

# **Threats to Seabirds**

**Proceedings of the**

**5th International Seabird Group conference**

**Glasgow, 24 -26 March 1995**

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**Editor: Mark L. Tasker**

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## Introduction

Mark L. Tasker

Joint Nature Conservation Committee, 17 Rubislaw Terrace, Aberdeen, AB1 1XE, UK.

This was the fifth conference of the Seabird Group and the second held in the excellent environment of the Kelvin Conference Centre in Glasgow. We are particularly grateful to our sponsors, listed earlier in this volume, for their support. The conference was attended by some 144 delegates, of which about 40% were from 17 countries outside the United Kingdom. We were very pleased to welcome delegates from further afield in Europe, the Middle East, Australasia and North America. More than one third of the attendees were from their "home ground" of Scotland, perhaps illustrating how important seabirds are to Scotland.

The theme for this occasion was "Threats to seabirds". This topic was examined under several main headings: pollution, fisheries, introduced mammals, disturbance and others. As with all other Seabird Group conferences, papers were not confined to the main theme. These proceedings reflect abstracts of all contributed and invited papers. These abstracts have not been externally refereed, and those interested in any aspects of them are invited to contact relevant authors before quoting from them.

Papers at this conference were nearly all of a high standard and it is difficult to single out individual papers of special merit. Some general points were made though. John Weins identified the importance of assessing effects of pressures on seabirds using scientific methods where possible. It is important to assess actual threats against potential pressures. Some threats may be temporary while others may cause permanent changes. Population changes caused by temporary threats (e.g. catastrophic oil spills) may recover after several years; the results of other temporary threats may be more permanent. Some threats are longer-term: of especial note here are the results of mammalian introductions to islands and other areas. The harm done by American mink, imported to Britain (and elsewhere) to satisfy the vanity of rich humans, was bought out well by Clive Craik. It is difficult to see how the damage done to the seabirds of his study area in the Inner Hebrides of Scotland can be reversed. In other areas, the situation is more encouraging. New Zealander colleagues have led the way in eradicating mammal from ecosystems to which they are alien; closer to home, Bernie Zonfrillo has set the conditions for Ailsa Craig to recover its former biological glory by organising the eradication of rats from that island. These examples are commendable and should be followed by further action.

Further afield, we learned of the bycatch of albatrosses and other seabirds on long-lines set by fishermen. Sandy Bartle, John Croxall and their co-workers have shown long-term declines in species subject to this bycatch. If this problem remains unchallenged, then we can expect local extinctions of some populations. It does not seem to be beyond the ingenuity of man to devise a fishing system that does not have this bycatch problem.

Attendees at the conference were invited to participate in the preparation of a Strategic Habitat Action Plan being assembled as part of BirdLife International's conservation programme for dispersed species in European seas. A questionnaire was handed out asking participants to judge the relative importance and geographic scale of a list of threats to a selected set of seabirds using European waters. The Strategic Habitat Action Plan will be used by BirdLife International and its partners to guide conservation actions in European Seas. The Plan, along with others covering other European Habitats will be published in the BirdLife Conservation Series in a book provisionally entitled *Habitat conservation for birds in Europe*.

## **The long-term breeding disaster of puffins at Røst; causes and consequences**

Tycho Anker-Nilssen

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During summer, two thirds of the seabirds breeding along the Norwegian mainland coast are puffins *Fratercula arctica*. Approximately one third of these puffins breed in colonies in the Røst archipelago in Nordland, where the population now amounts to about 500, -600,000 pairs.

When food supplies are adequate, first-year herring of the Norwegian spring-spawning stock is the principal food of young puffins at Røst. Due to the combined effect of extensive overfishing and changed oceanographic conditions, this herring stock collapsed completely in the late 1960s and remained well below 5% of its former peak level for a full 20 years. An important increase in spawning numbers came about in 1988, thanks to the fortunately strong year-class of 1983, but, although the expectations are good, the stock is still only about 25% of the peak numbers.

Studies of puffins at Røst were initiated in 1964, and for the last 20 years they have been focused on food supply, reproduction and population development. During the 20 years when the herring stock was at its lowest, the puffins had a decent breeding success in only four seasons, while in most years the chick mortality was almost total. Based on indices presented by the Marine Research Institute in Bergen from acoustic surveys in the Barents Sea in August-September, the abundance of herring fry drifting past Lofoten explains most of the year-to-year variation in the survival of puffin chicks at Røst during the last two decades. Various aspects of the feeding ecology and breeding success of the Røst puffins now seem to be robust and early indicators of the year-class strength of this herring stock.

In 1990, a colour-ringing programme was established in order to monitor adult survival rates. Assuming that the population trend in 1983-87, when natal recruitment had to be insignificant, reflected the adult mortality at the time, the registrations of colour-ringed birds now indicate that adult mortality has improved considerably. This raises interesting questions about the costs of reproduction for the adults and the possible effects of a skewed age distribution resulting from the recruitment failure.

Puffin energetics, the moderate calorific quality of first-year herring in summer, and the numbers of puffins native to Røst, indicate that this population will consume about 15 billion individual herring (nearly 20 000 tonnes) during the 45 day long fledging period, if 75% of their diet (by weight) consists of herring. Although this proportion varies from year to year, adult puffins are likely to feed on herring for a much longer period each season, and the total population of puffins breeding in the countries of Nordland and Troms, where herring is likely to be the most significant prey, is more than twice that of Røst. Additionally, the Røst population was more than twice its present size less than 15 years ago. Considering these circumstances, puffin predation may, at least in some years, be a significant mortality factor for young herring. In order to determine the magnitude of this predation, however, better information is needed with respect to herring survival during early stages (from three to nine months of age), the food chosen by adult puffins for their own maintenance, and what factors are the most important in determining the availability of herring to puffins.

Although their breeding success improved markedly in 1989-92, the Røst puffins are still experiencing reproductive problems and need new recruits. The sudden premature terminations of chick feeding and colony attendance registered in recent years remain to be explained, but suggest that this ecosystem is far from completely restored.

**Commercial ship traffic along the northern sea route - a major threat to the marine birds?**

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Commercial ship traffic along the northern sea route (NSR) may be a reality in a few years. Presently a co-operative project between Japan, Russia and Norway, the International Northern Sea Route Programme (INSROP) is being carried out. INSROP is a comprehensive multi-disciplinary five-year research programme (1993-1997) designed to investigate the practicality, environmental impact, commercial value and political implications of the development of the NSR. Covering some 2200-2900 nautical miles, the NSR stretches from Novaya Zemlja in the west to the Bering Strait in the east.

Ship traffic along the NSR is not new as Russian vessels have sailed through this area for many years. However, if the NSR is realised ship traffic including foreign vessels will increase. The main effects of increasing ship traffic along the NSR in relation to marine birds are pollution, noise, physical disturbance to sea ice and waste. In the final environmental impact assessment all these effects will be analysed. The main results from the project will be compiled in an environmental atlas and environmental impact assessment which will focus on the total impact of commercial traffic along the NSR shipping lanes.

Within the Russian Arctic, seabirds have been studied quite extensively in the Barents Sea, but to a lesser degree in the Chukchi Sea. Very little is known about seabirds in other Siberian marine areas. In general, the distribution of seabird breeding colonies is known but very few counts have been conducted. The largest colonies of Brunnich's guillemots *Uria lomvia* and kittiwakes *Rissa tridactyla* are located at Wrangel Island, eastern Cukot Peninsula, New-Siberian Islands and Easter Taimyr. Little auks *Alle alle* breed in several places along the east coast of Severnaya Zemlya archipelago. Black guillemots *Cepphus grylle* inhabit all suitable shores along arctic archipelagos and east Chukotka. Populations of ivory gull *Pagophila eburnea* breeding in the Kara Sea region probably comprise more than half of the world population.

So far we have analysed the potential effects of oil pollution in the region. The most vulnerable species in relation to long-term effects seem to be divers, seaduck, auks and ivory gulls. Other potential effects of shipping remain to be analysed and it is at present too early to state that NSR activity will be a major threat to marine birds. However, the NSR area contains large populations of marine birds including dark-bellied brent goose *Branta bernicla bernicla* (which are endemic to the area). Ivory gulls and Steller's eiders *Polysticta stelleri* have a significant proportion of their world populations in the area. Therefore, negative effects that influence such species may have serious consequences.

## **Tuna long-lining in the Southern Ocean and its effects on New Zealand seabird populations**

J.A. (Sandy) Bartle

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Numbers of albatrosses and petrels caught on Japanese tuna longlines were calculated from catch rates recorded by fishery observers over 1472 days 1987-94. Mean catch rates on observed vessels showed that the Japanese fleet caught over 11,700 birds, including 7500 albatrosses, in New Zealand waters during this period.

If the catch rate in earlier years was similar to 1987-1994, reliable historical data on Japanese fishing effort in New Zealand waters can enable calculation of seabird catch back to 1973. By assuming that the relative frequency of capture of different species was constant, it was also possible to estimate average annual losses of key species.

These figures were then compared with recorded rates of population decline. Population data on New Zealand seabirds involved in longline bycatch are not accurate, and demographic data not available. Nevertheless, the relative proportion of recorded decline accounted for by tuna longline mortality ranged from 14% to 100% for different species, closely reflecting the known foraging ranges of each. Species composition, sex and age classes caught were obtained from a sample of 390 specimens of 18 species returned by observers for autopsy at the Museum of New Zealand.

Seabirds apparently most affected by longlining in New Zealand waters are the endemic Antipodes and Auckland Is. wandering albatrosses *Diomedea exulans antipodensis* and *D.e. gibsoni*, which are caught with high frequency relative to their low densities at sea. Most wandering albatrosses caught were breeding adults (of the New Zealand forms, 76%) and, in the Auckland Is. race, 71% were males. In grey petrels *Procellaria cinerea* an even greater sex ratio bias (89% breeding females) coupled with an exceptional level of longline mortality (calculated at over 20,000 birds since 1973) suggests that their Pacific populations are in jeopardy.

Longline mortality in New Zealand waters is insufficient to explain the declines on Campbell Island of New Zealand black-browed *Diomedea melanophrys impavida* and grey-headed albatrosses *D. chrysostoma*. Banding recoveries show that birds from New Zealand populations of these species are frequently caught on tuna longlines elsewhere. However, despite a high level (white-capped albatross *D. cauta steadi*) and high rate (southern Buller's albatross *D.b. bulleri*) of capture on longlines, numbers of these albatrosses do not appear to be declining.

Voluntary and compulsory mitigation measures currently in use have been found to be insufficient to reduce mortality of key species to an acceptable level. For this reason, and because the measured catch rates of seabirds on tuna longlines elsewhere in the Southern Ocean are even higher, the New Zealand conservation movement is calling for a world-wide moratorium on tuna longline fisheries.

## Impact of tick infestations and tick-borne virus infections on seabirds

Tim Barton<sup>1</sup>, Miles Nunn<sup>2</sup>, Mike Harris<sup>1</sup> and Pat Nuttall<sup>2</sup>

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The coloniality of seabirds provides ideal conditions for blood-sucking ticks and the arboviruses that they transmit. Some 30 species of tick are associated with seabirds; approximately 100 viruses have been isolated from 12 of these species. Viruses have been isolated from tissues collected from sick birds and from ticks removed from dead birds (Chastel, 1988, *Adv. Dis. Vector Res.* 5:25). In addition, high levels of tick infestation of breeding birds have been implicated as causing nest desertions, developmental abnormalities, and poor breeding success (Feare, 1976, *Ibis* 118:112; King *et al.*, 1977a, *Wilson Bull.* 89:157; King *et al.*, 1977b, *Condor* 79:507; Duffy, 1983, *Ecology* 64:110; Chastel *et al.*, 1987, *Ann. Parasitol. Hum. Comp.* 62:492). However, despite the frequency of tick infestations and associated virus infections, their effects on the population dynamics of seabirds are unknown.

A 14-year study of cliff- and burrow-nesting marine birds on the Isle of May, Scotland, has found marked differences in the breeding output and post-fledging survival of chicks from individual nest-sites and/or individual birds (Harris and Wanless, 1988, *Ibis* 130:172; Harris and Wanless, 1989, *Condor* 91:139; Wanless and Harris, 1988, unpublished data). This is in line with many previous studies. Such individual differences are probably caused by a variety of factors, e.g. differences in the quality of birds and/or nest-sites, bird density, etc. (e.g. Coulson, 1968, *Condor* 91:139; Birkhead, 1977, *J. Anim. Ecol.* 46:751). In addition, very substantial inter-year differences in post-fledging survival have been recorded (Harris, Halley and Wanless, 1992, *Ibis* 134:335). The effect of disease on the breeding and survival of seabirds is virtually unknown. Based on the Isle of May, we are examining the observed variations in breeding success and post-fledging survival of chicks in relation to parasitism by ticks and associated viruses.

Guillemot *Uria aalge* breeding sites (n=958) were scored for their suitability as tick habitat. Analysis of breeding success data collected for each site over a maximum of 13 years as yet indicates no relationship between breeding success and the quality of nearby tick habitat. Numbers of ticks on nestling guillemots were low. Analysis of 1993 data revealed no effect of ticks on host condition based on measurable parameters. 1994 data represent a wider range of tick numbers per infested bird and are currently being analysed. Of the birds examined, 627 adult and 653 nestling guillemots were colour ringed. These are being monitored to assess the long term survival of infested and uninfested birds.

Individual birds (n=3893) of 6 species and various ages were examined to ascertain host preference of *I. uriae*. Data from 1993 showed inter-species and inter-age differences. Kittiwakes *Rissa tridactyla* and fulmars *Fulmarus glacialis* had significantly higher infestation rates than guillemots, razorbills *Alca torda*, puffins *Fratercula arctica* and shags *Phalacrocorax aristotelis*. Adult birds were more frequently infested than young. Combined data for 1993 and 1994 are being analysed to control for colony and date effects. The location of attachment of *I. uriae* on adult and young guillemots and kittiwakes differed: adult birds had most ticks on the head and neck regions while nestlings had most on feet, legs and belly. Inter-age differences were consistent for both guillemots and kittiwakes. There was no difference in location of ticks between kittiwakes and guillemots within the two age categories examined, and little evidence for differential preference of body location between adult and nymph ticks. The mean duration of attachment of nymphal ticks on kittiwake nestlings was  $5.8 \pm 1.0$  days.

Data on infestation rates for *I. uriae* were obtained from March to July (inclusive) in both 1993 and 1994 which includes the pre-breeding, breeding and post-breeding periods. Contrary to the literature, activity peaked in mid-May for larval and nymphal ticks and late May to early June for female ticks. There was a second, smaller peak of nymphal activity in mid-July. Very few ticks were attached to birds for most of the guillemot chick rearing period. Analysis of the prevalence of engorged ticks from samples collected from the ground confirmed these activity periods and shows that there is little feeding activity outside the period March to July. No ticks overwintered in the engorged state and hence they were capable of feeding without delay in the following season.

