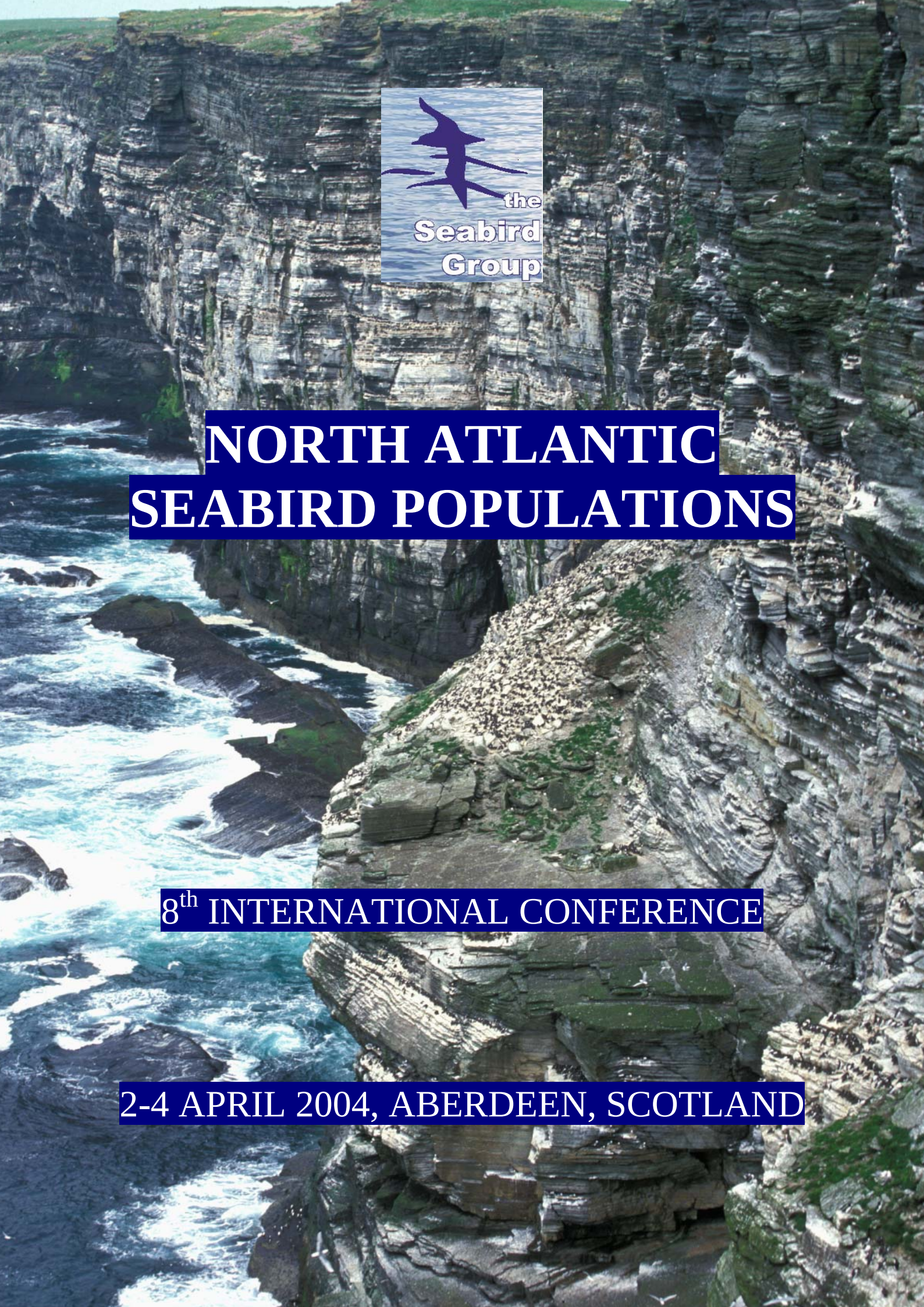

NORTH ATLANTIC SEABIRD POPULATIONS

8th INTERNATIONAL CONFERENCE

2-4 APRIL 2004, ABERDEEN, SCOTLAND

THE SEABIRD GROUP

NORTH ATLANTIC SEABIRD POPULATIONS

PROGRAMME AND ABSTRACTS

8th INTERNATIONAL CONFERENCE

2-4 APRIL 2004, ABERDEEN, SCOTLAND

Sponsored by

BP Exploration Ltd
Joint Nature Conservation Committee

Royal Society for the Protection of Birds
Scottish Natural Heritage

PROGRAMME

Friday 2nd April

1600-2100	Arrival, Accommodation Desk open in Crombie-Johnston Hall, Registration Desk in King's Conference Centre
1800-1900	Reception and buffet in King's Conference Centre, including raffle with book prizes
1900	Welcome - Mark Tasker, Chairman of The Seabird Group
1905-1930	Ian Mitchell and Stephen Newton Launch of the book 'Seabird populations of Britain & Ireland'
1930-2015	Anthony J. Gaston and H. Grant Gilchrist Ice, seabirds and climate change in the Canadian Arctic
2000-0100	Cash Bar in Crombie-Johnston Hall

Saturday 3rd April

0830	Registration Desk opens in King's Conference Centre
0900	Opening of the Conference
Session 1	Chair: Jim Reid
0905-0930	Ian Mitchell Seabird populations in Britain and Ireland: the last 30 years
0930-0950	Steve Newton, Brian Madden and John Calladine Herring and Lesser Black-backed Gulls: a tale of contrasting fortunes
0950-1010	Tim E. Dunn The status of petrels in Britain and Ireland
1010-1030	Norman Ratcliffe Diagnosis of the decline of the Arctic Skua population in the Northern Isles
1030-1100	Coffee/tea break
Session 2	Chair: Chris Wernham
1100-1120	Theresa M. Burg, Karen D. McCoy and Thierry Boulinier Studying seabird metapopulation functioning: contrasting genetic and demographic approaches
1120-1140	Morten Frederiksen, Mike Harris and Sarah Wanless Modelling the Isle of May Black-legged Kittiwake population

1140-1200 Daniel Oro
