26% p.a. during the first 20 years, slowing to 16% p.a. and 7% p.a. during successive decades (Fig. 2, Table II). Since the last published census in 1985, the Norwegian Gannet population continued to increase until 1991 at a mean rate of 7.8% p.a., a rate similar to that calculated for the previous decade. This is the highest regional rate recorded in the North Atlantic (e.g. 1.8% p.a. (1972-1984) in North America (max. 4.2% on Funk Island) (Nettleship & Chapdelaine 1988), 4.2% in eastern Iceland (1989-1994, Gardarsson 1995) and 2.0% in Scotland (1969-1985, Murray & Wanless 1986)). It is also much higher than the 2-3% for the whole North Atlantic population (Nelson 1978b, Wanless *et al.* 1986, Murray & Wanless 1986) indicating that immigration is still taking place.

A comparison of the rates of change between the individual colonies suggest relationships between the rate of increase and age of the colony (Table II). Numbers increased most rapidly during the early phases of colony establishment, presumably because of immigration from other colonies. This effect is particularly evident on Storstappen where numbers increased at a rate of 78% p.a. during the first eight years (1987-1995, Table II) and where there was clear evidence of immigration with 30 birds ringed as pulli or adults in other colonies being controlled during four visits to the colony. These included two birds from colonies outside Norway with the one from Les Etacs representing a movement from the most southerly colonies in the East Atlantic (49° 42'N) to the northernmost, a distance of nearly 3000 km. Two birds caught in 1995 were ringed as pulli in 1990 and 1991 and are the first direct evidence of self-recruitment into the colony.

While four Gannets ringed outside Norway have been controlled in Norwegian colonies, 55 others have been recovered along the coast of Norway. Forty-six were ringed in Britain, seven in Iceland and two on the Channel Islands. The majority (37) were found along the North Sea and Skagerak coasts of Norway and thus within the home waters of British Gannets (Thomson 1974), 18 were found north of 60°N. Of these, one was from the Shetlands (Noss), eight were from elsewhere in Scotland (Bass Rock 6, Ailsa Craig 1, Scar Rocks 1), three were Welsh (Grassholm) and five were Icelandic (Eldey 3, Sulnasker 2). Of the 18 found north of 60°N, 12 were recorded during the breeding season (April-August). One was recorded in October, four in January (including three of the five Icelandic birds) and one in February. Eight of the 12 summer visitors were 1-4 years old when found and were thus probably young prospectors.

The majority of British and Icelandic Gannets disperse within the North Sea or migrate southwards along the Iberian and NW African coasts (Thomson 1974, Nelson 1978a). However, some of the younger birds are more adventurous and move northwards to form part of the nucleus of birds prospecting for new breeding sites in Norway. Whereas the initial establishment of colonies is obviously dependent on the immigration of birds from outside, this is one of the few studies which shows this so clearly for Gannets. The results also demonstrate that such immigrants do not necessarily originate from the nearby colonies, but may move large distances (for example the recoveries of birds from Grassholm and Les Etacs). In his discussion concerning intercolony movements, Nelson (1978a) questions whether there is a "network of interchange" embracing all the colonies in the NE Atlantic or whether the population is divided into more or less discrete entities defined by "simple geography". The recoveries of so many British and Icelandic ringed birds along the Norwegian coast and controls in North Norwegian colonies and the control of a Norwegian ringed bird in Shetland support the argument that there is indeed such a network and that there is no limit to the distance between the natal colony and that in which the bird recruits. There is, however, still no evidence of interchange across the Atlantic.

It is, nevertheless, possible that the initial rapid increase (>120% p.a.) of the most recent colonies (Hovsflesa and Storstappen) is due to a relatively high rate of immigration from neighbouring Norwegian colonies, whereas the slower initial growth of e.g. Runde and Syltefjord was due to the reluctance of birds to establish themselves outside what was then the Gannets' normal breeding range. The increase in breeding numbers in North Norway indicates that Gannets are consolidating their position in the region, and records of Gannets on land at other sites in the region suggest that the establishment of further colonies is likely. A record in 1993 of two Gannets on two sites among guillemots *Uria* spp. breeding on Kharlov off the Kola Peninsula (Fig. 1, Kh. J. Krasnov pers. comm.) fits in with the pattern of spread northeastwards.

With only 10% of the adults but nearly half the chicks being controlled on nests outside the colony in which they were ringed or controlled (including one exceptional adult which was ringed in one colony and controlled in two others at 5 year intervals), it is clear that the establishment and early growth of new colonies is based mainly on the immigration of immature birds. A 10% rate of colony interchange for adults recorded here is very similar to the 94% and 88% rate of nest site fidelity documented for males and females respectively on Bass Rock (Nelson 1978a).

The earlier decline and extinction of the colony on Skittenskarvholmen was thought to have been due to excess disturbance (Barrett 1979), but it is not clear why numbers on Skarvklakken and Hovsflesa have decreased since 1991. Both are protected colonies (nature reserves) where access and disturbance is forbidden. The large number of recruits from Skarvklakken and Hovsflesa controlled on Storstappen do, however, suggest a possible movement northwards out of these colonies. It is possible that environmental factors have become more favourable at Storstappen. Food items recorded during ringing visits to Storstappen in 1991, 1993 and 1995 were exclusively of herring *Clupea harengus* (pers. obs.), a preferred food item of North Norwegian Gannets (Montevecchi & Barrett 1987). It is possible that the recent increase in herring stocks (Anon. 1995) has resulted in increased availability of herring off western Finnmark compared with off Nordland. It is, however, also possible that many Gannets simply did not attempt to breed in 1995, a year when many seabirds fared very badly or failed totally along the coast of Nordland (T. Anker-Nilssen, pers. comm.). It is thus important that repeat counts be made over the next few years to resolve this problem.

ACKNOWLEDGEMENTS

This study was supported financially by Tromsø Museum, University of Tromsø. Sincere thanks are due to Bengt Altman, Magne Asheim, Gunder Gabrielsen, Gunnar Henriksen, Hans Martin Iversen, Odd Jacobsen, Karl-Otto Jakobsen, Dagfinn and Arnt Jensen, Geir Helge Systad, and Finnmark Fjelltjenesten for their help in the field and to Gunnar Godø for information about Gannets in Sogn and Fjordane. Ringing data were supplied by the BTO Ringing Scheme which itself is supported by the BTO, and the Joint Nature Conservation Committee (on behalf of the Countryside Council of Wales, the Department of the Environment (Northern Ireland), English Nature, Scottish Natural Heritage), the National Parks and Wildlife Service (Ireland), the Icelandic Ringing Scheme, c/o Aevær Petersen of the Icelandic Museum of Natural History, the Norwegian Ringing Scheme, c/o Stavanger Museum, Paul Veron, Guernsey, Bergur Olsen, Faroes, and the ringers themselves. Thanks too to Dr. Bryan Nelson, Bernie Zonfrillo and David Brewer for helping trace the origin of the first "foreigner" to be controlled in a Norwegian colony (Brun 1971), and to Sarah Wanless and again to Bryan Nelson for their constructive criticisms of the manuscript.

SUMMARY

Between 1946-1991, the Norwegian Gannet population increased to ca. 3650 pairs. Between 1991-1995, numbers have remained stable. Six colonies have been established, five north of the Arctic Circle although one is now extinct. The newest colony was established in 1987 and already contains >500 nesting pairs (1995). Rates of population increase varied considerably in time and space with the newest colonies growing most rapidly. Ring recoveries provide evidence of considerable intercolony movements, especially of young birds, and immigration of birds from colonies throughout the NE Atlantic population range.