Thirty Kemerovo (KEM) group orbiviruses were isolated from ticks collected during the study, mostly from unengorged adult female *I. uriae* (n = 201). Kemerovo group viruses have 10 segments of double-stranded RNA; each segment codes for a single protein. Each isolate from the Isle of May has a unique genotype. Two of the isolates, Maiden virus (MDNV) and Colony virus (COYV) have been cloned and sequenced. Some of the double-stranded RNA segments are highly conserved. For example, the core protein, VP7, of MDNV, COYV and BRDV (which was isolated from ticks collected in Scotland 20 years ago) is 95% identical. Other segments are divergent: the two outer capsid proteins VP4 and VP5 of COYV and BRDV are about 60% and 70% identical, respectively. COYV is non-pathogenic in a laboratory model. We are investigating the potential of reassortment between Isle of May Kemerovo group virus isolates to alter phenotype. Specifically we want to know if swapping a single double-stranded RNA segment will make the non-pathogenic isolate COYV pathogenic.

The percentage of adult female ticks infected with the orbiviruses increased during the breeding season of their seabird hosts, reaching a peak of 14% in July, and then decreased. One-third of 15 engorged adult female ticks collected in June 1994 had virus. Seabirds thus appear to be acting as amplifying hosts for the virus. Adult male ticks (n = 64) showed a similar percentage of infection with KEM group virus to females in April, but the percentage of infected males did not appear to increase by July. There are significant differences between sites on the island in the percentage of adult female ticks which are infected with virus. The dynamics of virus infection in ticks and the amplifying role of seabirds are being examined further.

### **Are seabirds adequately protected by international law?**

Leslie Batty

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Seabirds may be protected directly by wildlife treaties and indirectly by treaties and customary international law concerned with the state of the marine environment. This paper focuses on global Red Data species and species of conservation concern in Britain and Europe. It assesses the extent to which these seabirds are directly protected by being specifically listed in international legal instruments.

Of the twelve regularly breeding British Red Data seabird species, and the 27 Species of European Conservation Concern with an unfavourable status, all are legally protected by one or more of the European Community Wild Birds Directive, the Bonn Convention and the Berne Convention. In addition a number of important seabird colonies have been designated as Special Protection Areas under the 1979 Wild Birds Directive and will become Natura 2000 sites under the 1992 Habitats and Species Directive.

This situation contrasts with that of the 55 global Red Data species listed by BirdLife International: only 18 (33%) appear to be specifically covered by existing international wildlife treaties. The main problems facing 68% of these species concerns their breeding sites, and 65% are restricted in their breeding range to single States. Problems of state sovereignty arise when dealing with endemic species, but responsibility for threatened species within their territories is increasingly being accepted by States through treaties such as the 1992 UNCED Convention on Biological Diversity as well as through emerging custom, and this should be built upon.

The entry into force, in 1994, of the UN Convention on the Law of the Sea provides opportunities for integrating seabird conservation more fully into the management of the world's oceans. It recognises the need for fishery management to "*take into consideration the effects on species associated with or dependent upon harvested species*"; it highlights the need to "*protect and preserve ... the habitat of depleted, threatened or endangered species*" from marine pollution, and strengthens the legal basis for the establishment of tanker routing systems and Particularly Sensitive Sea Areas (PSAs). However, it also stresses the need for more specific regional conventions and agreements, and it is these which are likely to be more directly effective in the conservation of seabirds. The UNEP Regional Seas programme of framework conventions and protocols, covers the distributions of approximately 75% of the world's threatened seabirds, and includes such terrestrial areas as may be designated by the Parties. The 1990 Kingston Protocol to the 1983 Cartagena Convention on the wider Caribbean is arguably the most comprehensive regional wildlife protection treaty in the world and covers endemic as well as transboundary species. Nevertheless, nature conservation protocols only exist so far for four regional seas, and only one lists a global Red Data seabird in its appendix.

## **Restoration of seabird islands: the New Zealand experience**

Brian D. Bell

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Islands around the world have suffered from the introduction of exotic animals and New Zealand is no exception. Because New Zealand (like several oceanic islands) had no land mammals other than some small bats, the effects were possibly more devastating. Some terrestrial birds were lost and seabird numbers decimated. No seabirds have become extinct but some have reached the critically endangered status, notably the magenta petrel *Pterodroma magenta*.

It was recognised very early that some of the negative effects of exotic animals could be halted or limited by the control or eradication of the animals. The first island eradication began in the 1920s but it was not until after World War Two that animal eradications became a more regular management practice. Work began with the easier to remove species and with small islands.

With experience, larger islands were tackled and more difficult species. A notable advance was the eradication of cats from Little Barrier Island (3083 ha). The development of new poisons, particularly second generation anticoagulants, and better methods for distributing them has meant that most species can be tackled and the size of island is limited only by the financial resources available. To date, New Zealand agencies have eradicated 14 different animals from over 100 islands ranging in size up to 11,400 ha.

The results of eradication have been striking both in the recovery of the vegetation and of fauna, and marked increases in the seabird populations. Macauley Island, the Poor Knights Islands and Little Barrier Island are examples of what can be achieved. In all cases there has been a marked recovery of the seabird numbers. New Zealand agencies are now looking to expanding the

eradication programme over the next two to three years and will be dealing with large islands (over 2,000 ha) and those with multiple species.

New Zealand experience has not been exclusive and a number of other countries have begun similar programmes with encouraging success. While seabirds are faced with problems such as fisheries interaction, human predation and pollution, they are most vulnerable on their breeding islands. It is here that we can have the most immediate effect to protect and restore seabird numbers. We have the ability to restore islands, all that is needed is the will and commitment to do the work. New Zealand has shown what can be done and it is time for other countries around the world to accept this challenge and to begin restoring their islands and their seabird populations.

## **Penguins in Perth?**

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Perth, the capital of Western Australia, is a rapidly growing city of 1.2 million. About 40km from the city centre lie Penguin Island, home to the largest population of little penguins *Eudyptula minor* in the western half of the continent. This population of approximately 500 breeding pairs is long established, but lies only 600m offshore from the satellite city of Rockingham and is readily accessible across a sand bar at low tide. Little penguin populations are declining throughout Australia, especially close to expanding urban areas and this small isolated population may be particularly vulnerable. Annual fluctuations in breeding phenology and success have been associated with the strength of the Leeuwin current, a southward flow of warm, low salinity water down the coast of Western Australia, which increases in weak ENSO years. Against this background, there has been a steady and very substantial increase in recreational boat activity in the vicinity of the island, and a similar increase in commercial fishing for the small clupeids which form the majority of the penguins diet. The island is now closed for part of the breeding season but still receives about 100,000 visitors each summer. Recent nest-box studies demonstrated very substantial falls in occupancy, hatching and breeding success associated with increasing human disturbance.

## **Behavioural and genetic evidence for specific status of dark and light morphs of the herald petrel *Pterodroma heraldica*, and the need for protection from rat predation**

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Dark and light morphs of the herald petrel are reproductively isolated on Henderson Island in the Pitcairn Group in the central South Pacific. Not only do light birds breed exclusively with light and dark birds exclusively with dark, but there are also differences in the location of nesting of the two forms and their in their calls. MtDNA sequence data support the behavioural data in suggesting the two morphs are separate species. The specific name *atrata*, given by Solander on Cook's first voyage, is suggested for the dark morph.

Evidence from Henderson Island from 1991/92 suggests that rats *Rattus exulans* were destroying the majority of petrel hatchlings. The predation is of serious conservation concern since Henderson Island is probably the major stronghold of *P. atrata*. Given Henderson's size (37km<sup>2</sup>), the obvious solution, rat eradication is not practical there (although it may become so in future).



We suggest that rats be eradicated on Oeno, one of the other islands in the Pitcairn group, to provide at least one safe haven for petrels in the area. Papers on the above topics are in press in *Ibis* and the *Biological Journal of the Linnean Society*.

## **Terns in Brittany: population trends and conservation**

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Historically, six species of terns have bred in Brittany. Three of them may be considered as marginal for their episodic presence or small numbers: gull-billed tern *Gelochelidon nilotica*, arctic tern *Sterna paradisea*, and little tern *S. albifrons*. Thus, only the three remaining species will be considered here, for their absolute or relative important breeding numbers: Sandwich tern *S. sandvicensis*, common tern *S. hirundo*, and roseate tern *S. dougallii*.

Between 1820 and 1920, there are no precise data. The dominant impressions from this period are that seabird populations in general seem to have been at their lowest historical levels between 1880 and 1920, and that terns were perhaps the commonest species, perhaps especially roseate. Between 1920 and 1950, data on terns are scanty. From 1950, the development of field ornithology led to good counts all around Brittany. Until the beginning of the 1970s, common and roseate terns populations remained respectively about 2000 and 500-600 pairs (with a maximum estimate of 800 pairs in 1967). Sandwich tern numbers fluctuated between 300 and 4700 pairs within a clear context of general increase. Almost all terns breeding on the French Atlantic coast breed in Brittany. Within Brittany, there is great geographical instability, both between and within the different breeding areas. Instability is certainly due to a huge growth in the herring gull population over the same period (6000 pairs in 1955, 26,000 in 1970). Sudden changes occurred in 1973-74. Half of the Breton Sandwich terns emigrated to the south-west of France (Banc d'Arguin, Gironde, 1800 pairs in 1974). Roseate terns crashed to about 100 pairs. Common terns probably decreased at the same time (1080 pairs in 1977-78). In addition to the increasing gull-tern competition, it is clear that the extreme fragility of the colonies (greater sensitivity to disturbance increased by their small size) has also occurred.

Since 1958, the SEPNB (Société pour l'Etude et la Protection de la Nature en Bretagne) has created 14 reserves for terns. Management and protection has focused on a regional network of historically or potentially attractive areas, leading to positive results on some, but not all, of the reserves. The SEPNB's -Observatoire de Sternes en Bretagne- (Tern Survey in Brittany) started in 1989, is now integrated into the European roseate tern conservation programme. In addition to an annual census and estimate of breeding success, conservation measures include vegetation management and providing suitable sites, extermination of rats, gull culling, putting up signs, providing information to fishermen and yachtsmen, and preventing disturbance. Volunteers take responsibility for reserve management, helped by seasonal wardens which allows a daily presence and efficient wardening when necessary. There are few scientific studies on terns in Brittany. All activities rely upon considerable involvement by SEPNB's volunteers.

In 1987-88 (last national census), respectively 24%, 100%, and 84% of the French Atlantic coast Sandwich, roseate and common terns were breeding in Brittany. Today, Breton populations seem to be more or less stable. All Sandwich (1200-1600 pairs) and roseate terns (80-100 pairs), and about 75% of common terns (900-1100 pairs) breed on SEPNB reserves. Roseate terns numbers represented 6-7 % of the European population.

## **The use of discards and offal from trawlers by seabirds in the North Sea**

Kees (C.J.) Camphuysen<sup>1</sup>, Belen Calvo<sup>2</sup>, Jan Durinck<sup>3</sup>, Kenny Ensor<sup>2</sup>, Robert W. Furness<sup>2</sup>, Stephan Garthe<sup>4</sup>, Genevieve Leaper<sup>1</sup>, Henrik Skov<sup>3</sup>, Mark L. Tasker<sup>5</sup> and Chris J.N. Winter<sup>1</sup>

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The importance of discards and offal for seabirds were studied on a North Sea wide scale in February 1993 and in May, August and November 1994 onboard fisheries research vessels during the International Bottom Trawl Survey (IBTS). The project provided information on the numbers and spatial distribution of scavenging seabirds, on co-occurrence of seabirds and commercial trawlers, on dominance hierarchies among scavengers in areas differing in species composition and relative abundance of seabirds, and provided quantifications of proportions of discarded biota which are consumed by seabirds. Current knowledge on quantities of fish discarded from commercial fisheries in the North Sea are summarised and consumption rates of seabirds throughout the North Sea were used to estimate total consumption by scavenging seabirds. From discard experiments, it was estimated that overall consumption rates varied between 95% for offal (n=5779), 80% for roundfish (n=22,177), 21% for flatfish (n=2375) and 6% for benthic invertebrates (n=905). Consumption rates and total numbers of scavengers were relatively high in the northwestern half of the North Sea, while scavenging appeared to be of greater significance in winter than in summer. The densest concentrations of seabirds located were birds feeding 'naturally' on prey near the surface. At fishing grounds, however, up to several thousands of scavengers could assemble at a single trawler. However the distribution of none of the species could be explained in terms of trawler densities, but the amount of discards produced is immense and seabirds utilise discards and offal on a great scale, indicating that measures to reduce discards in commercial fisheries are likely to affect feeding opportunities for scavenging seabirds.

## **Numbers of seabirds and their North Sea distribution in 1993/94**

Kees (C.J.) Camphuysen<sup>1</sup>, Belen Calvo<sup>2</sup>, Jan Durinck<sup>3</sup>, Kenny Ensor<sup>2</sup>, Robert W. Furness<sup>2</sup>, Stephan Garthe<sup>4</sup>, Genevieve Leaper<sup>1</sup>, Henrik Skov<sup>3</sup>, Mark L. Tasker<sup>5</sup> and Chris J.N. Winter<sup>1</sup>

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During the International Bottom Trawl Surveys (IBTS) of February 1993, May, August and November 1994, seabirds were surveyed by means of strip-transect counts in order to assess spatial distribution patterns and to estimate total numbers of seabirds in the North Sea. Target species for this project were scavengers such as fulmar, gannet, herring gull and kittiwake, but all seabirds and marine mammals were counted following methods developed for the European Seabirds at Sea (ESAS) database (300m wide transect, 90° scan, and a snap-shot for flying birds). The project provided an excellent opportunity to synoptically survey the North Sea four times in one year. Overall coverage was 1750 km<sup>2</sup> in August and 2155 km<sup>2</sup> in November. In each surveys four fisheries research vessels were used and most of the North Sea and Skagerrak were visited by at least two of these vessels. More unique than the 6% increase of ESAS database from these surveys alone was the opportunity to take a snap-shot of the entire area at once. Only small parts of the North Sea were surveyed each year prior to the May survey of 1994

## **The use of discards and offal from trawlers by seabirds wintering in the North Sea**

Kees (C.J.) Camphuysen<sup>1</sup>, Kenny Ensor<sup>2</sup>, Robert W. Furness<sup>2</sup>, Stephan Garthe<sup>3</sup>, Ommo Hüppop<sup>4</sup>, Genevieve Leaper<sup>1</sup>, Henrik Skov<sup>5</sup> and Mark L. Tasker<sup>6</sup>

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The importance of discards and offal in seabird diets for seabirds wintering in the North Sea were studied and the implications of new regulations in commercial fisheries were assessed. Most fieldwork was carried out from the February 1993 International Bottom Trawl Survey (IBTS) fisheries research vessels. Fifteen species were observed as scavengers at the trawl. Of these only fulmar (estimated at 720,000 individuals), gannet (70,000), common gull (57,000), herring gull (297,000), great black-backed gull (175,000) and kittiwake (298,000) occurred in substantial numbers in the North Sea. It was estimated that about 1500 fishing vessels were present in the North Sea. About 28% of the total number of scavenging seabirds in the North Sea were associated with commercial fishing vessels. This suggests that these seabirds spend over a quarter of their time at these boats. Seabirds consumed 100% of offal discards (n=605), 92.4% of roundfish discards (n=5000), 35.5% of flatfish discards (n=372) and 16.7% of benthic invertebrate or cephalopod discards (n=54). It was calculated that around 2 million 1000g scavenging seabirds may be supported by the offal and discards made available from North Sea fishing vessels in recent years (offal could support 1.1 million; roundfish, 880,000; flatfish, 180,000; and benthic

invertebrates 38,000 1000g scavenging seabirds in the North Sea). Because of its high calorific value and high consumption rate, offal represents the most important portion of this waste, but is monopolised by only a few scavenging species, mostly fulmars and kittiwakes.