Influence of food availability on demography and population dynamics in a Mediterranean seabird

1200-1220 Sin-Yeon Kim and Pat Monaghan
Are changes in food availability responsible for the decline in Herring Gull numbers?

1220-1240 Mark Grantham
Winter distribution of British and Irish Guillemots and the oil spill threat

1240-1400 Lunch in Crombie-Johnston Hall

Session 3 Chair: Sarah Wanless

1400-1420 Robert T. Barrett, Tycho Anker-Nilssen and Svein-Håkon Lorentsen
The status of seabirds breeding in mainland Norway

1420-1440 Bergur Olsen
Common Guillemots in the Faroes over 30 years

1440-1500 Bernard Cadiou
Recent population increase of European Storm Petrels in Brittany

1500-1520 Verónica Neves and Robert W. Furness
Present status of Roseate Terns in the Azores

1520-1620 **Poster Session** and Coffee/tea break

Session 4 Chair: Euan Dunn

1620-1640 Kees Camphuysen
Foraging status of the Northern Gannets from the Bass Rock

1640-1700 Stephen C. Votier, Jonathan E. Crane and Robert W. Furness
Temporal and spatial variation in discard utilisation by Great Skuas

1700-1720 Jose M. Arcos, Daniel Oro and Xavier Ruiz
Significance of fishery waste for a NW Mediterranean breeding seabird community: a bioenergetics approach

1720-1740 Philipp Schwemmer and Stefan Garthe
At-sea distribution and activities of Lesser Black-backed Gulls in the German Bight - a reflection of the exponential population growth?

1740-1800 Sarah E. Davis, Robert W. Furness and Ruedi G. Nager
The influence of food availability on life history parameters of Arctic Skuas

1900 Cash Bar opens in Elphinstone Hall

1930-2100 Conference Dinner in Elphinstone Hall, followed by Ceilidh to 0100

Sunday 4th April

Session 5 Chair: Mike Harris

0905-0930 Brian D. Bell
Recovery of seabird populations after the removal of invasive species.