REFERENCES

- ANON. 1995. Ressursoversikt 1995. *Fisken og Havet*, Sæmr. 1-1995: 1-83.
- BARRETT, R.T. 1979. Changes in the population of Gannet *Sula bassana* in North Norway. *Fauna Norv. Ser. C, Cinclus* 2: 23-26.
- BARRETT, R.T. 1981. The 1979 population of Gannets *Sula bassana* in North Norway. *Proc. 2nd. Nordic Congr. Ornithol.* 1979: 85-87.
- BRUN, E. 1967. Hekking av havsule, *Sula bassana*, i Nord Norge. *Sterna* 7: 1-11.
- BRUN, E. 1970. Havsulen, *Sula bassana*, etablert som hekkfugl i Lofoten. *Sterna* 9: 141-147.
- BRUN, E. 1971. Havsule, *Sula bassana*, fra Bass Rock, Skotland hekkende på Anøya. *Fauna* 24: 22-24.
- BRUN, E. 1972. Establishment and population increase of the Gannet *Sula bassana* in Norway. *Ornis Scand.* 3: 27-38.
- BRUN, E. 1979. Present status and trends in population of seabirds in Norway. In: Bartonek, J.C. and Nettleship, D.N. (eds.). *Conservation of marine birds of northern North America*, pp. 289-301. US Dep. Int. Fish & Wildl. Serv. Wildl. Res. Rep. 11, Washington DC.
- FISHER, J. and VEVERS, H.G. 1943-1944. The breeding distribution, history and population of the North Atlantic Gannet *Sula bassana*. *J. Anim. Ecol.* 12: 173-213; 13: 49-62.
- GARDARSSON, A. 1995. [Numbers of Gannet (*Sula bassana*) in Iceland 1989-1994.] *Náttúrufræðingurinn* 64: 203-208. (In Icelandic, English summary).
- GJERSHAUG, J.O., THINGSTAD, P.G., ELDØY, S. and BYRKJELAND, S. (eds.) 1994. *Norsk fugleatlas*. Norsk Ornitologisk Forening, Klæbu.
- GURNEY, J.H. 1913. *The Gannet, a bird with a history*. Witherby, London.
- MONTEVECCHI, W.A. and BARRETT, R.T. 1987. Prey selection by Gannets at breeding colonies in Norway. *Ornis Scand.* 18: 319-322.
- MONTEVECCHI, W.A., BARRETT, R.T., RIKARSEN, F. and STRANN, K.-B. 1987. The population and reproductive status of the Gannet *Sula bassana* in Norway in 1985. *Fauna Norv. Ser. C, Cinclus* 10: 65-72.
- MONTEVECCHI, W.A. and HUFTHAMMER, A.K. 1990. Zooarchaeological implications for prehistoric distributions of seabirds along the Norwegian coast. *Arctic* 43: 110-114.
- MURRAY, S. and WANLESS, S. 1986. The status of the Gannet in Scotland 1984-85. *Scottish Birds* 14: 74-85.
- NELSON, J.B. 1978a. *The Gannet*. Poyser, Berkhamsted.
- NELSON, J.B. 1978b. *The Sulidae: Gannets and Boobies*. Oxford University Press, Aberdeen.
- NETTLESHIP, D.N. and CHAPDELAIN, G. 1988. Population size and status of the Northern Gannet *Sula bassanus* in North America, 1984. *J. Field Ornithol.* 59: 120-127.
- NYGÅRD, T. 1980. Sklinna, sjøfuglenes utpost mot oljen. *Trøndersk Natur* No. 2, 198: 44-46.
- THOMSON, A.L. 1974. The migration of the Gannet: a reassessment of British and Irish ringing data. *Br. Birds* 67: 89-103.
- VALEUR, P. 1947. Havhesten og havsula på Rundøy. *Naturen* 70: 370-379.
- WANLESS, S. 1987. A survey of the numbers and breeding distribution of the North Atlantic Gannet *Sula bassana* and an assessment of the changes which have occurred since Operation Seafarer 1969/70. NCC Rep. No. 4: 1-100.
- WANLESS, S., MURRAY, S. and HARRIS, M.P. 1986. Gannets – a boom in numbers and distribution. *BTO News* 145: 8-9.

Robert T. Barrett, Tromsø Museum, Zoology Department, University of Tromsø, N-9037 Tromsø, Norway.

Alv Ottar Folkestad, N-6072 Haddal, Norway.

An analysis of biometrics of oil contaminated Common Guillemots *Uria aalge* in south-west Britain 1980-1994

J.M. Stratford and K.E. Partridge

INTRODUCTION

During winter months each year, the south-west coast of Britain receives a steady influx of oil contaminated seabirds. Clark and Kennedy (1968) noted that an incidental value of rehabilitating oil contaminated seabirds was the accumulation of biometric information. This principle together with a close association with the RSPCA oiled seabird rehabilitation unit in Plymouth, south Devon has enabled the authors to gain access to a large number of birds.

Considerable work has been carried out in the past on Common Guillemots *Uria aalge*, suggesting geographical variation in biometry and morphology (Jones 1985). With significant numbers of birds oiled in south-west waters each year, it was felt that more could be learnt, especially with regard to ageing and sexing of birds from external features. The populations from which birds originated could also be ascertained. Such information is useful for organisations involved in rehabilitation work. This paper presents an analysis of biometrics of Common Guillemots collected between 1980-94.

METHODS

Corpses of oiled Common Guillemots have been collected since 1980 from the local and other rehabilitation units in the south-west of Britain for examination. A total of 80 birds in reasonably good condition were also collected for examination during routine beached bird surveys. A series of biometric measurements and other morphological data has been routinely recorded from dead birds, and latterly external measurements from live birds at rehabilitation centres have also been collected. Measurements at rehabilitation centres were carried out immediately the birds were brought in.

Detailed examination of birds was carrying out following Jones *et al.* (1982). Inter-observer errors were obviated by one author (JMS) carrying out all internal examinations and the other (KEP) carrying out all external measurements throughout the study. The sex and age of dead birds was determined by dissection, with age being determined by the presence (immature) or absence (adult) and size of cloacal bursa (Rose 1981). The amount of abdominal and subcutaneous fat was judged by eye and scored on a scale from 0 = no fat to 3 = thick deposits. For all age classes of females, the condition and morphology of the oviduct was investigated to assess whether the bird had previously bred (Yu & Marquardt 1973, Verma & Walker 1974, Gilbert 1979).

Upper wing plumage shade was judged by eye against a base set of wings numbered sequentially from 1 (lighter) to 8 (darker). The base set was calibrated at the British Museum using a densitometer to cover the range of plumage shades found in *aalge* birds. The calibrated set of wings were stored in light proof and cool conditions. Winter plumage face and nape patterns were scored 1-5 and A-C depending on the amount of white, using reference charts (Jones 1985) compiled from an earlier photographic study of 130 birds collected in south Devon (P. H. Jones, K. E. Partridge & J. M. Stratford unpubl). Bridling in birds was recorded and head moult was assessed by presence of mottling.

RESULTS

Sex and breeding status

The overall sex ratio of Common Guillemots collected between November and May did not differ from parity (170 males, 196 females, $\chi^2 = 1.71$, $df = 1$, ns with Yates correction). However, there was a seasonal difference (Figure 1) with females recovered more frequently between November and February (80 males, 120 females) and males predominating between March and May (90 males, 76 females, $\chi^2 = 7.37$, $df = 1$, $p < 0.01$). The sex distribution was different in adults and immatures (Table I), with significantly more females than males among adults ($\chi^2 = 7.25$, $df = 1$, $p < 0.001$) and no difference in the sex ratio of immatures ($\chi^2 = 1.33$, $df = 1$, ns). The proportion of post breeding females (from oviduct condition) declined as the year progressed (Table II). None of the immature females judged by bursa were found to have a distended oviduct.

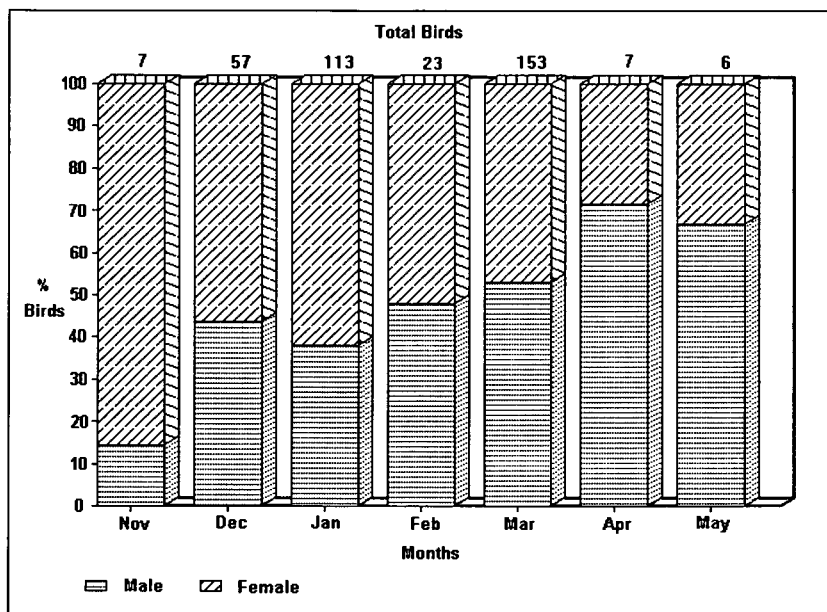


Figure 1. Sex ratios of Common Guillemots collected in south-west Britain 1980-1994.