### **Approaches to determining bag limits and hunting seasons for murrens in Newfoundland**

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Recently a legal mechanism to regulate the murre hunt in Newfoundland and Labrador was identified, with the result that a bag limit and shorter hunting season are now in place. In this paper I describe the approach taken to determine these new hunting restrictions. Data on harvest levels and hunter preferences were obtained from nine murre harvest surveys conducted between 1977 and 1990, and a survey of hunter opinion conducted in 1988. A population model estimating the effects of harvest levels on murre populations was constructed. The model estimating the effects of the annual harvest on murre populations was constructed. The model predicted a sustainable harvest at about 50% of past levels, which ranged from 600,000 to 900,000 birds annually.

Seventy-four percent of hunters surveyed (n=1224) requested a daily bag limit of 20 birds/person or less. Preferred hunting seasons followed a north-south pattern with the majority of hunters in the north opting for September-November or October-December and those in the south opting for January-March. Data on the frequency distribution of daily bag size and the monthly trend in the number of murrens harvested in each murre hunting zone was used to model the effects of varying bag limit and season length on harvest reduction. Finally, bag and possession limits, and zone-specific hunting seasons were determined such that the target harvest reduction was achieved while at the same time accommodating hunter preferences.

### **Effects of North American mink on British seabirds**

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Feral North American mink *Mustela vison*, descendants of escapees from fur farms, have become common and widespread in Britain in the last twenty years. They live and breed as successfully on the rocky coastline of west Scotland as they do along the rivers and streams of lowland Britain. The characteristics of feral mink which cause widespread whole-colony breeding failures of island-nesting seabirds are their swimming ability, their high coastal density compared with native predators, and their pronounced habit of surplus killing. Mink commonly reach small islands one to two km offshore and prey on eggs and chicks of colonial ground-nesting gulls and terns. In a study area along the mainland coast of west Scotland between the towns of Mallaig and Machrihanish (ca 55° to 57°N), mink predation at seabird colonies was relatively slight in the mid-eighties but became severe in the years 1989-1994. This change is believed to have coincided approximately with the saturation of this coastal habitat by mink in the late stages of their spread and multiplication.

In 1992, 1993 and 1994, the effects of mink on productivity were assessed at over 30 mixed and single-species island colonies of black-headed gull *Larus ridibundus*, common gull *L. canus*,

common tern *Sterna hirundo* and arctic tern *S. paradisaea*. Unless they were large (> 100 prs), colonies at which mink predation was detected always produced no or almost no fledged young. Colonies at which predation by mink was not detected generally produced about 0.2 - 1 fledged chick/pair nesting. Colonies at which mink were killed (early or mid-breeding season in 1992-93; in February or March in 1994) had about the same productivity as colonies where mink predation was not detected. Thus, in all three years, there was a very close association between mink predation and total breeding failure. In general, and excluding colonies at which mink were killed, a majority of colonies and a majority of pairs lost all offspring as a result of predation by mink.

If it is assumed that, in the absence of mink predation, the whole study population of each species would have had the productivity seen in the same year at those colonies where mink predation was not detected, simple proportion gives the percentage by which the total numbers fledged in the study area were reduced by mink. In 1992, 1993 and 1994, these percentage reductions were: black-headed gull 66, 89, 51%; common gull 55-62, 84-86, 72-75%; common tern 16-21, 33-58, 17-72%; arctic tern 64-67, 86-87, 44-48%. (The two figures respectively exclude and include in the calculation those colonies at which mink were killed; when included, it is assumed that mink would not have been killed and that the colonies would have fledged no young.) The relatively low figures for common terns arise from the existence in the study area of a 200-300 pr offshore colony which was unaffected by mink, at least until late in each year. After one or more years of mink-related whole-colony breeding failures, colony sites are abandoned and birds tend to move to mink-free breeding sites. This has had two notable effects on seabird populations:

- (1) A small number of larger-than-usual colonies has formed in the diminishing mink-free areas.
- (2) As numerous sites of small colonies have been abandoned, entire areas, such as sealochs, archipelagos and firths, have become devoid of breeding seabirds.

While the primary effect of mink on larids, shags *Phalacrocorax aristotelis* and mute swans *Cygnus olor* in the study area has been to produce widespread annual breeding failures, mink prey in a different manner on another group of seabirds. This group includes eider *Somateria mollissima*, red-breasted merganser *Mergus serrator*, and black guillemot *Cephus grylle*. In this group, besides taking eggs and young, mink also kill considerable numbers of incubating adults. Razorbill *Alca torda* and puffin *Fratercula arctica* are not yet recorded in this group, probably because they breed farther offshore in the study area. Their colonies also tend to be larger, so that any effects of mink, which are solitary and territorial, may be correspondingly less. Although quantitative records of the effects of mink on this group of seabirds are fewer, examples can be given of mink causing striking adult mortality of black guillemots and permanent abandonment of their breeding sites.

It is believed that mink are having more measurable effects on seabird numbers and distribution than all the oilspills of the last few decades, yet they attract much less media attention. The effects of mink include massive surplus killing, widespread annual whole-colony breeding failures, colony site abandonment, population movements, decline in numbers, and local extinctions of breeding terns, gulls and other seabirds.

## **Gull populations on Great Saltee Island: 1979 - 1994**

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Great Saltee Island, Co. Wexford, is one of the most important and well censused seabird colonies in Ireland. Detailed results from elsewhere have shown major changes in the status of *Larus* gulls

in Ireland over the past decade. This study, aimed at a detailed census of herring, lesser black-backed and great black-backed gulls on Great Saltee Island in May 1994. The results show a marked decline since 1980 in herring and great black-backed gull population sizes, but the number of lesser black-backed gulls have increased. Continuing investigations are examining the causes of the declines and increases.

### **Dead or alive, night or day: how do albatrosses catch squid?**

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For many albatross species squid are important prey. Whether albatrosses depend on scavenging (e.g. of vomit from cetaceans, post-spawning die-offs or fishery waste) or on live-capture of squid (e.g. via diel vertical migrations in association with aggregations of squid prey) is controversial. We review the nature of interactions between squid and the four species of albatross breeding at South Georgia using data on the foraging range, methods and timing of feeding of albatrosses in relation to the size, distribution, buoyancy characteristics (floaters or sinkers), bioluminescence and prey of the squid and access to fishery waste. We conclude that most evidence for scavenging needs critical re-evaluation; nevertheless, whereas wandering albatrosses and possibly light-mantled sooty albatrosses probably depend significantly on scavenged squid, black-browed and especially grey-headed albatrosses are unlikely to do so.

### **A long-term study of black guillemots in northern Alaska**

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A population of black guillemots was increased from ten pairs to 1972 to more than 200 pairs in the early 1980s through the provision of manmade nest sites. Banding of all young from 1975 to the present has shown cohorts typically return to their natal colony at three years of age. Age at first breeding and the percentage of returnees recruited is dependent on the availability of nest sites when a cohort returns to the colony. Cohorts reaching three years of age when vacant sites were present had an average age of first breeding of 3.6 years and 86% of returnees recruited compared with 5.2 years and 35% for cohorts returning to a colony with no vacant nest sites.

The growth and maintenance of the colony have been dependent on immigration with Cooper Island cohorts making up less than 20% of the recruits from 1983 to 1989. Only since 1990 when the population began to declining have native birds made up more than 50% of recruitment. Survival of breeding birds has averaged 85% but has declined in recent years being only 70% in 1993. Because a compensating increase in recruitment has not occurred, the population decreased to 150 pairs in 1994. Males may be experiencing a higher mortality rate. In 1993 and 1994 some widowed females were unable to attract mates and one male was paired with females at adjacent nest-sites. The increase in mortality of breeding birds has allowed essentially all of the non-breeders associated with the colony to obtain nest sites. A female banded in 1983 obtained her first nest site in 1993 at a minimum of twelve years of age.

### **Seabird distribution off north-west Europe**

## European Seabirds at Sea co-ordination Group

c/o Joint Nature Conservation Committee, 17 Rubislaw Terrace, Aberdeen, AB1 1XE, Scotland

A number of organisations in the U.K., Norway, Sweden, Denmark, Germany, The Netherlands and Belgium began comprehensive studies of seabird distribution in offshore waters in the late 1970s or 1980s. In 1991, with funding from the UK Department of the Environment, as part of its contribution to the North Sea Task Force, all available data were bought together to produce a common database, the European Seabirds at Sea (ESAS) database. Examples are shown of distribution patterns of seabirds in the North Sea, including guillemot (breeding and non-breeding season), little auk and divers (winter), lesser black-backed gull and sandwich tern (summer). Information collected in a standard effort-related fashion on cetaceans is also available, and is illustrated with white-beaked dolphin. An atlas will be published in summer 1995 using data from ESAS: Stone, C.J., A. Webb, C. Barton, N. Ratcliffe, C.J. Camphuysen, T.C. Reed, M.L. Tasker and M.W. Pienkowski 1995. *An atlas of seabird distribution in north-west European waters*. Joint Nature Conservation Committee, Peterborough. An electronic version will be available on the UKDMAP system.

## Murre hunting in West Greenland

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The subsistence hunting in Greenland puts a heavy toll on various populations of thick-billed murre *Uria lomvia* (Brünnich's guillemot). While some local populations are perfectly healthy (Thule), others have declined significantly (Upernavik) or even disappeared (Ummannaq), owing to the former (until 1988) practice of hunting in the breeding season. By far the largest numbers of birds are shot during the winter hunt (15 October - 15 March) in south-western Greenland (south of 69°N), where the most recent estimate (1988/89) implied a total harvest level of 175,000 - 370,000 birds, most of them first-year birds. Ring recoveries suggest that most of these birds are winter visitors from Spitsbergen. While the hunt for private consumption is hard to monitor, market sale in the towns provide an opportunity to evaluate seasonal and annual variation in commercial hunting. The market sale was monitored in Nuuk, the capital of Greenland, in 1988/89 and again in 1993/94 and 1994/95. In all years, the hunt peaked shortly after the wintering birds arrived in the archipelago in late October. In November, the daily average of birds for sale ranged from 315 to 447. In 1988/89, numbers gradually declined from November to March, but in 1993/94 the kill remained high at more than 250 birds daily until the hunting season ended. In the most recent season (1994/95) the hunt was much more concentrated in the autumn. Estimate overall sale on the market in Nuuk were 40,705, 51,069 and 45,579 birds in 1988/89, 1993/94 and 1994/95. Analysis of variance showed that there was some difference between years that depended on variation between months, but there seemed to be no upward or downward trend in the total hunt by professional hunters in Nuuk. Unless Nuuk is a special case, the professional hunters in West Greenland may still shoot nearly 100,000 birds annually as in 1988/89. Hunting regulations could in theory have affected private hunting patterns differently from that of the professional and it is unknown if the total winter hunt is still at the 1988/89 level of 175,000 - 370,000 birds.

Whereas by-catch of seabirds was a significant mortality factor in the 1970s when an international salmon fishing fleet operated in the offshore waters of West Greenland, the local small-scale coastal salmon fishery in that has taken place since 1976 probably has had very little impact on the

seabird populations. During the last two years Greenland fishermen have had no commercial salmon quota, and large-scale net-entanglement of seabirds is probably history in West Greenland.

## **The role of antarctic top predators in the carbon dioxide exchange of the Southern Ocean.**

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It has been suggested that carbon dioxide respired by antarctic top predators could return to the atmosphere 20-25% of the Southern Ocean's primary produced carbon, thus reducing the area's potential to act a sink for the excessive levels of the greenhouse gas CO<sub>2</sub> (Huntley *et al.* 1991. *Science* 253: 64-66).

During multidisciplinary cruises on board MV Polarstern in the western and eastern Weddell Sea, respiratory return of carbon never exceeded 2% of primary production, not even in areas with extremely high densities of birds, seals and whales. Extrapolation to the annual cycle in the whole southern ocean suggests an average respiratory carbon return of at most 0.3-0.6%. This figure is supported by other overall estimates for antarctic primary production and top predator populations.

It may be concluded that birds, seals and whales are insignificant in the Southern Ocean's capacity to absorb CO<sub>2</sub>. Important errors in Huntley *et al.*'s model could be that trophic interactions within model-boxes (e.g. squid eating fish) are largely ignored, and the assumption that the primary production is completely consumed by zooplankton and the microbial network.

High densities of top predators were consistently present in the sea-ice, contrasting with low apparent primary production. The discrepancy may be explained by considerable production by ice algae (not included in this study) and/or a highly efficient trophic network in the sea-ice because of a two-dimensional concentration of prey and predators on the underside of the ice. Future work will be focused on this sea-ice system, with particular attention to the potential risks of climate-induced changes in the extent or characteristics of the seasonal sea-ice cover. At its maximum, the sea-ice covers about 20 million km<sup>2</sup> of the Southern Ocean: changes in extent, ice-thickness, snow-cover, etc., could seriously affect the populations of top predators that depend on this environment.

## **Are industrial fisheries a threat to seabirds?**

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Many seabirds depend on small, shoaling, pelagic fish as food. These fish are generally short-lived, and abundant, and are often subject to industrial fisheries for production of high protein meal as an animal feed. Several fish stocks supporting industrial fisheries and seabirds have collapsed in recent years: capelin in the Barents Sea, herring in the Norwegian Sea, anchovies in Peru, sandeels at Shetland. Seabird populations have fallen in numbers and suffered breeding failures as a result. However, in no case is it clear that industrial fishing caused the collapse. Fisheries biologists suggest that since recruitment of industrial fish is generally independent of spawning stock biomass, industrial fisheries do not threaten stock size of seabird food supply.



In the North Sea the catch of the lesser sandeels *Ammodytes marinus* exceeds the mass of any other fish harvested, averaging around 800,000 tonnes per annum. Sandeels are the main lipid-rich food of most North Sea seabirds during the breeding season, and remain an important food of some seabirds, such as guillemots and shags, in winter. They are also a major food of large predatory fish (of high commercial value) and of many marine mammals. Thus they are pivotal in the ecosystem, but industrial catches are unregulated.