0930-0950 Richard Podolsky
Successes and failures to artificially increase seabird numbers

0950-1010 Colin M. Beale and Pat Monaghan
Visitor access to seabird colonies: stressed birds and poor breeding success

1010-1100 **Poster Session** and Coffee/tea break

Session 6 Chair: Kees Camphuysen

1100-1120 Betty Anne Schreiber and Gary Schenk
Survival and determinants of population size in a multi-species tropical seabird community over 35 years: Johnston Atoll, central Pacific Ocean

1120-1140 Gilles Chapdelaine, Jean-François Rail, Andrew W. Boyne, Gregory J. Robertson and John W. Chardine
Status and long-term changes of seabird populations in the Estuary and Gulf of St. Lawrence, Canada (1980-2003)

1140-1200 Steve Oswald, Brian Huntley and Keith C. Hamer
Exploring the impact of climate on the distribution of Great Skuas breeding in the UK

1200-1220 Ulrike Kubetzki, Stefan Garthe and Robert W. Furness
Winter movements of Northern Gannets

1220-1240 William R.P. Bourne
North Atlantic gadfly petrels

1240-1400 Lunch in Crombie-Johnston Hall

Session 7 Chair: Mark Tasker

1400-1420 Jennifer Lavers and Ian L. Jones
Demography of the Razorbill at the Gannet Islands, Labrador

1420-1440 Hallvard Strøm
Status of seabirds breeding in Svalbard, Franz Josef Land and Novaya Zemlya

1440-1500 Olivier Chastel, Claus Bech and Geir Wing Gabrielsen
Hormones and BMR in Black-legged Kittiwakes rearing chicks

1500-1520 Linda J. Wilson, Phil J. Bacon, Jenny Bull, Uli Dragosits, Trevor D. Blackall, Tim E. Dunn, Keith C. Hamer, Mark A. Sutton and Sarah Wanless
Ammonia emissions from UK seabird colonies

1520-1540 Antonio Hernandez-Matias and Peter H. Becker
A field test of food information transfer through local enhancement in a colonial seabird

1540 Closing remarks

1550-1630 Coffee/tea break

Monday 5th April

0830-1730 Field visits in Aberdeenshire

1245-1330 lunch in Udny Arms, Newburgh

List of Poster papers

José Manuel Arcos, David Álvarez, Patricia M. Leyenda, Ignatio Munilla and Alberto Velando: Seabird mortality caused by the *Prestige* oil spill: preliminary insights from a drift blocks experiment

José Manuel Arcos, Esther Hernández, Daniel Oro and Robert W. Furness: Mercury levels in the NW Mediterranean: what do fish and seabirds reveal?

Gonzalo M. Arroyo and David Cuenca: The migration of seabirds through the Straits of Gibraltar: the Migres Seabird project

Vidar Bakken: Wintering areas of guillemots in the North Atlantic based upon ringing recoveries

Stijn Bierman, Mike Harris, Sarah Wanless, David Elston, Ian Wilson and Xavier Lambin: Allee effect caused by benefit of crowding in a colonial seabird

Maria Bogdanova, Ruedi Nager and Pat Monaghan: Youthful incompetence and adult experience: effects on reproductive output

Bernard Cadiou, Jean-Marc Pons and Pierre Yésou: Status and trends of breeding seabirds in France

Kees (C.J.) Camphuysen and Mardik L. Leopold: Dutch Great Cormorants invade an offshore area

Barbara Cheney, Hera Sengers, Sam Mansfield and Paul Thompson: Inter-annual variability in the breeding success of Northern Fulmar

Kenna Chisholm and Hugh Insley: European Storm Petrel monitoring in North Scotland

Jonathan E. Crane, Stephen C. Votier and Robert W. Furness: Migration of Great Skuas as shown by satellite telemetry

Mariana Diaz and Robert W. Furness: Recruitment in the Great Skua

Tobias Dittmann and Peter H. Becker: Breeding site choice at different scales: colony attendance in prospecting Common Terns

Carsten Egevang: Relaying by Arctic Terns in Greenland

Morten Frederiksen, Mike Harris and Sarah Wanless: Spatio-temporal pattern of Black-legged Kittiwake nesting success

Julien Gasparini, Torkild Tveraa and Thierry Boulinier: Variation in parental quality and the correlation between egg size, clutch size and the ability to produce a replacement clutch in Black-legged Kittiwakes

Rebecca Harris, Mark Pokras and Florina Tseng: The Seabird Ecological Assessment Network (SEANET): a citizen science initiative for marine ecosystem health