TABLE I. SEASONAL CHANGES IN AGE CLASSES AND SEX OF GUILLEMOTS COLLECTED IN SOUTH-WEST BRITAIN 1980-1994

| Month | No. examined | Immatures | | | Adults | | |
|-------|-----------------|-----------|---------|-------|--------|---------|-------|
| | | Males | Females | Total | Males | Females | Total |
| Nov | 5 | 1 | 4 | 5 | 0 | 0 | 0 |
| Dec | 48 | 12 | 15 | 27 | 9 | 12 | 21 |
| Jan | 82 | 17 | 20 | 37 | 16 | 29 | 45 |
| Feb | 21 | 5 | 5 | 10 | 4 | 7 | 11 |
| Mar | 141 | 62 | 42 | 104 | 14 | 23 | 37 |
| Apr | 6 | 4 | 0 | 4 | 0 | 2 | 2 |
| May | 6 | 4 | 2 | 6 | 0 | 0 | 0 |

TABLE II. SEASONAL CHANGES IN THE PROPORTIONS OF ADULT FEMALE COMMON GUILLEMOTS WHICH HAD BRED PREVIOUSLY COLLECTED IN SOUTH-WEST BRITAIN 1980-1994

| <i>Month</i> | <i>No. adult females</i> | <i>% previously bred</i> |
|--------------|--------------------------|--------------------------|
| Dec | 12 | 100 |
| Jan | 29 | 59 |
| Feb | 7 | 14 |
| Mar | 23 | 0 |
| Apr | 2 | 0 |

Morphometry, plumage and body condition

There was no significant difference between wing lengths of adult males and females ($t_{167} = 0.78$, n.s.) but immature females had significantly longer wings than immature males ($t_{206} = 2.37$, $p < 0.02$ Table III). In both adults and immatures, culmen length and gonys depth of males were significantly longer than those of females ($t_{173} = 4.33$, $p < 0.001$; $t_{207} = 5.17$, $p < 0.001$; $t_{173} = 3.48$, $p < 0.001$; $t_{206} = 5.98$, $p < 0.001$). Head and bill lengths of adult males were significantly longer than those of adult females ($t_{96} = 4.67$, $p < 0.001$) but there was no sex difference among immatures ($t_{102} = 0.72$, n.s.).

TABLE III. MEASUREMENTS OF COMMON GUILLEMOTS COLLECTED IN SOUTH-WEST BRITAIN 1980-1994

| | <i>Adult males</i> | | <i>Adult females</i> | | <i>Immature males</i> | | <i>Immature females</i> | |
|------------------------------|--------------------|---|----------------------|---|-----------------------|---|-------------------------|---|
| | <i>n</i> | <i>mean \pm S.D. (range)</i> | <i>n</i> | <i>mean \pm S.D. (range)</i> | <i>n</i> | <i>mean \pm S.D. (range)</i> | <i>n</i> | <i>mean \pm S.D. (range)</i> |
| Wing length (mm) | 57 | 197.3 6.32 (186-220) | 112 | 198.1 6.52 (180-220) | 108 | 192.4 5.72 (176-208) | 100 | 194.4 6.28 (180-207) |
| Culmen length (mm) | 60 | 47.4 2.58 (40-52.3) | 115 | 45.7 2.25 (40.5-51.6) | 109 | 47.4 2.49 (41.5-52.3) | 100 | 45.6 2.48 (38-51.5) |
| Gonys depth (mm) | 60 | 12.9 0.89 (11.0-15.0) | 115 | 12.4 0.85 (10.2-14.6) | 108 | 12.2 0.64 (10.8-13.5) | 100 | 11.7 0.57 (10.2-13.3) |
| Head and bill length (mm) | 32 | 113.1 4.19 (103.8-121.5) | 66 | 109.6 3.10 (101.0-116.0) | 51 | 112.6 4.15 (103.0-122.0) | 53 | 110.2 3.32 (101.2-118.0) |

The proportion of birds in summer plumage appeared to increase from January onwards. The overall percentage of bridled birds was 3.5% ($n = 570$) and none of the monthly values exceeded 7% (Table IV). The proportion of bridled birds and birds in head moult do not appear to be associated with collecting date. The dorsal view of the categorised head patterns were divided into two groups, ignoring birds in category 3 which intergraded between the two extremes. Neither the dorsal nor lateral views were found to be associated with age (Table V). Wing plumage scores varied between 2 and 8 (Table VI). Dark winged birds (high scores) tended to be recorded in mid-winter (November-February) while those collected between March and May tended to have lighter plumages (scores of 3-6).

The majority of birds collected lacked any abdominal (72%, $n = 570$) or subcutaneous fat (74%, $n = 570$) and there was no evidence of any seasonal pattern in body condition (Table VII).

TABLE IV. SEASONAL VARIATIONS IN PLUMAGE CHARACTERISTICS ON COMMON GUILLEMOTS COLLECTED IN SOUTH-WEST BRITAIN 1980-1994

| Month | n | Percent of birds | | | |
|-------|-----|------------------|----------------|---------------|----------------|
| | | bridled | winter plumage | in head moult | summer plumage |
| Nov | 15 | 7.0 | 86.0 | 7.0 | 7.0 |
| Dec | 68 | 1.5 | 89.7 | 2.9 | 7.4 |
| Jan | 199 | 2.5 | 79.0 | 9.0 | 12.0 |
| Feb | 63 | 0.0 | 84.2 | 9.5 | 6.3 |
| Mar | 178 | 6.7 | 82.5 | 7.9 | 9.6 |
| Apr | 41 | 2.4 | 75.6 | 12.2 | 12.2 |
| May | 6 | 0.0 | 0.0 | 50.0 | 50.0 |
| Total | 570 | 3.6 | 71.0 | 14.1 | 14.9 |

TABLE V. HEAD PATTERNS OF COMMON GUILLEMOTS COLLECTED IN SOUTH-WEST BRITAIN 1980-1994

| | Dorsal view | | Lateral view | |
|----------|----------------------|-----|----------------------|----|
| | 1&2 | 4&5 | A | C |
| Adult | 90 | 58 | 44 | 72 |
| Immature | 72 | 49 | 35 | 56 |
| | $\chi^2 = 0.01$ n.s. | | $\chi^2 = 0.05$ n.s. | |

DISCUSSION

Sex

The sex ratio of oiled birds changed over the winter with females being recovered more frequently at the start of the period and males predominating between March and May. The flightless young are cared for on leaving the natal colony and are subsequently accompanied for several months by adult males (Harris & Birkhead 1985). Female birds remain at the colony for several weeks after the young have departed. It is possible that the sexes remain segregated during their wintering period. In this study females with previous breeding experience were recovered almost entirely in December and January. It may be that these birds winter for a short period in south-west waters and return to their breeding colonies before individuals with no breeding experience. Alternatively birds may just pass through the northern English Channel waters during this period. There does not appear to be a simple technique to demonstrate previous breeding experience in males and we were therefore unable to determine whether a similar seasonal pattern was shown by them.

Distribution and plumage

The range and distribution of wing lengths indicates that Common Guillemots recovered in south-west Britain during the winter are predominantly from the southern part of their geographical distribution (Jones 1988). The biometric data suggest that birds wintering in the western approaches are mainly from the Irish Basin and south-west British populations with some birds from Scottish colonies (Jones 1985). In this study five birds which had been ringed on Canna west Scotland and two ringed on Saltee south Eire were recovered. All of the Irish Basin and Scottish ringed birds recovered were juveniles. It has previously been shown that Common Guillemots from north-west Scotland disperse south through the Irish Basin or remain near their natal colonies (Mead 1974).

The plumage of the Common Guillemot becomes darker with latitude of origin (Jones 1985). The shade of exposed parts on the upper wing has been found to fade over time, particularly for a

TABLE VI. UPPER WING PLUMAGE SHADE OF COMMON GUILLEMOTS COLLECTED IN SOUTH-WEST BRITAIN 1980-1994

| | <i>n</i> | <i>Plumage score</i> | | | | | | | |
|-------|----------|----------------------|---|----|----|----|----|-----|-----|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Nov | 13 | 0 | 0 | 0 | 0 | 1 | 3 | 4 | 5 |
| Dec | 60 | 0 | 0 | 0 | 2 | 5 | 8 | 20 | 25 |
| Jan | 184 | 0 | 1 | 5 | 20 | 32 | 38 | 37 | 51 |
| Feb | 50 | 0 | 0 | 2 | 3 | 7 | 9 | 19 | 10 |
| Mar | 104 | 0 | 2 | 17 | 19 | 21 | 24 | 16 | 5 |
| Apr | 40 | 0 | 0 | 0 | 4 | 9 | 14 | 7 | 6 |
| May | 5 | 0 | 0 | 1 | 3 | 1 | 0 | 0 | 0 |
| Total | 456 | 0 | 3 | 25 | 51 | 76 | 96 | 103 | 102 |

TABLE VII. SEASONAL CHANGES IN THE SIZE OF SUBCUTANEOUS AND ABDOMINAL FAT DEPOSITS OF COMMON GUILLEMOTS COLLECTED IN SOUTH-WEST BRITAIN 1980-1994.