In this talk I consider how reasonable it is to claim that industrial fisheries do not affect seabirds, and what level of evidence would be required to provide a convincing scientific case for or against the sustainability of such a fishery alongside healthy seabird populations.

### **Mitochondrial DNA and ectoparasites indicate evolution through intergeneric hybridization within the family Stercorariidae (Aves)**

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Classical taxonomy divides the skua family Stercorariidae (Aves) into two genera. Mitochondrial cyt b and 12S rRNA gene sequences show skua taxa within the genus *Catharacta* to be closely similar but considerably diverged from *Stercorarius parasiticus* and *S. longicaudus*, a pattern consistent with classical taxonomy. However, near identity of sequences in *C. skua* and *S. pomarinus* suggests recent hybridisation between female *C. skua* and male *Stercorarius* in the evolution of *S. pomarinus*. The distributions among skua taxa of particular taxa of feather lice support the close evolutionary relationship between *S. pomarinus* and *C. skua*. This appears to be the first record of intergeneric hybridisation leading to the evolution of a new species, and supports the view that the clonal maternal inheritance of mtDNA can result in molecular phylogenies at variance with those based on nuclear genes.

### **Predation, kleptoparasitism and disturbance by yellow-legged herring gull on Audouin's gull in two western Mediterranean colonies**

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The rates of predation upon eggs and chicks, kleptoparasitism on courtship- and chick-feeding regurgitates, and of other disturbance by yellow-legged herring gulls on Audouin's gull, have been studied at both the Ebro Delta and Chafarinas Islands colonies at different stages of the Audouin's gull breeding season.

Responses to disturbance were grouped into three categories: alarm calls only, aggression responses to aerial intruders and aggression responses to terrestrial intruders. Two comparative

analyses of variation of these responses were undertaken. First, during four different periods of the day (periods of four hours from 6:00 a.m. to 9:00 p.m.), and second, during seven breeding stages: nuptial, egg-laying, incubation, egg-hatching, early nestling, late nestling and fledging phases.

Kleptoparasitism and predation rates recorded both in the Ebro Delta and the Chafarinas may be considered low when compared with other similar studies (Velarde 1992, Hario 1994), and it seems that the interactions did not represent a threat in either of the two colonies. In the Chafarinas Islands, the population of yellow-legged herring gulls has decreased since 1985 (from 5000 to 1500 breeding pairs), due to the cull of eggs and adults carried out there from 1987 to 1993. At the same time, the population of Audouin's gull has approximately doubled from 2000 to 4000 breeding pairs. The rates recorded in the Ebro Delta did not suggest a threat to the Audouin's gull colony, although the effects of low food availability brought about by the trawling moratorium (Oro in press) provoked a marked increase in predation rates, even on adult Audouin's gull (Oro & Martinez 1994).

The difference in the ratio of yellow-legged herring gulls to Audouin's gulls between the two colonies may explain the higher rates of interactions at the Chafarinas Islands. However, in both cases the studies were restricted to small parts of the colony which may not represent the whole colony. If the Chafarinas yellow-legged herring gull population increases, then there may be an increase in interactions with Audouin's gulls. Some yellow-legged herring gulls specialised as predators and although some predation rates are relatively large, the yellow-legged herring gull does not seem to constitute a threat to Audouin's gull population at its main breeding sites, at least at present population sizes.

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#### **The food of common terns *Sterna hirundo* in the Azores**

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Despite increased concern about numbers of terns in the Azores, there is a lack of knowledge of factors likely to affect their breeding success. Due to their particular sensitivity to changes in food availability and quality, the study of tern diet is very important in order to interpret and eventually predict fluctuations in population levels and therefore to ensure their effective conservation.

In 1994 we collected 779 pellets of common tern *Sterna hirundo* at colonies in the islands of Corvo (West group), Graciosa and S. Jorge (Central group) and Santa Maria (East group), in order to study their food preferences. The results showed that trumpetfish *Macroramphosus scolopax* was clearly the most common prey species (in terms of frequency of occurrence and number of

individuals), being present in about 90% of the pellets examined. On the Portuguese continental coast, this species showed strong fluctuations in its abundance during the last four years, with an apparent upward trend (F. Cardador, IPIMAR, pers.comm.), and so the values in the tern diet could reflect the same sort of stock behaviour in Azorean waters, but more data is needed. Boarfish *Capros aper* and blue-jack mackerel *Trachurus picturatus* were present in 28% and 22% of the pellets, respectively. All other fish species showed occurrence in less than 10% of the samples. Taken together, deep-water fish species (mainly Myctophids) were present in about 15% of the pellets analysed, a situation similar to that reported for yellow-legged herring gulls *Larus argentatus atlantis* in this archipelago (Hamer *et al.* 1994, *Seabird* 16: 30-33).

No major differences were detected between the groups of islands in terms of prey composition, but it is worth noting that Santa Maria (which is a particularly important site for common and roseate terns) showed the lowest prey diversity with trumpetfish present in 99% of the pellets and all other species with less than 10% of occurrence. This situation contrasts with observations from previous years where the diets included a greater variety of species (Monteiro, pers.obs.). Important annual variations in diet composition seem to have occurred at some sites, with a recent increase in the relative importance of trumpetfish (Monteiro, pers.obs.). Due to the strong fluctuations in the abundance of common terns' main prey item, it is suggested that the study of diets should be maintained and extended to the endangered roseate tern.

### **The distribution of pelicans in Greece: threats to their habitats and recommendations for protection**

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Dalmatian and great white pelicans were once widely distributed in Europe, but several colonies disappeared during the last century due to industrialisation, disturbance and pressures from human activities. Today, the Dalmatian pelican is classified as "vulnerable" on a global scale, while the great white pelican is protected in the Palaearctic. Greece is the only European Community state member where both species breed.

The distribution of the Dalmatian pelican covers thirteen wetlands (8 are Ramsar sites). It breeds at Lake Mikri Prespa and the Amvrakikos Gulf. During the nesting period, adults forage in the vicinity of the breeding colony or in nearby wetlands at maximum distance of 50 km (Lakes Kastoria and Chimaditis). The main migratory stop-overs and wintering sites are the Axios Delta, Lake Kerkini, the Keramoti lagoons, the Vistonis-Thracian lagoons-Ismaris complex, and the Evros delta in northern Greece, and the Kalamas river delta, the Amvrakikos gulf and the Messolongi lagoons in western Greece.

The great white pelican occurs in eight sites. It also breeds at Lake Mikri Prespa. During the breeding period adults forage in a variety of wetlands, at distances of 0-180 km from the colony. The species has the same migratory stop-overs as the Dalmatian pelican in northern Greece, but does not occur in western Greece. Great white pelicans do not winter in Greece.

Nineteen categories of threats have been identified in the habitats of the two pelican species, which either affect the birds directly or indirectly through habitat alterations. Of these, the most frequently occurring (in descending order of frequency) are: pollution, hunting, disturbance, water abstraction and dam construction, draining, improvement works in lagoons, electric cables, competition with fishermen (stock depletion of fishfarms and lagoons), illegal tree felling and dredging, road construction, fishing practices (causing disturbance and direct death by entanglement), water level fluctuation, permanent water level increase, river diversions, reed

management practices, grazing, reduction of protected areas, and industrial development. On the other hand, the sites which concentrate most of the above mentioned categories of threats, and are thus most threatened are (in descending order of importance): Lake Mikri Prespa and the Vistonis-Thracian lagoons-Ismaris complex, the Amvrakikos gulf, the Evros delta, Lake Kerkini and the Messolongi lagoons. The remaining wetlands face fewer threats, but not necessarily of minor importance.

The problem of pollution suggests the need for waste management schemes, regular monitoring of water quality, the education of farmers on prudent use of agrochemicals, while the promotion of organic farming in the peripheral zones is strongly recommended.

The supply of adequate equipment to local forestry services, the increase in number of wardens, stricter application of the law and education programs in schools concerning the value of wild birds could help to reduce this threat. Disturbance can be tackled by demarcation in the field of the sensitive areas, erection of signs and frequent wardening by the forestry services.

Management plans for existing water supplies and measures for water consumption control must be introduced for the abatement of water abstraction from wetlands. The impacts on downstream ecosystems should be considered before the construction of any new dam. The classification of Lake Chimaditis as Special Protection Area should impede drainage of this site. The replacement of hazardous electric power lines will eliminate this source of pelican mortality. Competition with fishermen could be tackled with proper financial measures.

Fisheries improvement works should be carefully designed and deepening of entire lagoons must be forbidden. Number of grazing animals should be adjusted to the carrying capacity of the sites. Road construction in regular pelican roosts must be cancelled. Water level fluctuation must be controlled and reed management practices carefully designed to avoid dire impacts on pelican breeding and roosting habitats.

### **The cost of egg production**

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Avian brood manipulation experiments have strongly influenced life history theories, particularly in relation to the evolution of clutch size. Lack suggested that clutch size is set by the number of young that parents can adequately provision. Brood enlargement has shown in many species that parents can apparently rear more young than the number of eggs that they lay; this is taken as empirical evidence that observed clutch sizes are less than the Lack value. However, such experiments have failed to include the full cost of an increased brood since they omit the process of egg production and generally at least some of the incubation costs. In this study conducted on common terns *Sterna hirundo* breeding on Coquet Island, Northumberland in 1994, we compare parents given an extra egg or chick with those that had to produce additional young themselves. We show for the first time a trade-off between producing and rearing extra eggs, the inclusion of egg production resulting in reduced chick provisioning, growth and survival.

### **Effects of oil spills on Shetland black guillemots *Cephus grylle***

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A total of 729 oiled Black Guillemots were found in Shetland in early 1979, following an oil spill at the Sullom Voe Terminal and spillages from unknown sources that mostly affected western coasts. The significance of this mortality was difficult to assess as there were few quantitative data on breeding numbers in Shetland. The Shetland Oil Terminal Environmental Advisory Group therefore commissioned Oxford University to devise a scheme for monitoring changes in breeding numbers of Black Guillemots both in Yell Sound, where the greatest concentration of oiled birds was found in 1979, and elsewhere in Shetland.

The scheme adopted involved periodic counts of adult birds during the pre-breeding period, when they congregate close to potential nest sites during the first few hours of daylight. Study sites chosen were the entire coastline of Yell Sound, to monitor changes after the 1979 spill and the consequences of any further spills at the Sullom Voe Terminal, and sample stretches of coastline distributed strategically around Shetland.

In view of their inshore, relatively sedentary habits, the location where an oiled black guillemot is found is likely to be a good indication of its breeding area. Changes in pre-breeding numbers were examined in relation to known instances of mortality from oil pollution, evidenced by temporal and geographic clusters of oiled black guillemots found on monthly beached bird surveys, and by organised searches of beaches following the Braer oil spill in January 1993.

Pre-breeding numbers in Yell Sound increased by 139% (9% per annum) between 1983 (537 counted) and 1993 (1,285) and by 18% between the most recent surveys (1991-1993). Increases during the mid-1980s at most study sites on the west and north-east coasts of Shetland may also have been related to losses from oil pollution in 1979. Since the monitoring scheme began, there were instances when local occurrences of oiled birds were followed by decreases in pre-breeding numbers at nearby study sites: in 1985 (5 oiled birds found, decreases at two sites of 11% and 14%), 1991 (22 found, decreases at three sites of 14-44%), and in 1993 following the *Braer* oil spill (203 found, decreases at four sites of 18-37%). In each case, these decreases were followed by increases in succeeding years, some only slight (6% p.a. was the minimum), but between 20-27% p.a. at four sites and 37% between 1993-94 at one site affected by the *Braer* oil spill. Possible factors allowing these relatively rapid increases after losses in oiling incidents are discussed.

### **Threats to cormorants from fisheries interests**

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As is now the case in several countries of the world, there is growing concern in Britain regarding the significance of impacts by cormorants on commercial fisheries, particularly in inland situations. Thus there is mounting pressure on the relevant authorities to exercise comprehensive control of the expanding cormorant population, with many anglers and fishery managers believing that a national control strategy is needed. Consequently the cormorant may soon become a threatened bird in Britain, especially in freshwater environments.

The available information on populations, distributions and impact by cormorants will be summarised in this paper. Overall the cormorant population is believed to be expanding slowly (<5% per annum), but there appears to have been a very steep increase in the numbers wintering inland, especially in southern England. The winter population is perhaps approaching 20,000

individuals. This overall increase, and the fact that there are approximately 600 nests at inland colonies, means that cormorants are more visible to anglers and fishery managers, providing the fuel for conflict. The evidence for significant impact by cormorants on fisheries is scant and, whilst predation levels may be significant in a few localities, it has yet to be demonstrated that the losses to fisheries are serious overall.

New information on the breeding status of cormorants in Wales will be presented, as well as the results from a major assessment of cormorant occupancy and impact at stillwater game fisheries in England and Wales. The Welsh survey produced a total of 2,291 nests in 20 colonies in 1994; roughly the same number of colonies as in 1969 and 1985 but the number of nests has increased by about 60% over the past 25 years. The survey of inland game fisheries, though limited because it was questionnaire-based, revealed sharp increases in the use of such habitat and, not surprisingly, there was widespread concern from fishery managers at these sites. However, despite this, there was no apparent relationship between cormorant density and anglers' catches of rainbow trout, the principal stock fish, though there may have been localised damage. The usefulness of these studies will be highlighted and a strategy to ensure that the cormorant is not condemned before being tried will be proposed.

## Important seabird foraging areas in Svalbard and northern Barents Sea waters

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The Brünnich's guillemot *Uria lomvia* constitutes a major component of the seabird community in the waters surrounding the high-arctic archipelago of Svalbard, with about 1.3 million individuals occupying breeding colonies. The largest breeding colonies are located in the south-eastern parts of the archipelago, and nearly half of the breeding population is in the Storfjorden area. The two main seabird colonies in Storfjorden are Stellingfjellet and the adjacent Kovalskifjellet, where recently the number of Brünnich's guillemots were estimated at 450,000 and 90,000 individuals respectively. Other major colonies of this species are located at Bear and Hopen Islands, each comprising about 175,000 individuals. Common guillemots *Uria aalge* are abundant on Bear Island.

During the breeding season, guillemots in these colonies have a high food demand, both for feeding themselves and provisioning their chicks. Brünnich's guillemots almost feed their nestlings exclusively with fish, while the adult diet may include a large proportion of crustaceans. Seabirds are not uniformly distributed at sea, but they tend to be aggregated in areas where they are actively feeding. Aggregations of the prey taken by seabirds are often associated with physical structures in the marine environment, which are governed by factors such as bathymetry, water masses and mixing regimes, physical oceanographic gradients, and in polar regions also sea ice. In the northern Barents Sea one of the most pronounced oceanographic features is the frontal region between the warm North Atlantic Current coming from the southwest and meeting the cold Arctic water coming from the northeast. In this study, evidence is sought for physical processes or features in the ocean that might enhance the concentration or availability of prey to guillemots in a predictable way.