Antonio Hernández-Matías, Lluís Jover and Xavier Ruiz: Social attraction and habitat quality influence breeding habitat selection in marshland Common Terns

Arnaud Le Nevé and Bernard Cadiou: Tern conservation in Brittany

Bente Limmer and Peter H. Becker: Body mass change with age in adult Common Terns

Maite Louzao, José Manuel Arcos and Daniel Oro: Trawlers, Balearic Shearwaters and Shags: new insights from the Balearic Islands

Sonja C. Ludwig and Peter H. Becker: Assortative mating in relation to age and body condition in Common Terns

Jan-Dieter Ludwigs and Peter H. Becker: Pairing for the first time: Causes and consequences of mate choice in recruiting Common Terns

Nele Markones and Stefan Garthe: Influence of hydrographic features on the distribution of seabirds in the southeastern North Sea

Claire A. McSorley, Ben J. Dean, Andy Webb and James B. Reid: Extending the boundaries of terrestrial breeding seabird colony protected areas into the marine environment

Ralf H.E. Mullers, Rene A. Navarro, Les G. Underhill and G. Henk Visser: How important is the timing of breeding in Cape Gannets?

Stuart Murray, Michael C. Shrewry, Greg P. Mudge and Stuart Spray
A survey of the Manx Shearwater colony on Rum, Inner Hebrides in 2001

Jens Nyeland: Apparent trends in the Black-legged Kittiwake in Greenland

Matt Parsons and Roddy Mavor: The Seabird Monitoring Programme of the United Kingdom

David Pinaud and Henri Weimerskirch: Using First-Passage Time analysis to assess the scales of interaction with marine environment

Claire Pollock and Colin Barton: Review of divers, grebes and seaduck distribution and abundance in the SEA 5 area

Martin Poot, Richard Witte, Suzan van Lieshout, Sytse Ybema, Bram Couperus and Kees Bakker: Distribution of Common Guillemots and Razorbills in relation to abundance of pelagic fish in a part of the Dutch North Sea

Atocha Ramos, Mónica Dopico, Roberto Bao, Martin Heubeck, Diana Humple, Kees (C.J.) Camphuysen and Antonio Sandoval Rey: The Prestige incident: assessing the impact of a major oil spill

Lea Riffault, Karen D. McCoy, Claire Tirard, Vicki L. Friesen and Thierry Boulinier: Oil spill and seabird conservation: using population genetics to assess the geographic impact of the Erika oil spill on Common Guillemot populations

Daphne Roycroft, Tom C. Kelly and Lesley Lewis: Interactions between vertebrate predators and mussel longline aquaculture at an Atlantic sea loch

Betty-Anne Schreiber, Paul F. Doherty, Jr and Gary A. Schenk: The possible effects of contaminants on the survival, breeding dispersal and natal dispersal of Red-tailed Tropicbirds nesting on Johnston Atoll

Michelle Sims, David Elston, Mike Harris, Sarah Wanless and Ian Mitchell: Statistical power to detect trends in abundance of Common Guillemots using monitoring plot counts

Cecilia Soldatini, Ariele Magnani and Danilo Mainard: Natal dispersal and demography of Yellow-legged Gull from north Adriatic Sea colonies

Nicole Sonntag, Ophelia Engelhard and Stefan Garthe: The Pomeranian Bight – a hotspot for seabirds in the southern Baltic Sea

Jeffrey A. Spendelow, James D. Nichols, William L. Kendall, James E. Hines, Jeff S. Hatfield and Ian C.T. Nisbet: Detecting warning signs of trouble within population fluctuations: using capture-recapture modelling to uncover changes in population dynamics leading to declines

Iain J. Stenhouse, H. Grant Gilchrist, Mark L. Mallory and Gregory J. Robertson: A drastic decline in Ivory Gulls breeding in Canada

Kampanat Tharapoom, Ruedi G. Nager and Maureen M. Bain: Differences in eggshell characteristics and laying order in the Lesser Black-backed Gull

Yatuka Watanuki, Akinori Takahashi, Francis Daunt, Sarah Wanless, Mike Harris, Katsufumi Sato, and Yasuhiko Naito: Wing- and foot-propulsion of seabirds diving to deep water: comparison between Common Guillemots and European Shags