| <i>Month</i> | <i>No. birds examined</i> | <i>Percent of birds with fat</i> | | | | | |
|--------------|---------------------------|----------------------------------|-------------|-----------------------|---------------------|-------------|-----------------------|
| | | <i>Abdominal</i> | | | <i>Subcutaneous</i> | | |
| | | <i>none</i> | <i>thin</i> | <i>moderate/thick</i> | <i>none</i> | <i>thin</i> | <i>moderate/thick</i> |
| Nov | 15 | 60 | 40 | 0 | 57 | 29 | 14 |
| Dec | 68 | 83 | 9 | 8 | 86 | 5 | 9 |
| Jan | 199 | 68 | 23 | 9 | 68 | 21 | 11 |
| Feb | 63 | 83 | 17 | 0 | 82 | 9 | 9 |
| Mar | 178 | 71 | 26 | 3 | 80 | 11 | 9 |
| Apr | 41 | 71 | 28 | 0 | 43 | 14 | 43 |
| May | 6 | 83 | 17 | 0 | 83 | 17 | 0 |
| Total | 570 | 74 | 23 | 3 | 71 | 15 | 14 |

short period leading up to the post nuptial moult. In this study, the part of the wing used was the area protected from exposure to light when the wings are folded. Within the limits of the grading system adopted and the season of observation, this has proved to be a reliable measure of plumage shade. The table of plumage shade (Table VI) shows that there is a seasonal shift in plumage shade with darker birds tending to be recovered in the middle of winter. This, together with the biometric data and the information on female breeding status, suggests that wintering birds are present in south-west waters during mid-winter but move out of the area from February onwards. The ringing recoveries from Canna were all from January and February. In April and May most oiled birds are probably from local colonies. From personal observations at the colony at Berry Head, Devon birds visit the cliffs most days from the end of October through to the breeding season. Very large numbers of Common Guillemots have been observed off the south Devon coast, coincident with large populations of poor cod *Trisopterus minutus* (S. Colombe *pers. comm.*). In earlier work otoliths of poor cod and of bib *T. luscus* were found in stomach analyses of Common Guillemots recovered off the south Devon coast in January to March 1981 (Jones & Partridge 1982).

We found no evidence to suggest that winter plumage head patterns differed either between adults and immatures or between males and females. The patterning could be a genetically based characteristic or natural variability within the population. Wing feather characteristics ie. moult

boundaries and undergoing covert colouration (Kushert *et al.* 1981) have been used in some studies to identify first winter birds. However in the present study it was felt that the method, which even under ideal conditions, is at best subjective and likely to be prone to error (Jones 1985), was inappropriate because in some cases wing feathers were contaminated and discoloured by oil.

Body condition

It has been shown that Common Guillemots recover their fat deposits after the stress of breeding by the winter months (Furness *et al.* 1994). The fat reserves scored for the birds in this study, showed that most were very emaciated. It is possible that birds were in poor condition prior to oiling and then came ashore relatively quickly, alternatively birds might have been in good condition when they were oiled and used up their fat reserves as a consequence of oiling. We consider that off the south coast the latter is more likely as oiled birds have been observed to take up to a week to finally come ashore (C. Laban pers. comm.).

ACKNOWLEDGEMENTS

We wish to thank Peter Hope Jones who launched us on this study and encouraged us throughout. We also thank rehabilitation centre managers (Rex Harper and Colin Seddon) for access to live birds and collection of dead specimens; beached bird survey workers and other observers for collection of specimens from beaches, particularly Carol Laban for the large number of birds collected. Thanks are due to Sarah Wanless and an anonymous referee for very helpful comments on earlier drafts.

SUMMARY

Measurements and plumage characteristics of large numbers of oiled Common Guillemots washed ashore in south-west Britain have been routinely collected. The morphology and plumage characteristics suggest that most birds recovered originate from the southern part of the geographical range for this species. The results confirm that birds wintering in the western approaches are predominantly from Irish Basin and south-west British populations. Females with breeding experience are mainly recorded in December and January.

REFERENCES

- CLARK, R.B. and KENNEDY, J.R. 1968. *Rehabilitation of oiled seabirds*. University of Newcastle upon Tyne, 57pp.
- FURNESS, R. W., THOMPSON, D.R. and HARRISON, N. 1994. Biometrics and seasonal changes in body composition of Common Guillemots *Uria aalge* from north-west Scotland. *Seabird* 16: 22-29.
- GILBERT, A.B. 1979. Female genital organs, in KING, A.S. and McLELLAND, J. (eds.) *Form and function in birds Vol.1*. Academic Press, London.
- HARRIS, M. P. and BIRKHEAD, T. R. 1985. Breeding ecology of the Atlantic Alcidae. In: Nettleship, D. N. and Birkhead, T. R. (eds.). *The Atlantic Alcidae. The Evolution, Distribution and Biology of the Auks Inhabiting the Atlantic Ocean and Adjacent Water Areas*. pp 155-204. Academic Press.
- JONES, P. H. 1985. Determination of age, sex and origin of guillemots *Uria aalge* and razorbills *Alca torda* killed in oilspills and other incidents. MSc Thesis. Open University.
- JONES, P. H. 1988. The European cline in wing length in Guillemots *Uria aalge*. *Seabird* 11: 19-21.
- JONES, P.H., BLAKE, B.F., ANKER-NILSSEN, T., JONES, P.H. and RØSTAD, O.W. 1982. *The examination of birds killed in oilspills and other incidents – a manual of suggested procedure*. Nature Conservancy Council, Aberdeen. 32 pp.
- JONES, P. H. and PARTRIDGE, K. E. 1982. Examination of Guillemots killed by oil off the coasts of south Devon and north Cornwall in 1981. *Devon Birds* Vol.36 No.1: 10-14.
- KUSHERT, M., EKELOF, O., and FLEET, D. M. 1981 Neue kriterien zur altersbestimmung der Trottellumme (*Uria aalge*) und des Tordalken (*Alca torda*). *Seevogel* 2: 58-61.
- MEAD, C.J. 1974. The results of ringing auks in Britain and Ireland. *Bird Study* 21: 45-86.
- ROSE, M.E. 1981. Lymphatic System, in KING, A.S. and McLELLAND, J. (eds.) *Form and function in birds Vol.2*. Academic Press, London.
- VERMA, O.P. and WALKER, C.A. 1974. Adrenergic activity of the avian oviduct *in vivo*. *Theriogenology* 2: 47-61.
- YU, J.Y. -L. and MARQUARDT, R.R. 1973. Development, cellular growth and function of the avian oviduct. I. Studies on the magnum during the reproductive cycle of the domestic fowl (*Gallus domesticus*). *Biology Reprod.* 8: 283-298.

Jeff Stratford, 93 Reddicliff Close, Radford Park, Plymouth, Devon, PL9 9QJ, UK.
Ken Partridge, 165 Stanborough Road, Elburton, Plymouth, Devon, PL9 8NY, UK.

Observations of movements of North Atlantic Gannets *Morus bassanus* from Cape St Vincent, Portugal

F.J. Walker

INTRODUCTION

Little appears to have been written about seabird movement from south-west Portugal, and neither Moreau and Monk (1957) nor Owen (1958) give prominence to seabird movements in their respective papers on migration in south-west Portugal. As I intended to remain in Sagres for a number of months I decided to fill the gap.

Nelson (1978) describes how breeding adult North Atlantic Gannets *Morus bassanus* begin to leave their ledges in Britain from September onwards, the young having left several weeks earlier. Nelson shows a general southerly movement along the western European seaboard, with up to 400 Gannets per hour passing Cape Clear, Co. Cork, in autumn. Once clear of Ushant, a broad front movement continues south past north-west Spain (Estaca de Bares, Galicia), numbers increasing steadily from early September until early October. At Gibraltar, Garcia (1971) states that most adult Gannets arrive in the latter half of October, passage continuing through the month of November.

A small northerly movement was reported by Gaston (1970) from Cape Verde, Senegal, who recorded that nearly all Gannets seen passing the Cape were in brown plumage, and that movement rates were 400 brown Gannets and 18 white Gannets per hour between 13-17 April 1968. Nelson (1978) notes that 1477 birds were recorded moving north of Morocco between April and June, and similarly off Cape Verde in April, of which a negligible proportion were adult. At Cape Clear large movements of adults were recorded moving north in December, increasing in January, and peaking from March to mid-May (Nelson 1978).

The aim of the present paper is to augment these observations and to describe the magnitude, timing and direction of Gannet movements recorded during several winters at Cape St Vincent and Ponte de Sagres, south-west Portugal.

METHODS

Observations were made from Cape St Vincent (37°02'N 09°0'W) and Ponte de Sagres 5 km south-west. These two conspicuous promontories standing 50 m above the surging Atlantic Ocean, are a turning point for several species of seabirds. Watches were made regardless of weather, but were modified when driving rain from the west made the use of optics difficult. Listening watches were made during the few days of morning mist, when it is considered movement faltered or ceased. (When morning mist lifted at 1000 hrs small scattered groups of Gannets up to 300 m off shore commenced flying north).