Around Bear Island several radial ship-based transects showed an enhanced number of foraging guillemots in association with the frontal region between the well mixed cold water close to the island and the stratified Atlantic water further offshore. Diet analysis showed that they were mainly taking krill *Thysanoessa inermis* at the front.

Ship-based surveys in Storfjorden showed foraging Brünnich's guillemots were concentrated on the west side of the fjord and in the vicinity of the colonies. The largest concentrations of guillemots were over relatively deep water. Guillemots did not forage commonly in the inshore, coastal water, but passed over it. Concentrations of foraging guillemots were in the vicinity of a weak subsurface front where Atlantic water met cold, saline arctic water. However, correlations between the numbers of foraging guillemots and frontal areas in the study area were not strong. Nevertheless, acoustic biomass was correlated with the strength of subsurface horizontal temperature gradients and it is hypothesised that these accumulations of biomass may have been responsible for the correlation between guillemot numbers and the strength of the subsurface fronts. The distribution of Atlantic and arctic water in the Storfjorden region is governed by the bathymetry, and it is concluded that foraging guillemots often aggregate at frontal regions generated by strong bathymetric gradients in Storfjorden and around Bear Island.

## **Threats to seabirds in Alaska**

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Alaska has approximately 50 million breeding seabirds at 1,600 colonies. Most of the state's coastline is very remote, being inaccessible by road or fixed-wing aircraft. Nevertheless, economic developments have had major impacts on seabird populations. Foxes *Alopex lagopus* and *V. vulpes* were introduced by fur farmers to the Aleutian Islands and islands of the Gulf of Alaska starting in the 1880s and seabird populations on many islands were severely reduced. Local populations of several species are recovering following natural die-offs and the removal of foxes. The threat of rat *Rattus norvegicus* introductions to seabird islands is increasing especially on the Pribilof Islands where new fishing ports are being developed. Commercial fisheries may have affected populations in all regions south of the Bering Strait through mortality in fishing gear, discharges of offal and changes in populations of prey fish. Populations of several seabird species have declined in the Bering Sea during the past 20 years. However, the relative influences of overfishing and climate change on forage fish populations are not certain. Logging is reducing habitat for marbled murrelets *Brachyramphus marmoratus*. Oil and fuel spills are a potential threat to local populations throughout the state. Subsistence harvest of seabirds is pursued less than in former times but is still important in the diets and cultural networks of coastal villages. Subsistence harvest probably has little impact on populations.

## **Threats to seabirds: potential versus actual**

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In this paper, I shall discuss what we mean by "threat to seabirds", how we identify and quantify "threats", and how the effects of, and responses to, the same situation differ between species. In this context, I shall discuss the effects of two major environmental perturbations on seabirds breeding in Shetland in recent years, i.e. the extreme changes in sandeel abundance and population structure in the late 1980s and early 1990s, and the wreck of the tanker *Braer* in 1993. The effects on the reproductive and foraging performance of shags, guillemots, kittiwakes and arctic terns will be examined, based on a combination of colony-based observations and radio tracking of foraging birds at sea. The data will be considered in relation to a detailed study of sandeels carried out by the Scottish Office Agriculture and Fisheries Department and others in conjunction with this study; this provided an independent measure of the abundance, distribution and age-structure of the sandeel population in the area where the birds were foraging, and the extent to which the fish had been affected by the oil spill. In terms of annual reproductive success, the surface feeding seabirds were the most affected by the food shortage, while the diving species continued to produce young. However, changes in the foraging behaviour of the latter species in response to poor food supply were very marked. The effect of the 1993 oil spill was most marked in the kittiwake, with a high degree of non-breeding, and breeding birds showing a significant haemolytic anaemia. However, the foraging performance and breeding success of all four species was very good. The extent to which such environmental perturbations do represent a "threat" and the susceptibility of different species will be discussed.

## **The Madeiran storm petrel *Oceanodroma castro* in the Azores: a case of annual breeding with two morphometrically and temporally distinct populations**



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The breeding of the Madeiran storm petrel was firstly confirmed for the Azores and recorded in three small offshore islets: Ilhéus da Vila (off Santa Maria), and Baixo and Praia (off Graciosa). Following extensive field work comprising monthly visits to the former colonies, some aspects of the breeding biology of the Madeiran storm petrel were elucidated.

Birds return to breeding grounds on islets off Graciosa by the end of March but on St. Maria they were absent until early August. Two populations temporally separated by about four and half months (spring and autumn) and morphometrically distinct, breed annually on Graciosa, apparently without significant interchange of individuals. The estimated laying, hatching and fledging dates are 19 May, 30 June and 8 September for the spring population and 1 October, 11 November and 28 January for the autumn population.

Adults breeding in spring are significantly smaller than birds of autumn (nape, culmen, nostrils, gonys, tarsus and weight) and lay significantly smaller eggs. Oddly, the tail is significantly longer in spring breeders than in autumn breeders and also the wing length (which did not differ significantly between populations) is proportionally longer in spring breeders.

The morphological differences found between adults at different seasons could potentially give rise to separate forms of the same species. The evolutionary aspects of this rare breeding strategy among colonial nesting seabirds are discussed.

### **Mercury concentrations in seabirds from colonies in the Portuguese Atlantic**

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We studied mercury concentrations in adult breast feathers, down of hatchlings and eggs of seabirds from colonies covering a wide geographical sector of the temperate to subtropical north-east Atlantic. Species and monitoring units were selected to ensure varied levels of spatial (pelagic vs. coastal), vertical (pelagic vs. mesopelagic) and temporal (long-term vs. short-term) integration of mercury within marine ecosystems.

Mercury concentrations were markedly higher in the petrels (feeding on mesopelagic fish) than in the shearwaters (feeding on pelagic fish), reflecting an enhanced bioavailability of mercury in mesopelagic waters. Overall mercury concentrations in tissues of pelagic and coastal seabirds showed a remarkable general homogeneity, suggesting an even distribution of mercury contamination in the marine ecosystems of the study area, from the coastal south-west Europe to the remote middle of the North Atlantic. The poor current knowledge on the diets of Portuguese Atlantic seabirds prevents a full explanation of some particular observed inter-colony differences in mercury concentrations at this time.

Mercury levels observed in this study were in close agreement with levels reported for seabird populations of the same or related species elsewhere in the Atlantic. This provides evidence of global pollution by mercury.

## **Conservation of seabird populations in the Portuguese Atlantic**

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The mainland of Portugal and the archipelagos of Azores, Madeira and Salvages (henceforth designated as Portuguese Atlantic) comprise a wide oceanic area in the temperate and sub-tropical sector of the North-east Atlantic (30°-39°N, 8°-31°W). Fifteen seabird species breed regularly in this region and these include petrels and storm-petrels (5 species), shearwaters (3 species), terns (3 species), gulls (2 species), shags and guillemots.

The Portuguese Atlantic represents a transition between boreal, temperate and tropical oceanic areas and so it is the southern breeding limit for species of predominant boreal distribution (guillemots and lesser black-backed gulls) and the northern breeding limit for predominantly tropical and sub-tropical species (Bulwer's petrel, Madeiran and white-faced storm-petrels).

Thirteen species breeding in the area were designated as Species of European Conservation Concern (Categories 1-4; Tucker and Heath 1994, *BirdLife Conservation Series* No.3). Of these, nine species were considered to have an Unfavorable Conservation Status (Categories 1-3), and the Portuguese Atlantic hold more than 50% of their European populations. The most important are (in brackets: proportion of the European population; main breeding area): Fae's petrel (100%; Madeira), Madeira's petrel (100%; Madeira), Bulwer's petrel (86%; Madeira), Cory's shearwater (55% Azores), little shearwater (80%; Madeira), white-faced storm-petrel (99%; Salvages), Madeiran storm-petrel (93%, Azores and Madeira) and roseate tern (60%; Azores).

Most seabird populations, especially those of islands, were reduced dramatically since the 16th century by human exploitation, predation by introduced mammals and habitat modification. Most probably main islands were important breeding sites in the past but nowadays the main colonies are located on islets or small and less accessible islands.

Current threats are diverse and affect the various species differently. Alien mammalian predators (rats, mustelids, cats and dogs) have a very detrimental effect on the populations of petrels and storm-petrels. Habitat loss due to overgrazing by introduced herbivores (goats and rabbits) affects some important seabird colonies. Human disturbance is a major problem, resulting in low productivity in several colonies of seabirds including endangered species such as roseate terns. Human exploitation of Cory's shearwater adults and chicks occurs in some colonies of the Azores and to a lesser extent in Madeira. Predation of small petrels by gulls may become important due to the increase in gull populations in the area.

Virtually all important seabird colonies in the Portuguese Atlantic are included in the National Classified Areas Network as Nature Reserves or Parks and/or SPAs under EC Directive 79/409. It is important to continue monitoring the breeding populations, to obtain data on productivity and to

assess the importance of the various threats to seabirds. For effective conservation of seabirds in the Portuguese Atlantic much conservation action is needed apart from legal protection of the sites. Management plans are required for virtually all sites. The effective wardening ongoing on Flores and Terceira (Azores), Desertas and Salvages (Madeira) and Berlenga (mainland) should be extended to other important seabird sites and complemented with predator control and intensive educational work. Large scale gull culling program has started on Berlenga and smaller control actions are ongoing in Madeira. Rats and rabbits should be eradicated from offshore islets of Madeira and Azores. Conservation projects under the EU's LIFE Programme are currently beginning to implement these actions in the Azores and Madeira.

### **Preliminary evaluation of the first yellow-legged herring gull *Larus cachinnans* population control at Berlenga Island, Portugal**

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The Berlenga Island Nature Reserve (Berlenga Archipelago), located 5.7 miles off the Portuguese west coast, is the main breeding colony of yellow-legged herring gulls in Portugal. The gull's numbers in this colony, together with those on the Spanish islands of Cies and Sisargas, constitute 55% of the total Iberian population. Since the 1970s, the Berlenga Island yellow-legged herring gull population has increased at an exponential rate (from 2500 adult gulls counted in 1974 to 44698 in 1994). This increase is probably associated with man's activities in creating refuse dumps on the mainland to serve expansion in tourism activities and in discarding fish at sea and in ports in the area.

Excessive gull droppings on the island has led to part of the endemic and indigenous flora being replaced by nitrophylic species. Two lacertid species, including an endemic subspecies are also depredated by gulls and are declining.

In May 1994, the Portuguese Institute for Nature Conservation and the Berlenga Nature Reserve started a gull control program. DRC-1339, a specific non-polluting avicide was used to cull the gulls. This avicide mixed with margarine was spread in small bread baits that were put on the nests. Forty-eight hours after baiting, carcasses were picked up. Two baitings, 5 days apart, were carried out to avoid changes in the sex ratio of the population. Bait acceptance rates were high.

Due to storms that occurred shortly after both baitings, an unknown number of gulls died in the sea. Consequently, from 17738 nests baited only 6976 carcasses were retrieved. We estimate that a greater number of gulls was culled. First results will be presented based on recent census. The culling program will continue for three or four more years. The main goal is to reduce population numbers to the 1974 level.

### **Seabirds and salmon nets in Scotland and Northern Ireland in 1992**

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Salmon fishing in Scotland and Northern Ireland has a long history, but only with the invention of the bag net in 1827, did an intensive sea fishery develop. This in turn brought about close regulation of the industry, which has prevailed since, e.g. bag nets are permitted in both countries, but stake and jumper nets only in Scotland.

Bag nets float at all stages of the tide, but stake and jumper nets dry out at low tide. All work on the principle of guiding fish into a trap set at the end of a leader arm, projecting seawards at 90° to the shore.

The number of stake nets in use has fallen from 270 in July 1894 (Archer 1895) to a maximum of 17 in 1992. Jumper nets were not in use in 1894. A maximum of 49 were found in 1992. Anecdotal evidence (M. Marquiss pers. comm.) supports the 1992 results that incidental bird captures in these nets are low to negligible, and have no impact on regional bird populations.

Bag net numbers in Scotland have also fallen. A minimum of 1174 were found in 1894, compared with 146 for the same area in 1992 (Berwick on Tweed to Cape Wrath). For Northern Ireland there are no historically equivalent figures, but no more than 15 nets have been fished in any year between 1980 and 1992 (Anon 1993).

Bag nets have long been known to entangle birds, but this is poorly documented (Harvie Brown 1895, Sim 1903). Not until the 1970s were efforts made to assess the impact of these nets (Bibby 1971, Melville 1973). Of the fisheries then identified as killing large numbers of auks, all were in Scotland. Of these, only Cruden Bay remains in operation (Bourne 1989) and became the focus of the 1992 study.

Fishermen here and at five other net stations co-operated with the RSPB to assess the impact of net deaths on the auk population of north east Scotland (Kincardine to Caithness). The total number of auks drowned was estimated to be around 2400 (1700 guillemots, 700 razorbills), losses that are relatively small compared to the total number of auks present in the area (Lloyd *et al.* 1991). Losses of breeding birds were estimated to represent <0.5% of the breeding population of the two species and c0.6% of sexually immature guillemots. Similar calculations, for Cruden Bay only indicate that about 1.2% of breeding auks and 6% of sexually immature guillemots were drowned (Murray *et al.* 1994). Auk colonies in the region increased between 1969 and the late 1980s (Lloyd *et al.* 1991). In the same period net stations closed down and overall netting effort declined by 51% (Anon 1991). This suggests that current levels of netting deaths are not exerting a major deleterious effect on the survival of guillemots and razorbills in north east Scotland.

Evidence gathered in 1992 suggests that chronic bird kills take place at all bag net sites in Scotland and Northern Ireland. Regrettable though these deaths are, the majority of nets catch few birds over a season, and do not pose a threat to any marine bird populations.

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## **Seabirds of the east coast of the USA: status, trends and threats**

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The east coast of the USA is low-lying, with extensive barrier beaches, no cliffs, and few small islands except in the Gulf of Maine. Breeding seabirds include about 500,000 pairs of 23 species, mostly gulls, terns and cormorants. Several million seabirds of 61 species visit inshore or shelf waters in non-breeding seasons. These include large numbers of shearwaters and storm petrels from the southern hemisphere, phalaropes from the Arctic and gulls from the Great Lakes. In addition, several million divers, grebes and seaduck winter off the coast. Most of the breeding species are increasing; only three breeders and two non-breeders are thought to be decreasing. Many of the increases are long-term recoveries from human depredation in the nineteenth century, and/or recoveries from the effects of toxic chemicals or other adverse factors in the 1960s. The decreases do not follow a common pattern. The most important long-term threat is probably global climatic change. The most important current threats are intensive human development and use of the coast, including promotion of gulls and other predatory species. Oil and man's fisheries are probably less important as threats to seabirds than in other areas; the net effects of fishing activities are probably positive. Threats to seabirds are mitigated by intensive management, especially focused on terns and pelicans.