Francis Wiese and Kim Elmslie: Evaluation and prevention of the impact of deliberate oil discharges on seabirds in the Canadian North Atlantic

Seabird mortality caused by the *Prestige* oil spill: preliminary insights from a drift blocks experiment

JOSÉ MANUEL ARCOS[1], DAVID ÁLVAREZ[1], PATRICIA M. LEYENDA[2], IGNACIO MUNILLA[2] and ALBERTO VELANDO[2]

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Since seabirds generally have low-reproductive rates and high survival, stochastic events potentially causing high adult mortality, such as oil spills, can severely affect their population dynamics. Here we present preliminary results of an experimental study to assess seabird mortality caused by the *Prestige* oil spill, off NW Spain, in November 2002. Using the number of retrieved seabird carcasses (21000), we focused on finding a correction factor to account for unreported birds (either lost at sea or undetected though washed ashore). The experiment involved wooden blocks simulating the drift of a bird corpse, and consisted of three phases: (1) we tested the adequacy of several block models, comparing their drift at sea with that of dead auks (the most common seabird casualties); (2) blocks and auk carcasses (75 each) were released in 50 beaches selected at random, to assess potential differences in their detection; (3) 600 blocks were released along four transects off NW Spain, selecting three points of release per transect, at different distances over the continental shelf. Detection rates were slightly higher for blocks than for seabird carcasses (64% vs. 47%). For the blocks released at sea recovery rates were considerably low (15% on average), although they varied greatly depending on the point of release (5-40%). Using these correction factors, a preliminary and most likely conservative estimate, gives a figure of 150000-250000 seabird casualties. This figure is among the highest ever reported for an oil spill.

Mercury levels in the NW Mediterranean: what do fish and seabirds reveal?

JOSÉ MANUEL ARCOS[1], ESTHER HERNÁNDEZ[1], DANIEL ORO[2] and ROBERT W. FURNESS[1]

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2. IMEDEA (CSIC-UIB), Miquel Marquès 21, 07190 Esporles, Mallorca, Spain

Mercury is a highly toxic trace metal, of particular concern in marine ecosystems due to bioaccumulation in biota and biomagnification through food chains. Given the increase of this metal in the environment, as a result of anthropogenic emissions, concern on the hazards to wildlife and humans should be taken seriously. Here we present preliminary results of current research on mercury levels in fisheries discards and seabirds in the NW Mediterranean. Among fish, benthic species have the highest levels of mercury in areas of high local pollution, while mesopelagic fish have higher levels in pristine areas. Several fish species either approach or exceed EU mercury limits for human consumption. This is of particular concern as commercial species in discards were mostly immature fish, and mercury levels tend to increase with age. Concerning seabirds, there is a clear relationship between the percentage of discards in their diet (main way of accessing benthic fish) and their levels of mercury. Thus, discards could pose a risk for species of conservation concern, such as the Balearic Shearwater *Puffinus mauretanicus*. Concern arises since, in the last five years, a large increase (over 200%) in mercury levels has been detected in NW Mediterranean biota, best reflected by seabirds.

Significance of fishery waste for a NW Mediterranean breeding seabird community: a bioenergetics approach

JOSÉ MANUEL ARCOS[1], DANIEL ORO[2] and XAVIER RUIZ[3]

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Email: j.m.arcos@bio.gla.ac.uk
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3. Dept. Biologia Animal (Vertebrats), Universitat de Barcelona, Avda. Diagonal 645, 08028 Barcelona, Spain

Consumption of fisheries discards is often cited to explain recent changes in seabird communities (e.g. population increase of scavenging seabirds, and decrease of more specialised seabirds mediated by competition and predation). Under an ecosystem-based approach, management strategies should take account of these indirect effects of fishing, for which a thorough understanding of the relationship between discards and seabird communities is necessary. An essential component of this is estimating energy flow to quantify the relationship between discard availability, discard utilisation and seabird requirements, which few studies have addressed. Moreover, most of these studies have simplified the situation, giving rough estimates that do not account for the intrinsic variability of the data. We paid particular attention to this variability, using randomization and bootstrap modelling techniques, to assess the implications of discards consumption for the Ebro Delta breeding seabird community. The local breeding seabird community obtains 52% (CV = 6%) of its energy requirements from discards, which comprises only 1/6th of the potential energy available from discards. However, total seabird numbers (local breeders, non-breeders and visiting distant breeders) consume around 85% of the total energy available (CV = 15%), thus approaching the sustainable limit. Audouin's *Larus audouinii* and Yellow-legged Gulls *Larus michahellis* obtain the greatest benefit from discards, while terns obtain only a small part of their requirements from this resource.