The direction of movement was taken from compass bearings and using the wind direction as a guide to the Gannets' heading. Numbers were counted in five minute periods, and a total of 642 watches were made, the average duration of a watch being 63.8 min (Table I). Watches were made as close to civil dawn as possible, and continued from sunrise for between 60-90 min (average 65.0 min).

Afternoon and evening observations were made difficult by a setting sun reflecting off the ocean, and the hundreds of visitors visiting "the most south-westerly point in Europe".

Birds were initially separated into immatures and adults, but later observations were made of adults, birds in their second and third calendar year and immature/juveniles using plumage

TABLE I. PERIODS OF OBSERVATIONS OF GANNET MOVEMENTS FROM CAPE ST VINCENT

| | <i>No. of Watches</i> | <i>Mean duration (min)</i> |
|-------------------------------|-----------------------|----------------------------|
| 23 January-08 March 1986 | 42 | 56.54 |
| 02 November-12 December 1992 | 31 | 76.82 |
| 04 January-31 March 1993 | 95 | 65.88 |
| 25 April-02 July 1993 | 42 | 49.82 |
| 01 August-20 November 1993 | 115 | 53.69 |
| 03 January-31 March 1994 | 99 | 76.06 |
| 18 September-17 December 1994 | 96 | 64.95 |
| 01 January-29 April 1995 | 122 | 66.55 |
| Total | 642 | 63.78 |

characteristics described in Nelson (1978). The direction of movement was classified into one of three groups: north (340° - 020°), south (160° - 200°) and west (270° - 300°). On several occasions two distinct movement patterns were recorded, north and south in December and January, and south and west in September and November.

Wind directions were taken from the compass roses set in concrete at the two points of observation, and by prismatic compass (Table II). Wind speed was estimated using the Beaufort scale, but they were far too variable to summarise over such a long period of observations.

TABLE II. WIND DIRECTIONS RECORDED AT SAGRES PENINSULA 1992-1995

| <i>Wind from</i> | <i>Jan-March No. of days</i> | <i>1992-1995 %</i> | <i>Oct-Dec No. of days</i> | <i>1992-1994 %</i> |
|-------------------------------|----------------------------------|------------------------|--------------------------------|------------------------|
| 315° - 045° | 126 | 56.50 | 56 | 33.73 |
| 046° - 135° | 48 | 21.52 | 41 | 24.69 |
| 136° - 225° | 13 | 5.82 | 10 | 6.02 |
| 226° - 314° | 19 | 8.52 | 35 | 21.08 |
| Calm | 17 | 7.62 | 24 | 14.45 |

RESULTS AND DISCUSSION

Few Gannets were recorded before actual sunrise, then numbers built up rapidly, peaking between dawn and dawn plus 60 min, before decreasing over the next 120 min (Fig. 1). This pattern was apparent in both the median and maximum counts and in each of the three springs and single autumn for which counts were made.

Gannets were first recorded moving south past Cape St Vincent and Ponte de Sagres in August (Fig. 2). Numbers peaked in October and November with hourly rates averaging 530 and 543 birds/hr and 456 and 527 birds/hr in 1993 and 1994 respectively. Northward movements either out of the Gulf of Cadiz or from the south were recorded from mid-September. Numbers peaked in January and February with hourly rates averaging 545 and 464 birds/hour, 649 and 682 birds/hour and 655 and 420 birds/hour in 1993, 1994 and 1995 respectively.

In both the northerly and southerly movement the percentage of birds in immature plumage was highest in autumn and spring, with adult-plumage birds predominant between November and the end of February (Table III).

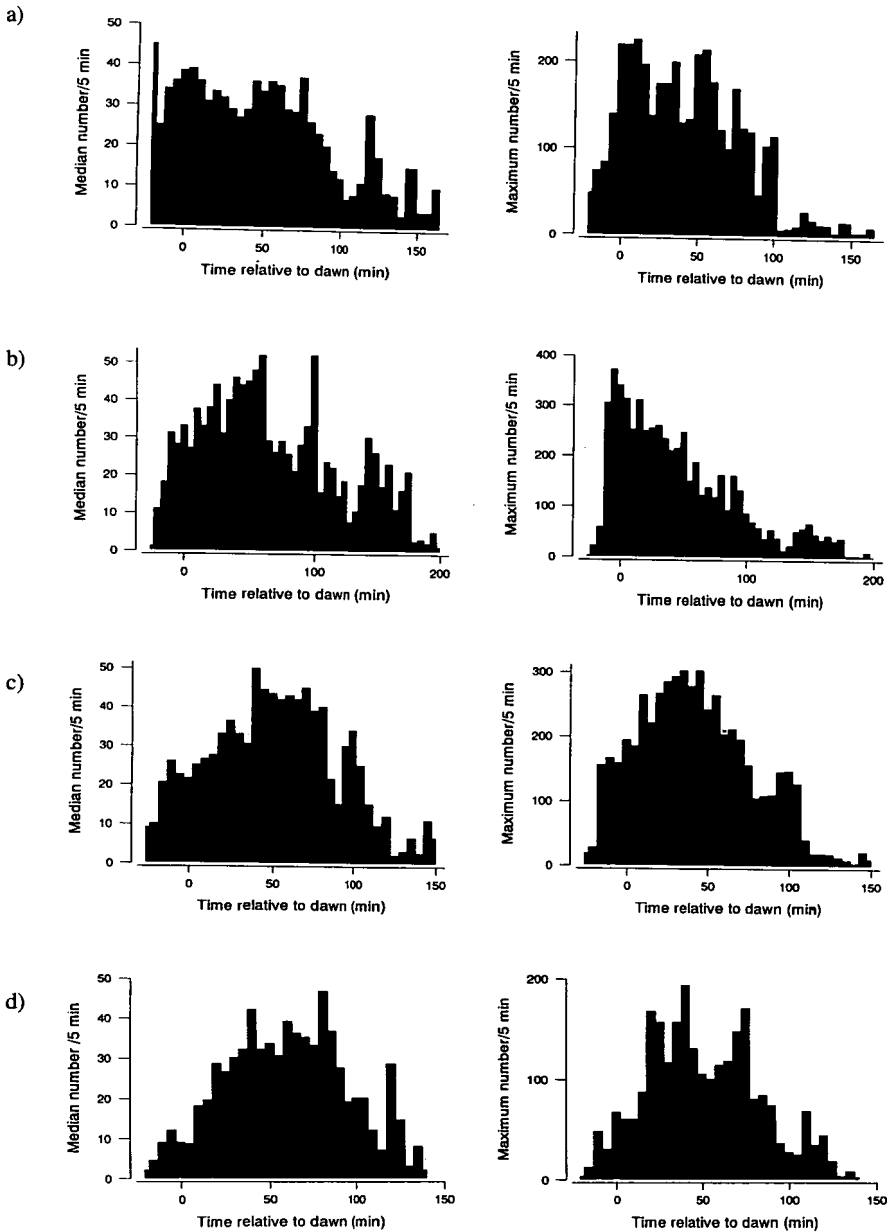


Figure 1. Changes in median and maximum numbers of Gannets in 5 min periods in relation to dawn at Cape St Vincent recorded a) January-March 1993, b) January-March 1994, c) January-March 1995, and d) October-December 1994.

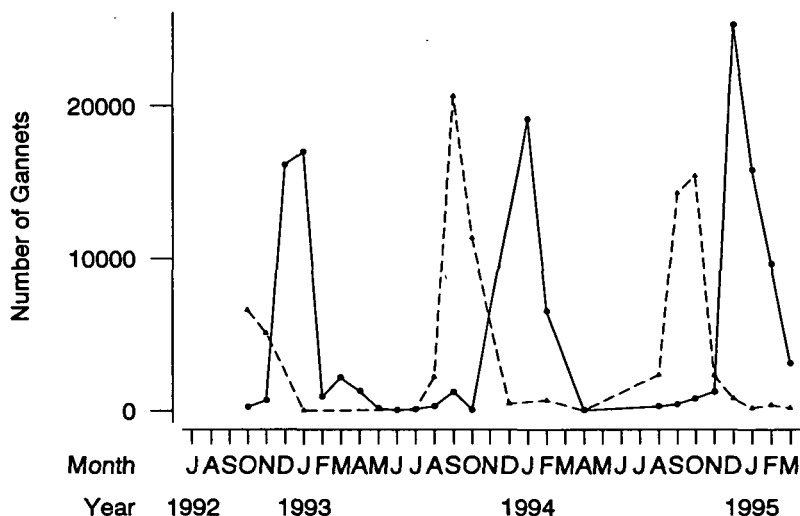


Figure 2. Monthly trends in numbers of Gannets recorded moving north (---) and south (—) past Cape St Vincent between November 1992 and March 1995.