## **Some aspects of the reproductive biology of the Bulwer's petrel *Bulweria bulwerii* on Desertas**

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We have studied the reproductive chronology, sex-related difference, morphological development and the factors that determine the overall reproductive success of Bulwer's petrels on Desertas in the Madeiran archipelago.

The study started on 26 April 1994. It was based on diurnal and/or nocturnal visits to marked nests situated on two areas (0.42 ind./m<sup>2</sup>, 0.021 ind./m<sup>2</sup> and 0.11 ind./m<sup>2</sup> in the control area). All birds were ringed and some biometric measures taken. Sexing was based on multivariate analysis and Mougins' index.

By the end of April the adults had already arrived. On 7 May ( $\pm 8.2$ ) they left the island for  $30.5 \pm 11.3$  days. The laying phase lasted 19 days and occurred on 5 June ( $\pm 5.1$  days). Both sexes shared the incubation period ( $45 \pm 2.5$  days) divided in well defined spells. Hatching occurred on 20 July ( $\pm 4.4$  days) and continued for 15 days. The guard-phase attendance decreased from 96.7% of the nests on the first day to 46.7% and 40.0% on the second and third days (n=30). The juveniles fledged on 19 September ( $\pm 4.9$  days),  $60.4 \pm 3.6$  days after hatching and three weeks after their parents had left. The overall success was 73.9%, the hatching success was 96.5% and the

fledging success was 86.0%(n=221). Loss during incubation was due mostly to egg abandonment (68.2%), to non viable eggs (13.6%) and to the existence of two eggs from two females on the same nest (13.6%) (n=22). Some juveniles died during the first two days due to lack of parental care, others on the fifth week after their parents left and some were also found predated by gulls *Larus argentatus atlantis* near the nest entrance (n=12). Results suggest that the Bulwer's petrel on Desertas does not seem to be endangered, although gull predation may become a problem in future.

### **Population size, breeding chronology, annual cycle and effects of inter-specific competition on the reproductive success of little shearwater *Puffinus assimilis baroli* in Selvagem Grande**

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Our study took place in the island of Selvagem Grande (32°01'N). Field work was carried out between January 1994 and January 1995, with the aim of a) identifying the breeding areas and estimating the population of little shearwater; b). studying reproductive chronology and success; c) studying the effects of inter-specific competition on reproductive success; d) studying breeding adults behaviour outside the breeding period.

Breeding density was assessed from 18 quadrats of 100m<sup>2</sup>, where an intensive search for nests was carried out. Distributed in different areas of suitable habitat, potential nest were marked (147 burrows). To check inter-species competition effects we followed nests that in previous years have been occupied by Bulwer's petrel, *Bulweria bulwerii*, (43 nests).

We calculated the breeding population of between 2050 and 4900 pairs, and expect real figure to lie towards the lower limit of this range as the quadrats were mostly placed in "good areas" that might not represent the whole breeding area.

Laying occurred between 18 January and 14 February, with peak on 20 January. Incubation lasted an average of 48.1 days (95% confidence limits: 46.3 and 50.0), and the last hatching date was 22 April. The average fledging period was of 56.8 days (95% confidence limits: 55.0 and 58.6), and the last juvenile left the nest on 5 July. The breeding success was 59%.

Competition with Bulwer's petrels for nest sites did not cause any failures. However, Cory's shearwaters *Calonectris diomedea*, looking for a place to nest, were responsible for 32% of the failures.

Outside the breeding season the adults returned to their nests regularly or, at least to their vicinity. The presence of "intruders" in the nests was common throughout the non-breeding period (July-December) but this did not cause any territorial fights.

Three major conclusions can be drawn from the study: 1. The confirmation of Selvagem Grande as a key site for this species; 2. That the extremely large colony of Cory's shearwaters in Selvagem Grande may be a limiting factor in the increase of *P. assimilis* population. On the other hand, and because of their nesting areas do not fully overlap, this does not represent a major threat; 3. That *P. assimilis* are present all year through in their breeding grounds. This can not be considered a "protogamic behaviour" as defined by Jouanin (1964) in one of the few papers ever written about this colony. Further research will be carried out.

Jouanin, C. (1964) Le comportement en juillet des petit puffins, *Puffinus assimilis baroli* (Bonaparte) de L'Ile Selvagem Grande. *Boletim do Museu Municipal do Funchai*, No XVII, pp. 140-157.

### **The effects of trawl moratorium on some breeding parameters of Audouin's gull *Larus audouinii* in the Ebro Delta, NE Spain**

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The influence of food supply on the breeding ecology of Audouin's gull was analysed in the Ebro Delta, NE Spain. The trawl fleet provides large amounts of discards for many seabirds in the area, but a fishing moratorium established in 1991, coinciding with the gull breeding seasons affected food availability. During 1992 the moratorium overlapped with the laying stage, while during 1993 it overlapped with the chick rearing stage. Laying intervals, hatching success, breeding success, fledging success and chick growth were compared between these years.

**Laying interval:** All the parameters related to egg production showed that in 1992 energetic constraints occurred during egg formation. In this year it was plain that females had difficulty in acquiring the energy necessary for egg formation. This low food availability greatly affected clutch size and egg volume, laying intervals decreased only slightly and differences were not significant. Our results suggest that food availability is not a proximate mechanism for the decrease in Audouin's gull laying interval, in contrast to the hypothesis of Lack (1968) who correlated food supply with typical bird laying interval.

**Hatching success:** This decreased significantly during 1992, probably related to changes in the egg size, incubating attendance or increase in predation (Hébert & Barclay 1988, Oro & Martínez 1994). Nest desertion during laying was also much higher in 1992, probably because many females were below a critical fitness threshold (Monaghan *et al.* 1992), and some of them deserted after laying the first egg.

**Chick growth, breeding and fledging success:** In 1993, chick survival decreased after the start of the moratorium, although fledging success was not significantly different from those recorded in 1992. This might indicate that the gulls were able to compensate partly for the reduction in food availability during the chick rearing stage (Monaghan *et al.* 1994). First, the condition and weight of chicks were significantly higher in 1993, possibly because eggs were much larger that year, and showed greater survivorship (Bolton 1991). Second, the moratorium in 1993 did not start until chicks were one week old, probably increasing their subsequent survival that year (Bolton 1991). Indeed, the chick survivorship during 1993 until the moratorium started was higher than in 1992. Finally, gulls might mitigate the lack of trawl discards by increasing night-time activity, increasing the foraging range to beyond the areacovered by the moratorium, replacing discards with food from the rice fields (Ruiz *et al.* in press), or diversifying their foraging strategies (showing both inter- and intra-specific kleptoparasitic behaviour)(Oro in press). Thus, during 1993 chick rearing stage, gulls probably worked close to the maximum tolerable physiological level (Reid 1987), although they were not able to compensate for the short food supply.

Audouin's gulls chicks from large eggs (in 1993) were heavier for their skeletal size than those from smaller eggs (in 1992). However, the start of the moratorium after chick hatching in 1993 brought about a decrease in both growth rates and survivorship, counteracting, but only partly, the

advantages of being heavier (Monaghan *et al.* 1989, Bolton 1991, Uttley *et al.* 1994). Indeed, chicks of the same age in 1992 were not significantly heavier than those in 1993, and fledging condition was higher in 1992, although differences between years were again not significant. Chick condition through the growing period was also higher in 1992, as was the rate of increase in chick weight, but growth rates were not significantly different between the years. At present, it is not possible to tell if the difference in fledging condition between the two years will affect future survivorship (Mills 1989).

Results showed that during chick rearing, Audouin's gulls can compensate for the effects of low food availability through changes in diet, increasing the foraging range or diversifying foraging strategy. It seems that the species can increase reproductive effort after hatching, whereas during the laying stage, the gulls had some constraints which limited their capacity to compensate for food shortages.

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## The effects of fishing activities on the diet of Audouin's gull *Larus audouinii* in the Ebro Delta, NE Spain

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The diet of Audouin's gull was analysed in relation to fishing activity in the Ebro Delta, NE Spain, during 1993 and 1994. Samples were collected under four different fishing regimes: when only nocturnal fishing activity occurred, when both nocturnal and diurnal activity occurred, when only diurnal trawls operated, and when no fishing activity occurred. Diets differed significantly at both taxonomic and typological levels, although clupeiforms (especially sardines *Sardina pilchardus*) represented the most frequently consumed prey under all regimes. This finding emphasised the ecological dependence of Audouin's gulls on clupeids. This dependence was even more marked in our study most gulls breeding during 1993 and 1994 were in areas where only night fisheries operated. More than 70% (by weight) of the diet is clupeid under night fishing conditions. It was possible to analyse the diet when no fishing activity occurred. This showed the ability of this species to catch clupeids and confirmed that Audouin's gull is a specialised nocturnal marine predator (Ruiz *et al.* in press). These results, compared with those obtained when only night fishing occurred, showed also that Audouin's gull scavenge at fisheries by night as consumption of clupeids increases (Beaubrun 1983, Oro & Martinez 1994, Oro in press).

A daytime trawling moratorium established in 1991 greatly affected the breeding ecology of Audouin's gulls at the Ebro Delta colony, decreasing many reproductive parameters and output (Oro & Martinez 1992). Exploitation of the night-time fishery was insufficient to compensate for loss of the daytime food source. The night fishery specialised on catching sardines (and discarded little) while the daytime fleet concentrated on catching anchovies *Engraulis encrasicolus* and generated large amounts of discards, most of them sardines. Benthic and mesopelagic items formed much of the diet of the gulls when daytime trawling occurred, and derived from discards. During the daytime trawling moratorium, the gulls fed to a greater than usual degree in rice fields, in dunes and on rubbish tips. The Ebro Delta colony, containing more than 60% of the total world population, is threatened if the moratorium on daytime trawling is continued for many years, as is currently being negotiated.

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## **An analysis of biometrics taken from guillemot victims of oil pollution in south-west England**

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Carcasses of oil contaminated guillemots, collected since 1981 from annual incidents of chronic oil pollution, have been examined and a series of biometrics and other morphological data recorded. The carcasses originated from birds stranded in south west England largely on the south Devon and north Cornwall coasts. They have in most cases been stored in deep freeze until opportunity allowed examination to take place. Some carcasses were examined in a fresh condition.

The biometrics recorded were in accordance with the recommended procedure laid down in "The examination of birds killed in oil spill and other incidents - a manual of suggested procedure". (Jones *et al.* 1991).

During the first two years or so of the period of times these examinations have been carried out, 1981 to 1993, other morphological criteria have been included, these were:-

- a) A classification of plumage shades recorded by comparison with a base set of dried wings, ranging from "*hyperborea*" birds (classed as 8) to "*albionis*" birds (classed as 3).
- b) A classification of face patterns of guillemots in winter plumage, evaluated from a reference chart showing a variation of face and nape markings. The reference chart was compiled from a study of some 130 photographed birds.
- c) The inclusion of a head + bill measurement.
- d) The condition of the oviduct in female birds recording whether it was distended or not indicating a post breeding age.
- e) The presence of a supra orbital eye ridge, a bony protrusion extending over the eyes. This feature is evident in young guillemots and may be determined by feel in both dead and living birds.

It was considered this added criteria might help in establishing age and distribution.

In total some 700 data sets have been recorded during the period of this study, this includes some 197 sets of external only data taken from live birds during their treatment time at the R.S.P.C.A. Oiled Seabird Cleansing Unit in Plymouth.

All data sets have been entered into a computer data base and have been analysed to test the distribution of the data and the variations between various parameters.

## **Are chorio-allantoic membranes reliable predictors of egg organochlorine burden in Audouin's gull *Larus audouinii***

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The distribution of organochlorine pollutants between yolks, embryos, and chorio-allantoic membranes (CAMs) in eleven pipping eggs of Audouin's gulls from the Ebro Delta, has been determined to assess the usefulness of CAMs as surrogates for predicting whole egg pollutant burdens. The reliability of predictions was checked using a concordance analysis based on four different parameters. The most abundant pollutants found were PCBs and DDTs, while levels of HCHs were much lower. Generally, the largest concentrations of contaminants were found in yolk sacs, followed by embryos and CAMs. The latter contained only 1.21% of the total concentration of organochlorines detected. Results show that CAMs could provide plausible predictions only for those pollutants being almost completely excreted to CAM, for example, HCHs, PCB52 and DDD. In the other organochlorines tested, the prediction obtained is too weak to recommend the use of CAMs for the estimation of their total burdens in eggs of Audouin's gulls. This suggests that reliability of CAMs as surrogates should be tested for each compound and species, prior to their incorporation into non lethal monitoring programs for endangered birds.

## **On the current status of Audouin's gull *Larus audouinii* in the Mediterranean**

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A review of the status of Audouin's gull in the Mediterranean Sea (updated to 1994 breeding season) is presented. Total numbers are around 17,000 pairs of which 94% breeds in the Spanish coasts: 10,143 in the Ebro Delta, 4136 in the Chafarinas Islands, 996 in the Balearic Islands, 400 in a new colony found at Grosa Island (Murcia), 275 at the Columbretes Islands and 150 at the Alborán Islands (Ruiz *et al.* 1994). The main potential threat for the species comes from the concentration of 84% of the world population in only two colonies, those of the Ebro Delta and the Chafarinas Islands. Other threats may derive from changes in both fishery activities and commercial exploitation of discards. Furthermore, it seems that there is a low number of suitable breeding sites for these gulls, and habitat competition with yellow-legged herring gulls *Larus cachinnans* may be important. Nowadays the bulk of the Audouin's gull population nests in protected sites, but there are still small colonies affected by disturbance from tourists. Little is known about the present status of colonies in the East Mediterranean and potential threats in most of the colonies outside Spain.

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## **Threats to albatrosses at South Georgia**

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At South Georgia, populations of wandering, grey-headed and black-browed albatrosses *Diomedea exulans*, *D. chrysostoma* and *D. melanophris* are all declining. The magnitude and nature of these population changes are reviewed, together with an assessment of their demographic causes. For wandering albatrosses, the decline was first recognised in 1979 and is still continuing. It reflects about a 1% decrease in adult survival and a 5% drop in post-fledging juvenile survival, these contributing approximately equally to the reduction in population size. Breeding success is extremely consistent and has increased slightly over the last 20 years. The decrease in grey-headed albatrosses is widespread amongst Bird Island colonies but, such is the magnitude of interannual fluctuations in population size in this biennially-breeding species, that unequivocal declines were not evident until the late 1980s. No significant decrease in adult survival is apparent but recruitment to the breeding population nowadays is now about one-sixth of values 15 years ago. Breeding success is variable but without obvious trends. In black-browed albatrosses, by 1990 significant declines were only evident for a proportion of the colonies at Bird Island; nowadays all colonies are decreasing. At the main study colonies adult survival (since 1988) and recruitment (since the early 1980s) have both decreased significantly. Breeding success is highly variable and a recent succession of poor years (bad weather, low krill availability) has caused lower than average breeding success this decade compared to last and indicates little prospect of recruitment improving over the next ten years.