The migration of seabirds through the Straits of Gibraltar: the Migres Seabird project

GONZALO M. ARROYO and DAVID CUENCA

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The MIGRES SEABIRD Project develops a monitoring program on the migration of seabirds through the Straits of Gibraltar, the only natural connection between Mediterranean Sea and Atlantic Ocean. This migratory phenomenon concerns millions of seabirds every year. Thirty-six seabird species were observed passing the Straits between January 2002 and December 2003 (2002= 29 species; 2003= 34 species). Nearly 90% of the observations concerned only three species: Cory's Shearwater *Calonectris diomedea* (53,6%), Balearic Shearwater *Puffinus mauretanicus* (14,2%) and Atlantic Gannet *Morus bassanus* (10,3%). Other species were regularly observed: Sandwich Tern *Sterna sandvicensis*, Black Tern *Chlidonias niger*, Razorbill *Alca torda*, Atlantic Puffin *Fratercula arctica*, Great Skua *Stercorarius skua*, Audouin's Gull *Larus audouinii* and Lesser Black Backed Gull *Larus fuscus*. The main migratory peaks were in spring and autumn. Autumn migration concentrates between mid-October and mid-November, showing massive movements of birds in some days (more than 900 birds/10 min). Spring migration lasted from mid-February to May, being sparser and less conspicuous. The most important migratory peaks concerned mainly shearwater movements. The aim of this poster is to analyse the composition of migrating seabird communities and the phenology patterns of the main species. In this sense the Straits of Gibraltar offers suitable conditions to monitor seabird migration, as well as for studying other aspects concerning their ecology and their population dynamics and conservation.

Wintering areas of guillemots in the North Atlantic based upon ringing recoveries

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Modern Geographical Information Systems (GIS) make it possible to perform new and advanced analysis of ringing recovery data. I have used GIS (ArcView [Esri, inc.]) to map the wintering areas of Common Guillemot *Uria aalge* and Brünnich's Guillemot *Uria lomvia* in the North Atlantic. All recoveries of both species from all countries are gathered in two databases, comprising ca. 13000 and 5000 recoveries respectively. Kernel home range polygons are used to show the main wintering areas of the different populations. An advantage in combining the recovery material from different populations is obvious when one of the populations is frequently recovered in an area, but another is not. The latter can then be excluded as an important wintering area for the population. This is not possible if one looks at the distribution of one population only. A presupposition is that birds of the same age have been ringed in the breeding colonies in each of the populations in the same time period. The poster presents examples of the winter distribution of both guillemot species in the North Atlantic.

The status of seabirds breeding in mainland Norway

ROB BARRETT[1], TYCHO ANKER-NILSSEN[2] and SVEIN-HÅKON LORENTSEN[2]

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About three million pairs of breeding seabirds are distributed very unevenly along the coast of Norway. For example, more than 90% of the cliff-breeding birds breed north of the Arctic Circle. We take a closer look at Norwegian seabird distribution and population trends in relation to oceanography and food availability. The current Norwegian seabird monitoring programme was initiated in 1979, and since then monitoring of 17 species along the Norwegian coast has uncovered highly contrasting trends for different species and areas. Most alarming is the situation for the populations of Common Guillemot *Uria aalge* and the nominate subspecies of Lesser Black-backed Gull *Larus fuscus* in North Norway, both of which have decreased to a level where they risk local extinction. Numbers of Mew Gulls *Larus canus* in southeastern Norway have also dropped sharply. A similar, but less dramatic trend is registered for the Black-legged Kittiwake *Rissa tridactyla*. While Norwegian seabirds prey on a wide variety of fish and invertebrates, two energy-rich species have been highlighted as the most important prey for pelagic birds: the Norwegian spring-spawning herring *Clupea harengus* (0- and I-group) and the Barents Sea capelin *Mallotus villosus*. Both these stocks have fluctuated hugely in size, and we discuss their effects on seabird numbers and breeding success over the last two-three decades.