In addition to the normal north and south Gannet movements, a small but positive migration out of the Gulf of Cadiz was first noted on 29 September 1993, and was recorded until I left the area on the 20 November 1993 (Table IV). These westerly movements between 270° and 300° were not noticed or recorded in 1992 or 1994. The possibility exists that these Gannets may have been moving to eastern North American coastal waters, thence north to the Canadian breeding colonies (an American banded Gannet was recovered in Madeira in 1994 pers. comm. J.R. Mather). Alternatively the movements may have been associated with a prevailing set of weather conditions or pressure areas diverted northbound movements during this period.

TABLE III. SEASONAL CHANGES IN AGE COMPOSITION (AS REFLECTED BY PLUMAGE CHARACTERISTICS) OF GANNETS MOVING NORTH AND SOUTH PAST CAPE ST VINCENT IN 1994 AND 1995

| Year | Month | % birds (north) | | | | % birds (south) | | | |
|------|-------|-----------------|--------|--------|----------|-----------------|--------|--------|----------|
| | | Adult | 3 year | 2 year | Immature | Adult | 3 year | 2 year | Immature |
| 1994 | Jan | 97.8 | 0.1 | 1.9 | 0.3 | 92.9 | 0.2 | 6.0 | 1.6 |
| | Feb | 92.7 | 0.9 | 6.0 | 0.4 | - | - | - | - |
| | March | 68.7 | 4.7 | 21.8 | 5.2 | 50.7 | 3.4 | 41.4 | 3.9 |
| | April | - | - | - | - | - | - | - | - |
| | Sept | - | - | - | - | 39.4 | 2.1 | 25.9 | 32.6 |
| | Oct | 66.0 | 22.8 | 13.0 | 18.2 | 75.1 | 3.8 | 10.6 | 10.5 |
| | Nov | 89.3 | 0.9 | 5.6 | 4.2 | 92.7 | 2.0 | 3.5 | 1.8 |
| | Dec | 93.2 | 0.8 | 4.2 | 1.9 | 92.9 | 0.8 | 4.7 | 1.6 |
| 1995 | Jan | 96.9 | 0.4 | 2.1 | 0.5 | 87.0 | 1.0 | 7.6 | 4.4 |
| | Feb | 93.3 | 1.2 | 4.3 | 1.1 | 81.0 | 0 | 13.3 | 5.7 |
| | March | 88.0 | 2.4 | 8.2 | 1.5 | 72.0 | 1.4 | 24.1 | 2.5 |
| | April | 41.9 | 14.3 | 30.6 | 13.3 | 30.9 | 7.9 | 44.1 | 17.1 |

TABLE IV. WESTERLY MOVEMENT OF NORTHERN GANNETS CAPE ST VINCENT-PONTO DE SAGRES 1993

| | <i>Adult</i> | <i>3 year</i> | <i>2 year</i> | <i>Imm</i> | <i>Total</i> | <i>Av per hr</i> |
|-----------------|--------------|---------------|---------------|------------|--------------|------------------|
| 29-30 September | 43 | 17 | 41 | 154 | 265 | 176.66 |
| 04-15 October | 218 | 63 | 300 | 644 | 1225 | 198.64 |
| 08-20 November | 1571 | 6 | 110 | 110 | 1797 | 197.83 |

Gannets on migration off the Sagres Peninsula feed opportunistically as they pass in loose skeins or as small mixed-age parties. A few birds diving will break up the main stream, attracting up to 1400 birds in a feeding frenzy which lasts between 5 and 40 min (average 22.1 min), once exceptionally 90 min. When the feeding frenzy was over, Gannets formed large loose rafts whilst others continue their north or south movements. Exceptional numbers were:

| | | |
|------------------|----------------------|-----------------|
| 20 February 1993 | 1500-1530 local time | 1300-1400 birds |
| 23 February 1993 | 0825-0840 local time | >1200 birds |
| 26 January 1994 | 0855-0905 local time | >800 birds |
| 29 January 1994 | 0830-1000 local time | >1200 birds |

On many occasions large numbers of adult and immature Gannets arrived from the east out of the Gulf of Cadiz and at Ponte de Sagres, broke off their migratory movement to commence circling from a height of 30 m to several hundred metres for periods of up to 20 min, whilst others settled off the point in widely scattered rafts. The birds in flight were assumed to be cooling down by convection as they soared across the prevailing northerly winds, whilst the surface birds were cooling and resting before continuing their northerly movement.

Gannets rounding the Capes were very vocal, especially mixed-aged groups, either whilst circling or leaving the Cape to proceed north. In many cases, very low flying groups were initially picked up by their noisy calls, a harsh trisyllabic "gank" or "grank" as they turned the point.

ACKNOWLEDGEMENTS

My first and foremost thanks go to Dr Sarah Wanless, without whose unstinted help, and encouragement this article would never have been written. I am also indebted to Dr W.R.P. Bourne for his extracts from his library, M.J. Blair for his help and advice, G.F. Rivers for typing the original drafts and tables and M. Mackay for typing the final draft.

SUMMARY

Movements of adult and immature North Atlantic Gannets from Cape St Vincent and Ponte de Sagres, Portugal, made over several years are summarised. The majority of Gannet movements throughout the year take place from actual sunrise to plus 60 min, with a gradual decline until dawn plus 180 min. Southerly movements occurred mainly in October and November, those to the north peaked in January and February. An unusual movement of westbound (270°-300°) birds was observed between September and November 1993.

REFERENCES

- GASTON, A.J. 1970. Seabird migration off Cape Verde, Senegal in April 1968. *Seabird Report* 1970: 6-7.
 GARCIA, E.F.J. 1971. Seabird activity in the Straits of Gibraltar, A Progress Report. *Seabird Report* 1971: 30-35.
 MOREAU, R.E. and MONK, J.F. 1957. Autumn migration in Southwest Portugal. *Ibis* 99: 500-508.
 NELSON, B. 1978. *The Gannet*. T & AD Poyser, Berkhamstead.
 OWENS, J. 1958. Autumn migration in southwest Portugal 1957. *Ibis* 100: 515-533.

BOOK REVIEWS

DURINCK, J., H.SKOV, F.P.JENSEN and S.PIHL. 1994. Important marine areas for wintering birds in the Baltic Sea. European Union DG XI research contract no. 2242/90-09-01. Ornis Consult report, 110 pp. ISBN 87-985075-0-8.

This report presents the results of an international project to map the distribution of wintering seabirds in the Baltic Sea, carried out between 1988 and 1993 through surveys from the land, boats and aircraft. The authors and contributors are to be congratulated, both for the prompt production of this important document and for its clarity and appearance.

After introductory and methodological sections, there are two-page accounts of the 10 most important bird areas discovered, ranked according to the cumulative percentage of each species' wintering numbers as compared to the estimated total north-west European populations. This is followed by individual species accounts, including very attractive distribution maps, preferred depth zones and tabulated details of numbers counted and calculated densities in the main areas. My only criticism is that better proof-reading should have eliminated the small number of typing errors, e.g. the inexplicable Red-breasted Merganser figure on p.29.

It has long been known that the relatively shallow, brackish waters of the Baltic hold important wintering populations of seaduck and divers but the results of this project are startling, in that large previously unknown (or at least, undocumented) concentrations of certain species were discovered, causing some population estimates for north-west Europe to be revised dramatically upwards. Before this project, it was thought that the total north-west European wintering population of Velvet Scoters numbered some 250,000 birds; the new estimate for the Baltic alone is over 900,000! Similarly, estimated north-west European wintering Long-tailed Duck numbers rise from c.2 million to c.4.7 million, of which almost three million occur in just three areas - the Gulf of Riga and adjacent Irbe Strait, the Høburs Bank south of Gotland, and the Pomeranian Bay on the border between Poland and Germany. Other mouth-watering snippets include the discovery of 14,000 Smew wintering in the Szczecin/Vorpommern Lagoons on the Polish/German border and 5,760 Steller's Eider along the west coast of the Estonian island of Saaremaa. All this comprises the good news.

The bad news, in the form of threats to these large and vulnerable concentrations, was outlined by one of the contributors to the project, Saulius Svasas of the Lithuanian Institute of Ecology, at the Seabird Group's conference in Glasgow in March 1995. Ironically, some of the most important areas discovered were formerly military zones with strictly limited access and little prospect of damaging developments. All this has changed with the political and economic upheavals of recent years. Degradation of habitat through increased tourist development, commercial fisheries and even amber mining are all seen as potential, but mostly localised, threats. The greatest concern is for the old problem of oil pollution. Offshore drilling in the sedimentary basins of the eastern Baltic has already started, new or enlarged oil terminals, refineries and harbours are planned, and there will inevitably be increased tanker traffic in the region. The basic survey work on vulnerable seabird concentrations has now been done. Follow-up monitoring studies are clearly required and it is to be hoped that the nine Baltic countries that signed the 1992 New Helsinki Convention make rapid progress on the planned Baltic International System of Protected Areas.

Copies of the report may be obtained from Ornis Consult, Vesterbrogade 140, 1620 Copenhagen V, Denmark, price 250 Danish kroner.