Interactions with fisheries are known, or believed, to be important in all these population changes and such interactions are reviewed, especially from the perspective of the enhanced knowledge provided recently by satellite-tracking studies. Wandering albatrosses range particularly widely. In the breeding season, South Georgia birds cover vast areas of the South Atlantic, from sub-Antarctic waters south of South Georgia to shelf slope areas off southern Brazil and as far west as the Pacific coast of southern Chile. In subtropical areas birds are frequently caught by tuna longline vessels during this period. In the non-breeding season birds from South Georgia move rapidly across the Atlantic and Indian Oceans to wintering grounds off the east coast of Australia. They appear equally vulnerable to tuna longline fishing vessels during this period. In the breeding season, grey-headed albatrosses are particularly associated with the Antarctic Polar Front over a wide arc in the vicinity of South Georgia. At this time relatively few interactions with fishing vessels are reported. Information on distribution in the non-breeding season is extremely scanty although there are reports of birds caught, primarily in association with fishing activities, in the Indian and Pacific Oceans, particularly in the vicinity of Australia. Breeding black-browed albatrosses are primarily confined to shelf slope areas in the vicinity of South Georgia and, at least in some years, around the South Orkney and South Shetland Islands as well. After the breeding season, birds from South Georgia migrate across the Atlantic Ocean and many winter in South African waters, where they commonly associate with fishing vessels. Birds from the Falklands Islands, in contrast, mainly move north along the coastal shelf waters of South America and on the Patagonian Shelf. They are particularly vulnerable to a variety of fishing operations at this time and are the main species killed in association with longline fishing for toothfish. The rapid development of this fishery around southern South America, the Patagonian Shelf and South Georgia has undoubtedly accelerated population declines in black-browed albatrosses and is also contributing to the continuing declines in wandering albatross and possibly grey-headed albatross.

### **Provisioning rates and growth patterns in black-browed albatrosses**

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We developed automatic electronic weighing platforms to fit inside polystyrene replicas of albatross nests. We used these devices at Bird Island, South Georgia to measure the mass of meals and intervals between meals received by albatross chicks and also to provide detailed data for estimation of growth rates of these chicks.

Data from deploying 10 weighing platforms under black-browed albatross chicks in each of 3 years indicate substantial inter-and intra-annual variation in chick growth rate and adult provisioning performance. Thus although growth during the brooding period (to 21 days of age) was similar in all 3 years, growth to peak mass (90 days) was significantly lower in 1989/90 (despite showing the highest growth rate for the period 21-31 days). Peak mass was highest in 1991/92, lowest in 1989/90 and intermediate in 1992/93; chick mass at fledging was similar in 1991/92 and 1992/93 but lower in 1989/90. Growth rate, peak mass and fledging mass, however were not correlated with overall breeding success in the study colony, which was low in 1991/92, intermediate in 1989/90 and high in 1992/93. The growth indices were also not closely correlated with the mass of meals delivered or the intervals between meals. However most growth indices were significantly correlated with the rate at which adults delivered food (i.e. meal mass  $\div$  foraging trip duration). These results have important implications for the choice of indices of reproductive performance in albatrosses to best reflect variation in food availability at sea.

These weighing balances provide a very detailed set of data from which a variety of indices of chick growth performance and adult provisioning performance can be calculated. Because several indices are sensitive to environmental effects, this type of recording system should have considerable potential in routine monitoring studies of a variety of seabird species. Interspecies comparisons should also greatly enhance our knowledge of chick growth patterns, especially in relation to constraints of body size and provisioning rate.

## **Population, distribution and conservation of roseate terns in the Azores**

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The roseate tern population of the Azores was estimated at about 1000 pairs in 1989, comprising 60-65% of the Western Palearctic population. This poster summarises available information on population, distribution, threats and conservation of roseate terns in the Azores.

Apparently terns were common in the Azores in the 16th century and roseate terns were in the order of some hundreds in the 1960s. Comprehensive surveys were made in 1984 and since 1989 showing a steady decline from 1000 pairs in 1989 to 550 in 1994. They are most abundant on

Flores, Graciosa and S. Maria and breed mainly on offshore islets. Major inter-colony movements are common.

Human activities (fishing, boating, picnicking) along the coastline are a severe disturbance to terns and have led to total desertion of colonies of about 200 pairs. In other colonies eggs were broken and/or chicks were abandoned. Predation by rats or even hedgehogs may be important at some colonies. The substrate of some colonies is unstable and may lead to nest failures during strong rains. Small fish that are important prey for terns are used as bait by fisheries which may lead to competition between these and terns. Furthermore, breeding success may depend, to a certain extent, on the movements of underwater predators that force potential prey to the surface; data is needed to evaluate these hypotheses.

Wardening commenced on Flores, Terceira and Graciosa in 1992 to prevent disturbance of colonies and carry out education work. This has resulted in an almost absence of disturbance on main colonies of those islands. Future research should evaluate the importance of the various threats to nesting terns, which requires also continued monitoring.

### **Optimal foraging and host trade-offs in the kleptoparasitism of Sandwich terns *Sterna sandvicensis* by black-headed gulls *Larus ridibundus***

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The behavioural ecology of black-headed gull parasitism on Sandwich terns at Coquet Island was investigated between 1992 and 1994. Black-headed gulls demonstrated behavioural adaptations that optimised returns for energy invested in chasing. Gulls selectively attacked terns with larger fish due to the energy content of fish increasing exponentially with length.

The number of attacks made during a chase increased the cost of kleptoparasitism and decreased the likelihood of success; probably due to the gull relying on surprise to secure success from the faster and more manoeuvrable terns. As a result, most gulls only made a single attack in order to minimise the costs of kleptoparasitism.

Black-headed gulls often attacked in groups and this increased success. However, the average energy return per gull decreased with group size and it seemed the gulls were forming 'selfish groups' and attempting to profit from one another's energy investment rather than co-operating to increase success.

There was no evidence to suggest that terns were reducing the size of fish returned to the colony in order to avoid kleptoparasitism since the increased energy content of large fish outweighed the risk of loss. The rate of gull success would have to increase to three times the observed rate before such an energetic trade off would occur. However, foraging costs and the risks of injury have not been included in this model. Despite this, the selection of fish size by terns is probably governed by food availability and suitability of the fish for the chicks.

## **The status of *Larus* gulls nesting on buildings in Britain and Ireland, 1994**

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Gulls nesting on buildings are now a common sight in many coastal and, increasingly, inland areas of Britain and Ireland. This behaviour was first recorded in herring gulls *Larus argentatus* in southwest England early this century and its spread has been well documented by two comprehensive surveys, in 1969 (*British Birds* 64: 476-487) and 1976 (*Bird Study* 24: 89-104). However since 1976 no such survey has been carried out and therefore it was decided to carry out a survey in 1994 to assess the current numbers and distribution of gulls nesting on buildings and other man-made structures in Britain and Ireland. The survey was endorsed by the Seabird Group and British Trust for Ornithology (BTO).

Data from the JNCC/Seabird Group Seabird Colony Register and gull enthusiasts were used to identify sites for survey, and the Regional Representative network of the BTO provided essential help to organising volunteers to help with surveying sites. 76% of sites where roof-nesting gulls had been recorded in the past were checked.

The results of the survey show that since 1976 roof-nesting by gulls has continued to increase in Britain and Ireland, in terms of the number of species regularly nesting on buildings, the number of pairs involved and the number of sites colonised.

The herring gull is still the most abundant gull nesting on buildings in Britain and Ireland, however, roof-nesting lesser black-backed gulls *Larus fuscus* are increasing at a higher rate. It appears that since 1976 the rate of increase of herring gulls has slowed whereas that of lesser black-backed gulls has not. There is considerable regional variation in the increases of both these species, the pattern of which has changed from that reported in 1976. The proportion of coastal and inland sites where gulls nest on buildings also differs between the species.

Prior to the mid-1980s there had been only one record of common gulls *Larus canus* nesting on buildings and, although the number of pairs involved is still low, the spread of the behaviour in this species since then is reflected by records being received from a wide area of Scotland this year. The small number of records of great black-backed gulls *Larus marinus* nesting on buildings is similar to that reported by the 1976 survey, however, the records come from a much wider area of Britain.

### **The lesser black-backed gull *Larus fuscus* in Iceland**

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Along with three other gull species the lesser black-backed gull is a recent breeder in Iceland. It was first recorded breeding in the south of Iceland between 1920 and 1930 and at the bay of Faxaflói, its stronghold today, around 1950 (Guðmundsson 1955). The population has increased dramatically since its first colonisation and its breeding range is expanding to the northern and north-eastern part of Iceland. The lesser black-backed gull is now the most common gull in the south-west during the summer, but during the winter it migrates south as far as West Africa.

After the dramatic increase in numbers of lesser black-backed gulls the numbers of complaints to local councils from the public and food industry have risen. The lesser blacked gull in Iceland is very urbanised and gathers around fish factories, rubbish tips, sewage outlets and into towns scavenging for food. This has given rise to worries that the gulls might carry bacteria such as *Salmonella* and *Listeria* and could cause contamination in the food industry. Nuisance complaints from the citizens are common and it has been argued that the lesser black-backed gulls could affect other bird populations, such as eider ducks *Somateria mollissima*, and other ducks, and waders, through its predation on ducklings and young. Some local authorities have made attempts to control the numbers of gulls but these have largely been conducted without any monitoring of numbers before the control started, or the effect of the control.

In 1990, the Wildlife Management Institute started a research project on the population size of the lesser black-backed gulls in the south-western part of Iceland where the greatest numbers of gulls breed and where gull numbers are still increasing. At the same time experiments on the effectiveness of control measures have been made. A population model has been made to calculate the number of breeding gulls that must be killed each year for effective control and to estimate the cost of such a control programme. The population size in SW Iceland is estimated at 20,000 - 28,000 breeding pairs and a culling programme should aim to cull 40% of the breeding population each year.

### **Some potential threats to the tropical, mangrove-nesting lesser noddy *Anous tenuirostris melanops* in Western Australia**

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The lesser noddy is a small (112g), dark-plumaged, tree-nesting tropical tern restricted to the Indian Ocean. The eastern Indian Ocean population *Anous tenuirostris melanops* breeds only on three islands, 35km apart, in the Houtman Abrolhos group, near the edge of the continental shelf, off the mid-western coast of Australia. Until recently lesser noddies were thought to build their nests only among the branches of the grey mangrove *Avicennia marina*. The discovery, in 1993, of a small colony (30 nests) nesting alongside the larger, pantropical brown noddy *Anous stolidus* amongst *Nitraria* shrubs, may allow us to determine more clearly the nest-site requirements of the lesser noddy, a threatened species. Between 35,000 and 50,000 pairs of lesser noddies breed in established grey mangrove mangals, where they also roost throughout the non-breeding period; they are non-migratory (Fuller *et al.* 1994). These nesting and roosting sites are under threat from unpredictable cyclonic winds, on average, perhaps once every ten years, oil discharges from passing tankers (oil spills kill 96% of *A. marina* seedlings (Grant *et al.* 1993) and inundation if sea levels rise slightly (nesting areas are, at most, only one metre above sea-level).

The Houtman Abrolhos islands represent one of the most important seabird breeding stations in Australia and support nineteen species totalling over 1.6 million pairs (Fuller *et al.* 1994). For instance, eight tern species breed here, including over 260,000 pairs of sooty terns *Sterna fuscata*, over 130,000 pairs of common noddies *Anous stolidus*, 7,000 pairs of bridled terns *Sterna anaethetus*, 3,500 pairs of roseate terns *Sterna dougallii* and 2,000 pairs of crested terns *Sterna bergii*, in addition to the lesser noddies. More than one million pairs of wedge-tailed shearwaters *Puffinus pacificus* breed on the Abrolhos, as well as over 30,000 pairs of little shearwaters *Puffinus assimilis*, about 4,000 pairs of white-faced storm-petrels *Pelagodroma marina*, two cormorants, two gulls, ospreys and sea eagles. Although the islands are managed to minimise disturbances to these breeding seabirds, increasing pressure from tourism will require more intensive management. Safeguards should also be taken to prevent the establishment of mammalian predators such as feral cats or rats, upon the islands.



A further potential threat to the two noddy species is their apparent reliance on the larvae of the beaked salmon *Gonorynchus greyii*, which make up 70-90% of the regurgitates during their summer breeding season. Samples collected from lesser noddies outside the breeding period indicate that beaked salmon are only seasonally abundant, and that no single prey predominates in regurgitates in winter. Currently, there are no commercial fisheries for beaked salmon. However, the availability of this species may be affected indirectly by pressure from commercial fisheries upon locally abundant predator species such as scaly mackerel, captured as pot bait for the commercially important rock lobster industry.

Fuller, P.J., Burbidge, A.A. and Owens, R. (1994). Breeding seabirds of the Houtman Abrolhos, Western Australia : 1991-1993. *Corella* 18: 97-113.

## **Threats to seabirds in the Eastern Baltic**

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The Baltic Sea is the largest brackish sea area in the world. Coastal areas in the Eastern Baltic (from the Gulf of Riga (Estonia/Latvia) to Rostock (Germany), between 12°E and 24°E) are very important for wintering and migratory populations of divers, grebes, seaducks, gulls and auks, regularly supporting internationally important concentrations of more than 20 species. Particularly important are shallow semi-open bays and lagoons (the Gulf of Riga, Szczecin Lagoon (Poland), Mecklenburg-Vorpommern Lagoons (Germany) and Kursiu Lagoon (Lithuania/Russia). The Gulf of Riga is of outstanding importance for wintering populations of divers and seaducks, in mild seasons holding more than one million long-tailed ducks, up to 0.5 million velvet scoters and up to 30000 red-throated divers. This area also supports internationally important concentrations of migratory seabirds of several species. Szczecin-Vorpommern Lagoons are particularly important for wintering populations of smew, goosander and scaup, supporting up to 90%, 30% and 23% of their total NW European population, respectively. Internationally important wintering concentrations of another 6 seaduck species have been recorded in this area too. Kursiu Lagoon also regularly supports up to 17% of regional wintering goosander population. Up to 20% of the European winter population of the globally threatened Steller's eider regularly concentrate in 2 sites at the coast of Saaremaa island (Estonia) and at Lithuanian coast. Huge concentrations of wintering and migratory divers, grebes, seaducks and gulls have been recorded in offshore areas of the Eastern Baltic and particularly in the Pomeranian Bay (Germany/Poland) and along Kursiu Spit (Lithuania) with about 1 million long-tailed ducks and velvet scoters recorded in certain periods. Up to 30% of NW European black-throated and red-throated diver population concentrated in offshore waters of this marine area.