Visitor access to seabird colonies: stressed birds and poor breeding success

COLIN M. BEALE and PAT MONAGHAN

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The effects of human disturbance on seabirds are widespread and varied. Black-legged Kittiwake *Rissa tridactyla* populations are declining in many UK colonies, so any additional pressures caused by visitor disturbance to nesting colonies are of conservation concern. If we are to effectively manage the conflict between provision of public access and protection of breeding birds, we must understand the mechanisms whereby disturbance can cause declines in nesting success. This is particularly important in species such as Black-legged Kittiwakes that show little behavioural change when humans are present even in relatively close proximity. However, physiological responses to disturbance, such as raised heart-rates, have energetic costs that could lead to increased desertions and hence breeding failures. In an experimental study of disturbance effects on Black-legged Kittiwakes, we found little obvious behavioural response, but heart-rate elevation of up to 15% in some birds. We estimate that this heart-rate elevation increases the daily metabolic requirement of disturbed birds by at least 7.5 – 10%, sufficient to explain the observed increase in breeding failures. Disturbance effects may be more widespread than suggested by behavioural responses of birds, and management guidelines need to take account of this.

Recovery of seabird populations after the removal of invasive species

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Man has been responsible for the spread of alien species throughout the world. Some, particularly cats and rats, and rabbits and goats, have had a very destructive impact on seabirds and their habitats. Until relatively recently, little could be done to reverse this influence. Today improved techniques and technology have provided the means to remove invasive species from most island habitats with the right allocation of resources and a commitment of all concerned. The recovery of seabirds after removing invasive species is often spectacular but there are few well-documented cases. Most of the observations are more subjective, but are obvious to those who have been involved. There is a need for government and conservation agencies to take a more pro-active role in restoring island habitats.

Allee effect caused by benefit of crowding in a colonial seabird

STIJN BIERMAN[1, 3, 4], MIKE HARRIS[2], SARAH WANLESS[2], DAVID ELSTON[1], IAN WILSON[4] and XAVIER LAMBIN[3]

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The loss of the benefits of crowding in anti-predator behaviour as host density decreases is one putative mechanism leading to the Allee-effect (increasing population recruitment with increasing density). We fitted mathematical models to counts of Atlantic Puffin *Fratercula arctica* burrows (representing breeding pairs) over time at different locations within the breeding colony. Models incorporated an impact of Herring *Larus argentatus* and Lesser Black-backed Gulls *Larus fuscus* on puffin population recruitment, the magnitude of which was dependent on gull density, and a crowding advantage of puffins in their interaction with gulls. The parameterised models predict decreasing recruitment to the puffin breeding population with increasing gull density, and a critical population density below which puffin population recruitment is negative. This is a rare example of a system with both an understanding of the behavioural processes that cause Allee effects and evidence of its overall impact on population growth rates.

Youthful incompetence and adult experience: effects on reproductive output

MARIA BOGDANOVA, RUEDI NAGER and PAT MONAGHAN

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Parental age can influence different aspects of reproduction in birds. Most previous studies of age effects in reproduction have focussed on its impact on ability to rear chicks. As a result, it has remained unclear how age influences resource allocation during egg production and incubation and whether this has consequences for reproductive output. We used an experimental manipulation where potential effects of parental age on offspring performance operating through egg quality and incubation were teased apart in the Herring Gull *Larus argentatus*. Eggs of young and adult pairs were cross-fostered to be incubated by young and adult pairs, after hatching all chicks were reared under standardised conditions. We found that age of the laying parents had an effect on offspring condition early in the post-hatching period, while age of the incubating parents mattered later for survival of the chick until fledging.

North Atlantic gadfly petrels

WILLIAM R.P. BOURNE

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The gadfly petrels of the genus Pterodroma are now the rarest and most elusive North Atlantic seabirds. They are related to a larger radiation of Pacific forms and the subfossil record shows they were once extremely numerous, the warm-water equivalent of the Northern Fulmar *Fulmarus glacialis*. They feed off the continental shelves and along fronts at sea, mostly on cephalopods, and breed on oceanic islands, where most nest in the winter and disperse northwards in summer. After the introduction of mammalian predators to their breeding places, they all became seriously reduced. Examples include the Cahow *P. cahow* on Bermuda in the 17th century, and the Capped Petrel *P. hasitata* in the West Indies (where a race or a separate species, the Jamaica Petrel *P. h. caribbaea* may be extinct), large Fea's Petrel *P. feae* in the Cape Verde Islands and islets off Madeira, and small, summer-breeding *P. madeira* in the highlands of Madeira, Europe's rarest seabird. They present our most serious seabird conservation problem.