Martin Heubeck

NETTLESHIP, D.N., J. BURGER, M. GOCHFELD (eds). 1994. Seabirds on islands: Threats, case studies and action plans. BirdLife Conservation Series No. 1. BirdLife International, Cambridge. 318 pp. ISBN 0946888 23 X. £23.75 (from Natural History Book Service, 2-3 Wills Road, Totnes, Devon TQ9 5XN).

In 1984, the International Council for Bird Preservation (ICBP) published "Status and Conservation of the World's Seabirds" (eds. J.P. Croxall, P.G.H. Evans and R.W. Schreiber) which provided an up-to-date compendium of information on the status of seabirds, reviewed threats and highlighted gaps in our knowledge. This was followed in 1991 by "Seabird Status and Conservation: A supplement" (ed. J.P. Croxall) which filled many of the gaps in knowledge of seabirds listed in the former volume. The current volume published by the same organisation, now renamed BirdLife International, continues this admirable work. It results from a workshop held in New Zealand in 1990 but unlike proceedings of most conferences and workshops which are rarely read and gather dust on dingy shelves, this will be much thumbed and quoted for decades to come.

The book is a series of 19 reviews grouped into three sections. The first covers the principal threats to seabirds – pollution in all its forms, human fisheries, and predation and effects of humans on island nesting seabirds. The second includes more specific problems ranging from Brünnich's Guillemots in Greenland, the status of seabirds in Spitzbergen and the breeding seabirds of Madeira to cats on Ascension Island, the seabirds of China and adjacent seas, the guano islands of Peru and Amsterdam Island. The last section, "Action plans, progress and solutions", covers the conservation and management of seabirds on Christmas Island (Indian Ocean), Seychelles, Galapagos, Cape Verde Islands and the Gulf of St Lawrence. Problems abound, but there are success stories here too. There is something in this book for everyone, data to use, problems to worry about and birds and places to dream about! The book is exceptionally well-produced with the tables usefully high-lighted and maps clearly laid out. Everyone involved can be well satisfied with the results of their labours.

No seabird biologist or aficionado can afford to be without copies of this and the previous volumes. The total of 1403 pages contain the best review of the status, numbers, threats and conservation of any group of animals. However, we cannot afford to be complacent and we must all continue to support organisations large and small which fight for the well-being of the world's seabirds.

M.P. Harris

CAMPHUYSEN, C.J., CALVO, B., DURINCK, J., ENSOR, K., FOLLESTAD, A., FURNESS, R.W., GARTHE, S., LEAPER, G., SKOV, H., TASKER, M.L. and WINTER, C.J.N. 1995. Consumption of discards by seabirds in the North Sea. Final report EC DG XIV research contract BIOECO/93/10. NIOZ Rapport 1995 - 5, Netherlands Institute for Sea Research, Texel, 202 +LVI pp.

The lengthy list of co-authors of this volume is merely the first of an impressive array of large figures for the reader to absorb. They come fast and furious; 27 observers from 7 institutions in 5 countries; over 27000 kilometres steamed on 11 research vessels through 8250 kilometre squares; nearly 850 net hauls observed and over 500 discard experiments involving over 34000 fish...and I haven't even mentioned the birds!

As you may have gathered, this volume is the result of a major international collaboration with the aim of answering the key questions about seabirds and discards from the fishing industry in the North Sea. The authors build layer upon layer of information, including the distribution and abundance of seabirds at sea through the year, the distribution of fishery effort in the North Sea, the interactions of different seabird species at the trawl and the amount of waste discarded by the major North Sea fisheries. This information is used to assess the importance of discards to the North Sea's seabirds and the effects that measures to reduce discarding from commercial fisheries will have on seabirds.

The report is meticulously compiled and the rationale and methods are very clearly laid out. The limitations of the exercise and its shortfalls are openly acknowledged, but this adds to its value in pointing the way for future researchers. For instance depending on how 'observer effects' are incorporated either 1.8 million or 3.5 million fulmars were present in the North Sea! The strength of this project is that the researchers had the data to examine and incorporate such sources or error. My only gripes are minor and concern the presentation. The English is sometimes erratic, although this is hardly surprising given the amount of text, and the occasional page is completely missing.

Eight common scavenging seabirds were identified and 12 that only scavenged infrequently. The total number of scavenging seabirds estimated to be present in the North Sea in each of 4 cruise periods ranged from just over 1 million in February 1993 to almost 3 million in August 1994. The greatest number of scavenging birds are found in the north and west of the North Sea where consumption rates of discards and hence competition were highest. The most numerous scavengers were fulmars and kittiwakes, but gannets, great black-backed gulls and bonxies had the greatest competitive ability in the fight for food. I was particularly impressed by the description of the way gannets intimidate their competitors by 'screaming loudly' before plunge diving into the maelstrom of feeding birds, although fulmars, not surprisingly perhaps, failed to be impressed by this tactic.

In amongst the constant stream of data and fact are occasional anecdotal observations which illuminate the world of seabirds at sea for the uninitiated, such as the large number of gannets feeding with white-beaked and white-sided dolphins on herring close to the Dogger Bank which had apparently flown from the Bass Rock, over 300 km away. The estimate of 29000 bonxies in the North Sea in August 1994 sent me scurrying for the library to check the world population which is estimated to be 13600 pairs; even if a substantial number of young and non-breeders are thrown in this doesn't leave many elsewhere. The importance of the North Sea in winter for seabirds is illustrated by this figure and by others such as the 117000 great black-

backed gulls present in February 1993, compared with the North Sea breeding population of only 24,000. Facts such as these emphasise the true importance of this sea on our doorsteps which we so often take for granted and, some would say, abuse appallingly.

The book includes a useful section on the variety of fishing practices operating in the North Sea and their different discarding practices. Some of the more alarming statistics in the report relate to discarding. The beamtrawl fishery for sole in the southern North Sea results in an incredible 7 kg of fish and 6 kg of benthic invertebrates discarded for every kg of sole landed! The output of waste from this and other fisheries amounts to over half a million tonnes every year.

The study concludes that, subject to a few simplifying assumptions, discards in the North Sea could support 3.5 million 'average' seabirds, a pretty remarkable statistic. The authors acknowledge the previously noted coincidence between the rise of many seabird species in the twentieth century and increased availability of discards from expanding fisheries. Although they prefer to emphasise the likely role of other factors in these population changes they propose that, if natural foods are unavailable discards become important and that decreases in discard availability may have serious consequences for some species, notably great skuas, kittiwakes, lesser black-backed gulls and fulmars. The conclusions are inevitably tentative, but the areas on which future research should focus are identified, such as discarding and consumption at commercial trawlers, the diet of seabirds at sea in winter, vulnerable species, night-time scavenging and the inshore zone.

Finally, and on a slightly different note, this would make worthwhile reading for anybody contemplating a large collaborative study of almost anything. The final report was a mere ten days late, which, after such a huge amount of work is quite remarkable.

It's hardly bedtime reading, but for anyone interested in the subject it must be required reading.

John Uttley

CAMPHUYSEN, C.J. & LEOPOLD, M.F. 1994. Atlas of seabirds in the southern North Sea. IBN Research Report 94/6, NIOZ-Report 1994-8, Institute for Forestry and Nature Research, Dutch Seabird Group and Netherlands Institute for Sea Research, Texel, 126pp. ISSN 0923-3210.

The aim of this atlas is to describe the occurrence and distribution of seabirds in the southern North Sea, as observed from ship-based surveys, an aim which the authors fulfil admirably. The study area covers the Dutch sector of the North Sea, plus immediately adjacent waters; coverage of the area is good in most months of the year. After a brief description of the oceanography of the study area and the methods used, the atlas launches into a species-by-species account of seabird distribution in the southern North Sea. The same bi-monthly periods are used for all species, regardless of differences in their life histories, allowing for easy comparison between species. The distribution maps for most species are presented as densities of birds per km², while rarer species are presented as sightings of individuals. The maps are clear, with darker shading representing higher densities of birds; a particularly useful feature of the maps is the use of smaller symbols in areas where survey effort was low, acting as a caution to the reader when interpreting the maps in these areas. The accompanying text adds further details, giving the reader greater insight into the distribution patterns revealed by the maps. The results of these ship-based surveys are compared with the results of seawatching, aerial surveys and beached bird surveys. A comprehensive discussion for each species encompasses aspects of their life history, recent changes in population sizes (where appropriate), and threats to the species.

In the final section, the authors discuss the international importance of the Dutch sector of the North Sea for seabirds, and consider these waters in the context of a wider area. The importance of the study area as a flyway for migratory birds is highlighted. The relative merits of aerial and ship-based surveys are discussed, although the emphasis is on the disadvantages of aerial surveys, with little attention being paid to their advantages. The repeated criticism of one aerial survey report throughout the atlas, whether justified or not, unfortunately detracts from an otherwise professional piece of work. For a proper comparison, as the authors admit, simultaneous surveys need to be carried out in the same area on both ships and aircraft. The final sentence of the atlas draws attention to the need for intercalibration between aerial and ship-based surveys, something which is long overdue in this field.