Vulnerable seabirds concentrations are threatened by various large-scale developments which were initiated in the Eastern Baltic after considerable geopolitical and economical changes during recent years. Among all the potential threats to seabirds, pollution of marine habitats by oil is the most serious. Large sedimentary basins which potentially hold oil occur in the Eastern Baltic and some offshore drilling has already started. Up to 10 new or enlarged oil terminals and harbours may be constructed in the Eastern Baltic states. New transportation routes for oil tankers in sensitive coastal areas of high natural values are planned. These developments can potentially impact regional populations of several seabird species and cause habitat destruction in Important Bird Areas. A rapidly increasing commercial fishing in inshore waters also cause large direct losses of seabirds and environmental degradation of the most productive areas. Eutrophication and high concentrations of heavy metals and other sources of toxic chemical pollution in some sites probably also have negative effect on the populations of seabird species. Local impact may be

caused by the encroachment of recreation resorts upon some natural coastal wetlands and by increasing amber mining in Kursiu Lagoon and some other sensitive areas.

A development of a comprehensive monitoring programme of Important Bird Areas and a conservation plan for the whole region, identifying the most valuable sites for seabirds needs to be worked out as soon as possible.

## **The impact of the 1991 Gulf War oil spills on seabird populations in the northern Arabian Gulf**

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Following the unprecedented oil pollution during the Gulf War in 1991 the National Commission for Wildlife Conservation and Development (NCWCD, Riyadh) worked with BirdLife International and the European Commission (EC, Brussels) to quantify the damage to the internationally important marine and coastal bird populations along the eastern coast of Saudi Arabia, to gather more baseline information on these little studied populations, and to recommend action that should be taken. This presentation summarises the findings of these studies with respect to seabird populations and marine pollution.

Regular counts of dead birds along the impacted coast of Saudi Arabia indicated that at least 30,000 wintering seabirds were killed by the oil. Great crested grebe *Podiceps cristatus*, black-necked grebe *P. nigricollis*, great cormorant *Phalacrocorax carbo* and Socotra cormorant *P. nigrogularis* comprised 96% of this mass mortality (17-50+%), none of them were reduced to such an extent that recovery was impossible, and the recent high proportion of juvenile great cormorants indicates that recovery is taking place.

The only remaining breeding colony of Socotra cormorant north of Bahrain suffered serious losses during the oil spills and was reduced to less than 20 breeding pairs in 1991. In 1992-1995 this colony steadily recovered to the pre-war level of 100-150 breeding pairs. Six coral cay islands off Saudi Arabia harbour internationally important breeding colonies of swift tern *Sterna bergii*, lesser crested tern *S. bengalensis*, white-cheeked tern *S. repressa* and bridled tern *S. anaethetus*. Immediately after the Gulf War the breeding activities of these populations were closely monitored on Karan Island during four successive summers (1991-1994). Whereas in 1991 these populations and their breeding activities escaped major impact by the oil spills, there was a drastic decline in the breeding success of all four species in 1992 and 1993. White-cheeked tern was the most severely affected species, with all hatchlings being lost to predation by swift terns in two successive years. Monitoring of reproductive and behavioural parameters indicated that this decline was caused by a shortage in prey fish. Several studies on fish and fisheries have suggested that this shortage was due to a local stock recruitment failure which in turn was a direct result of the oil pollution. Exposure to the slicks and sheens was found to have significantly reduced the abundance of fish eggs and larvae when compared to samples collected in unexposed areas nearby. Consequently the decrease in the breeding success of the terns was a direct medium-term impact of the Gulf War oil spills. In 1994 the breeding success increased to similar levels as in 1991.

In the days following the Gulf War oil spill, numerous TV broadcasts and other press media predicted that the fauna of the Gulf region, including seabirds, would be diminished to such an extent that a full recovery would be impossible. Contradictory to these statements, the results of this study indicate that the impact of the largest oil spill ever recorded on seabird populations was temporary and very localised. At present, no indications have been found that the oil spills caused any longer-term effects, and all avian populations show signs of ongoing recovery.

## **Distribution, population estimates and conservation of breeding terns in the western Arabian Gulf**

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Although the Arabian Gulf has long been recognised as being of international importance for breeding seabirds, quantitative studies on these populations have rarely been undertaken. Most of the seabird colonies in this region are located on uninhabited arid islands to which access has always been difficult, in some cases impossible, mainly because of geographical, logistical, and political constraints. The recent creation of governmental conservation agencies in most Gulf states has facilitated access to these islands, and now most countries have a well-established seabird monitoring scheme. This paper summarises the combined results of these schemes on the status and distribution of breeding terns in the western Arabian Gulf, here defined as the combined territorial waters of Kuwait, eastern Saudi Arabia, Bahrain, Qatar and the United Arab Emirates.

Of the seven species of marine terns that regularly breed within this region, four occur in numbers of international importance. Of the latter, 38 breeding sites have been identified harbouring approximately 200,000 breeding pairs, including 88,000 pairs of bridled tern *S. anaethetus*, more than 59,000 pairs of lesser crested tern *S. bengalensis*, 46,000 pairs of white-cheeked tern *S. repressa*, and nearly 4,000 pairs of swift tern *Sterna bergii*. The breeding distributions of the other three species are still poorly understood; their breeding populations are tentatively estimated to be in the order of 10-50 breeding pairs for gull-billed tern *Gelochelidon nilotica* and Caspian tern *Sterna caspia*, and 560-660+ pairs for Saunders' little tern *S. saundersi*.

The population estimates of the four most common tern species indicate that the "1% levels" of their biogeographical populations that are currently used to identify wetlands of international importance and important bird areas in the Middle Eastern region have been seriously underestimated, especially for lesser crested and bridled tern. More realistic "1% levels" are proposed and used to identify regional priority areas for the conservation of breeding terns. The current conservation status of these priority sites is briefly discussed.

### **Temporal trends in the trophic status of the fulmar *Fulmarus glacialis*: a stable isotope approach**

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Stable isotope ratios of nitrogen ( $^{15}\text{N}/^{14}\text{N}$ :  $\delta^{15}\text{N}$ ) and carbon ( $^{13}\text{C}/^{12}\text{C}$ :  $\delta^{13}\text{C}$ ) have been determined in seabird feather samples and in the prey of seabirds. The results indicate that the isotopic signatures of feathers can be used to elucidate the trophic status of birds since there is a clear enrichment of  $^{15}\text{N}$  between prey and seabird feathers. Isotopic signatures were determined in northern fulmar *Fulmarus glacialis* feather samples from around the turn of this century and

from the present at two north-east Atlantic sites. The results from this analysis are consistent with a downward shift in trophic status in this species at both sites. Both  $\delta^{15}\text{N}$  and  $\delta^{13}\text{C}$  values declined significantly over time at St Kilda and at the northern isles and are indicative of a change in diet in fulmars to one consisting to some extent of prey of lower trophic status than at the turn of the century. Temporal shifts in trophic status in fulmars are discussed in relation to the availability of whale offal from whaling activities in the first two decades of this century.

### **The relationship between parental foraging efficiency and breeding strategies in black guillemots *Cephus grylle***

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Black guillemots exhibit comparatively large variation in several key breeding parameters (clutch size, laying date, laying interval, duration of incubation, hatching synchrony, chick feeding rate, duration of chick rearing period). The current study views this variation as reflecting a range of breeding strategies, and attempts to relate these to the foraging efficiency of the breeding adults. We are testing the specific predictions that parents of high foraging efficiency will: rear two chicks (the maximum); have relatively short laying intervals; take relatively few 'breaks' in incubation and therefore have relatively short incubation periods; will hatch chicks synchronously and will feed chicks at a comparatively high rate. Breeding behaviour and performance are being assessed by direct observation and using small video cameras in nest burrows. Foraging behaviour is being assessed using radio-tracking techniques. Preliminary results from the first field season are displayed and discussed.

### **The 1994-95 gannet survey**

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The gannet *Morus bassanus* is one of the few bird species for which a world population has been estimated on a regular basis. We are attempting to obtain counts from all the colonies in the eastern Atlantic in 1994 and 1995. This poster presents preliminary results of counts of British, Irish and Channel Island gannetries. Two new colonies, on Ireland's Eye and Rockall, have been established since the last major survey in 1984/85. Prospecting on the Shiant Isles has been abandoned. Numbers at most colonies were higher in 1994 than 1984/85 and in general increases have been most rapid in the smallest colonies. Gannet numbers have increased at about 3% per annum throughout this century. On the basis of counts so far received, there is no sign of any major change in this long-term trend.

### **The preening activity of common guillemots *Uria aalge* in relation to tick infestation on the Isle of May, Firth of Forth, Scotland**

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Avian preening and the factors which influence such behaviour have been rarely studied. Colonially breeding seabirds, such as the common guillemot, may suffer a high risk of ectoparasite infestation and, under such conditions, preening behaviour may have evolved as an adaptation to reduce such risk. The aim of the present study was to investigate relationships between infestation levels of common guillemots with ectoparasitic ticks and their preening behaviour.

Preliminary results suggest the importance of both self- and allopreening in reducing infestation. The duration of self- and allopreening was positively correlated with a score of the habitat available for ticks in sub-colonies. Allopreening showed similar decline with date of season as tick numbers found on birds. Periods of reduced self- and allopreening caused by adverse weather corresponded closely to periods of increased tick burdens.

Ticks found on birds were concentrated (72%) on the head and neck (which could not be self preened), suggesting that self-preening was effective at removing ticks from elsewhere on the body (perhaps with the exception of underparts, where 20% of ticks were attached). Ninety percent of allopreening targeted the head and neck, the areas which could not be self-preened. The addition of artificial ticks to the napes of individuals increased the duration of allopreening by their mates but not by neighbours. This suggested that mates were able to respond to the visual cue of attached ticks on their partners.

## **Is oil pollution a threat to seabirds? Lessons from the Exxon Valdez oil spill**

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The Exxon Valdez ran aground on 24 March 1989, releasing 41 million litres of oil into Prince William Sound, Alaska, and contaminating 2100 km of shoreline. The substantial mortality of seabirds and the litigation that followed the spill prompted an unprecedented number of scientific studies of the spill effects on seabirds, which I review here. I also comment on the difficulties in designing studies to assess spill effects, and on the role of science in such large-magnitude and high-profile environmental accidents.

Oil impacts seabirds by affecting population size and structure, reproduction, and/or habitat use. Modelling based on carcass recoveries suggested a total seabird mortality of 300,000 to 645,000, with "best estimates" of 375,000 to 435,000. "Before-after" studies, however, indicated that many bird species did not exhibit reduced abundance following the oil spill. Several species did show clear negative impacts, but most of these impacted species recovered within 2.5 years of the spill. Nearly 75% of the estimated mortality was of guillemots (*Uria* spp.), yet attendance levels at guillemot breeding colonies before versus 2 years after the spill did not show systematic differences related to exposure to the spill path. Studies of guillemot reproduction at the Barren Islands, where mortality was thought to be especially high, indicated that adult attendance on nesting ledges showed no systematic change from prespill levels. Reproductive success varied among locations and years, but was high in one well-studied colony in 1991, 2 years after the spill. Breeding onset may have been delayed for a few years following the spill, but these effects did not persist.

Effects of the spill on habitat use were investigated by surveying bird abundance in bays that were exposed to differing levels of initial oiling. More than half of the species analysed showed no evidence of oiling effects on their habitat occupancy. Many of the species showing initial negative impacts had recovered within 2.5 years of the spill. The species richness of a guild of winter

visitant and resident species that feed close to the shoreline exhibited the greatest negative association with oiling, whereas the richness of guilds of solitary or colonial species that dive or feed on fish showed no significant relationships with oiling at any time. A few species showed either inconclusive evidence of recovery or clear indications of persistent reductions in abundance in more heavily oiled bays, even after removing the confounding effects of variation in other habitat features. These species did not differ ecologically from other species that either showed no initial habitat impacts or recovered rapidly, so it does not appear that there are obvious ecological impediments to their recovery.

Overall, these studies indicate that the Exxon Valdez oil spill had substantial initial effects on seabird populations and communities. Effects on some species persisted for at least several years, but many of the effects disappeared relatively quickly. This suggests that both the birds and their habitats may have considerable resiliency in the face of severe but short-term perturbations such as oil spills. This apparent resiliency should not be a cause for complacency. The rapid recovery of many elements of the marine system, however, shows that early concerns about devastation of seabird colonies, massive reproductive failures, and recovery times in the decades were overstated. Evaluations of environmental impacts should be based on rigorous scientific studies rather than premature judgments.

### **Threats to seabirds in southern Africa**

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Seven species, and two subspecies, of seabirds are endemic to southern Africa (Namibia and South Africa). This region supports between 500,000 and 750,000 pairs of breeding seabirds about 80% of all seabirds breeding in sub-Saharan Africa. In addition southern African waters support in excess of three million annually visiting seabirds, largely from sub-Antarctic and Holarctic breeding localities.

Threats to breeding seabirds have been habitat alteration, exploration of guano and eggs, and latterly competition for space with seals. Predation and sickness are minor threats. Threats at sea include: substantial predation, especially by seals; pollution, generally minor except for irregular oil spills and, in particular interaction with various fisheries. Fishery competition includes outright competition for available stocks, capture on long-lines and in nets, and changing food availability.

Breeding species affected by several simultaneous threats have experienced substantial population decrease. This has exceeded 90% in the case of the African Penguin and sub-regionally the Cape Gannet and Bank Cormorant, all three endemic species.

Present conservation efforts focus on protection of breeding localities including control over guano exploitation, ecotourism and displacement of seals. Currently the greatest threats to southern African seabird populations are interactions with fisheries and competition with, and predation by, seals. Improved integrated management policies are needed to reconcile these issues. Further development of ecotourism at breeding localities must be cautious. Acute oil spillage is best met by improving response by staff of the regional seabird rehabilitation centre (SANCCOB). If commercial oil exploitation commences greater attention will have to be paid to the pelagic seabirds.

## **Rat Eradication on Ailsa Craig**

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Having arrived on remote islands through the agency of man, brown rats *Rattus norvegicus* are active killers and scavengers of seabirds. Their accidental introduction to Ailsa Craig in the late nineteenth century was accompanied by a decline in burrow-nesting seabirds in particular. Rat numbers are lowest after winter and this is the best period to commence eradication. Modern rodenticides will deal effectively with rats but great care must be taken to avoid secondary poisoning of non-target species. Warfarin was chosen for Ailsa Craig as a humane and cumulative poison. It is a decoagulant and is effective 3 - 5 days after ingestion. On difficult terrain such as Ailsa Craig, distribution of bait was greatly assisted by voluntary use of a Naval Helicopter. Two major bait drops in successive winters were undertaken on Ailsa and in total 6.5 tonnes of poison have been distributed. This is very labour-intensive but accurately targets the areas of rat activity. Evidence of rats has been monitored using several indices of rat activity. Confidence in the complete eradication of rats increases with time. On Ailsa Craig, vegetation has shown an immediate response and breeding bird species, formerly susceptible to rats, have now produced young to the fledging stage. Some new burrow or hole-nesting species such as black guillemot *Cepphus grylle*, shelduck *Tadorna tadorna* and wheatear *Oenanthe oenanthe* have bred on the island for the first time since records began in the mid 1800's and others such as the puffin *Fratercula arctica*, which in the past existed on the island in enormous numbers, are once again prospecting breeding sites.

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