This atlas is a polished product resulting from a number of years of surveying at sea. It will serve as an essential reference work for anyone engaged in similar offshore distribution studies, or for those people who are more than a little curious as to where seabirds go when they disappear over the horizon, out of sight of land.

Carolyn Stone

THE SEABIRD GROUP 1996

The Seabird Group was founded in 1966 to circulate news of work in progress on seabirds and to promote research. It is run by an elected Executive Committee and maintains close links with the three major British national ornithological bodies – the British Ornithologist's Union, the British Trust for Ornithology, and the Royal Society for the Protection of Birds. Membership (£10 per annum, £9 if paid by banker's order, £5 for students) is open to all with an interest in seabirds; for details please contact the Membership Secretary (address below) – payment by banker's order helps the Group.

Current Executive Committee The present Committee comprises: Chair S. Wanless, Secretary J. Uttley, Treasurer R.W. Furness, Membership Secretary S. Russell, Editor of *Seabird* S. Wanless, Newsletter Editor M. Tasker, also K.C. Hamer, G. Mudge, J.D. Okill, E.K. Dunn and P. Weaver.

Newsletters and Meetings Three Newsletters are circulated to members each year. They contain all sorts of items including reports on seabird conservation issues and research projects, news from seabird groups in other countries, book reviews, details of meetings, etc. The Newsletter Editor (address below) welcomes contributions from members. The usual venue for the Group's annual meeting is the BTO Ringing and Migration Conference at Swanwick, except when the Group holds its own conference, in which case the meeting is combined with that. Our conferences draw seabird workers from many countries to join in a forum of topical interest. In keeping with our desire to promote work in the field, practical manuals and guidelines evolve from the workshop sessions which cater for specialist topics within the conference theme.

Seabird Group Grants Each year the Group has some money available to help fund research conducted by members. All grant applications should be submitted to the Secretary by the end of February, and will be considered by the Executive Committee by the end of March. Successful applicants are required to submit a typed report, not exceeding 500 words, by the end of October of the same year for inclusion in the Newsletter. A full typed report (in triplicate) must be submitted by the end of the year.

Seabird Colony Register The Seabird Group has always sought to organise and implement national schemes involving the active participation of its membership, now standing at 350 members. The Group membership played a major role in the national Operation Seafarer survey whose results were published in 'The Seabirds of Britain and Ireland' (1974). The Group completed the Seabird Colony Register fieldwork in 1988, in cooperation with the Nature Conservancy Council, and the results were published in the book: 'The Status of Seabirds in Britain and Ireland' in 1991. This register was begun in 1985 to gather together all existing data on breeding seabird numbers in the British Isles, to bring our knowledge of their status up to date by detailed field surveys and to establish a computerised database which can be easily updated in the future. Although this round of survey work has been completed, it is important to continue monitoring of seabird breeding numbers: anyone eager to conduct counts on a regular basis should contact Kate Thompson, JNCC, 17 Rubislaw Terrace, Aberdeen AB1 1XE.

Seabird Journal In November 1984 the Group launched its new-look journal *Seabird*, numbered 7 in deference to its pedigree of Seabird Group Reports 1-6. Our priority is to maintain a high volume and quality of content and the current editor, Sarah Wanless, welcomes offers of papers (see Notice to Contributors, and address below). Members of the Seabird Group receive *Seabird* free of charge; additional copies to members, and any copies to non-members are £10 + 50p postage within the British Isles, £10 + £1 postage overseas. Postage overseas is by surface mail, unless the recipient can make prior provision for air mail. The subscription to Libraries is £15 per copy. To help reduce costs, overseas subscribers are kindly asked to make payment by international money order rather than by cheque. Back issues of *Seabird* 11 - 17 are available at £5

+ 50p postage per copy. There are no cost concessions for multiple orders of *Seabird* and postal charges are additive.

Who to write to While the Seabird Group maintains an accommodation address (c/o RSPB, The Lodge, Sandy, Bedfordshire SG19 2DL, England, UK), the following can be contacted directly, as appropriate. Please help the Group by enclosing a stamped addressed envelope for reply.

Secretary (general enquiries about the Group, seabird conservation matters, grants, etc.): John Uttley, SNH, 2-4 Alexandra Buildings, The Esplanade, Lerwick, Shetland ZE1 0LL, UK.

Membership Secretary (membership renewals, applications and enquiries): Sheila Russell, Clober Farm, Craigton Road, Milngavie, Glasgow G62 7HW, Scotland, UK.

Treasurer (subscriptions, donations, etc.): Dr Robert Furness, Department of Zoology, University of Glasgow, Glasgow G12 8QQ, Scotland, UK.

Editor of Seabird: Dr Sarah Wanless, c/o Institute of Terrestrial Ecology, Hill of Brathens, Banchory, Kincardineshire AB31 4BY, Scotland, UK.

Newsletter Editor: Mark Tasker, JNCC, Thistle House, 7 Thistle Place, Aberdeen AB1 1UZ, Scotland, UK.

EDITORIAL ACKNOWLEDGEMENTS

The editor wishes to thank the following colleagues who have refereed manuscripts or provided help and advice.

N. Aebischer, R. Barrett, M. Brooke, C.J. Camphuysen, R.W. Furness, K. Hamer, M.P. Harris, N. Harrison, M. Heubeck, J.B. Nelson, C. Stone, J. Uttley, A. Webb, P. Wright, B. Zonfrillo

NOTICE TO CONTRIBUTORS

Seabird publishes original contributions relating to any aspect of seabird ornithology as full-length papers (preferably not exceeding thirty manuscript double-spaced pages) or short notes. Although a portion of the journal will be of particular interest to UK members, contributions are welcomed on aspects of seabird ornithology from any part of the world so long as they are likely to be of general interest.

Seabird is indexed in the Aquatic Sciences and Fisheries abstracts, Ecology Abstracts and Animal Behaviour Abstracts of Cambridge Scientific Abstracts databases and journals.

Copyright is retained by the Seabird Group. Reference to contributions in *Seabird* may be made in other scientific writings but no extensive part of the text, nor any diagram, figure, table or plate may be reproduced without written permission from the Editor. Such permission will not be granted without consultation with the author(s).

Contributions should be submitted in the same format as used in recent copies of *Seabird*, and this is outlined below:

All submissions, of which *three* copies are required, must be typewritten, on one side of the paper, with double spacing and adequate margins. The approximate position of figures and tables should be indicated in the margin. Authors are advised to consult a recent copy of *Seabird* and follow the conventions for section headings, tables, captions, references, quotation marks, abbreviations etc. The Editor may return without consideration any submission that departs from the *Seabird* form of presentation. Spelling should conform with the preferred i.e. first-cited spelling of the *Shorter Oxford Dictionary*. Details of experimental technique, extensive tabulations of results of computation procedures, etc. are best presented as appendices. A full-length paper must include a summary not exceeding 5% of the total length.

On first mention a bird species should be designated by an English vernacular name drawn from *The Status of Birds in Britain and Ireland*, or from an authoritative faunistic work treating the appropriate region, followed by systematic binomial; author and date need be cited only in taxonomic papers. Thereafter only one name should be used, preferably the English one. Capitals should be used for the initial letters of all single words or hyphenated vernacular names (e.g. Great Black-backed Gull, White-eyed Gull) but not in a group name (e.g. gulls, terns). Trinomials should be used only if the subspecific nomenclature is relevant to the topic under discussion. Underlining is used for all words of foreign languages, including Latin, other than those which have been adopted into English. Underlining should also be used for phonetic renderings of bird vocalizations. Underlining is not needed for emphasis.

Measurements should be given in SI (International system of units), but if the original measurements were made in non-SI units, the actual values and units should be given, with SI equivalents inserted in parentheses at appropriate points. Measurements may be given in cm.

Figures and diagrams should be drawn in black ink on white board, paper or tracing material, with scales (for maps), and lettering given in Letraset. In designing drawings, authors are asked to note the page-size and shape of *Seabird*; originals should be 1½-2 times final size. Tables should be typewritten and spaced appropriately. References should be quoted in the text in the format indicated by the following examples: Harris 1980, Cramp & Simmons 1980, Monaghan *et al.* 1980. References at the end of the paper (following acknowledgements) should be given in the following format:

COULSON, J.C. and WOOLER, R.D. 1976. Differential survival rates among breeding Kittiwake Gulls *Rissa tridactyla* (L.). *J. Anim. Ecol.* 45: 205-213.

The author's name should be placed beneath the title of the paper and again at the end, together with the address, after the references.

Twenty-five offprints of each original contribution will be supplied free. Additional copies can be supplied on payment; orders will be required at the time of proof-correction. Reprints of book reviews will only be supplied if a request is submitted with the original copy; in this case the full number will be charged at cost.