Studying seabird metapopulation functioning: contrasting genetic and demographic approaches

THERESA M. BURG[1], KAREN D. McCOY[1] and THIERRY BOULINIER[1, 2]

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2. Laboratoire d'Ecologie, CNRS-Université Paris VI UMR 7625, Paris 75005, France

Multiple methods exist for studying seabird metapopulation dynamics including both demographic and genetic approaches. Understanding dispersal and population functioning is particularly important for seabirds which have large distributions and the potential to disperse over vast distances. In addition, baseline population information is critical in light of environmental or human-induced events e.g. climate change, oil spills, longline fishing. We present a comparison of demographic and genetic approaches to studying seabird dispersal and population dynamics. In some cases, these approaches are complementary and make similar biological inferences. In other cases, however, the patterns revealed are largely contradictory. This includes examples where both demographic and genetic data are in agreement and examples where the two show contrasting patterns. We discuss what might be causing these discrepancies and ways to combine both approaches to strengthen our understanding of seabird population biology.

Recent population increase of European Storm Petrels in Brittany

BERNARD CADIOU

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In 1968-1970, the first whole census of breeding European Storm Petrels *Hydrobates pelagicus* in Brittany gave an estimate of around 450 AOS for 20-22 colonies. Afterwards, a possible decrease was recorded in the 1980s, with less than 300 AOS. Since 1994 regular censuses were conducted and an increasing trend was recorded. There are 16-18 occupied colonies and the whole population was estimated to around 800 AOS in 2002. Different hypothesis are considered to explain this recent demographic trend. The increase occurred in spite of huge predation by gulls, especially Great Black-backed Gulls *Larus marinus*, on the largest colonies. Indeed, more than 2,000 Storm Petrels, both breeders and non-breeders, have been killed since 1996. The laying period showed a pronounced interannual variability, with 'normal, 'late' and 'very late' breeding seasons and, apparently, associated variations in recruitment or intermittent breeding. However, hatching and breeding success showed less variation. Intensive ringing of birds was conducted since the mid 1970s (more than 10,000 breeders or prospectors and 1,350 chicks) and allows some modelling approaches. Annual ringing of chicks on different Storm Petrel colonies in the NE Atlantic appears as a conservation priority to improve the knowledge of prospecting, dispersal and recruitment because these parameters still remains poorly investigated.

Status and trends of breeding seabirds in France

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A national census of breeding seabirds was carried out in France at the end of the 1990s, ten years after the previous one. It was organized by GISOM (the French Seabird Group). About 500 volunteers and scientists participated in the survey. Censuses were conducted using standardized methods and concerned 26 species breeding annually in coastal or inland colonies (including roof-nesting gulls). Counts were mainly made in 1997-1999, with additional data collected in 2000-2001. At the present time, about 235,000 pairs of seabirds breed in France. Past data, mainly available since the 1960s, allow the analysis of major changes which have occurred in the distribution and population status of breeding seabirds in France. Over the last decade, 12 species exhibited a positive population trend, 10 species appeared relatively stable and 4 species were decreasing. Human impact appears as one of the main factors influencing population dynamics of breeding seabirds. Predators, especially corvids or mustelids, are also a major threat for some species. Terns are the species more frequently concerned with management and conservation actions.

Foraging status of the Northern Gannets from the Bass Rock

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Northern Gannets *Morus bassanu*s are highly successful seabirds, given the long-term increase in breeding numbers in the North Sea and elsewhere in the North Atlantic. After many years of seemingly uninterrupted range expansion and colony growth, Northern Gannets are one of the first pelagic seabirds where the effect of intra-specific competition for food could be demonstrated. Northern gannets, like so many seabirds, perform long and often far-ranging, offshore foraging trips, as a result of which their foraging and feeding habits are particularly difficult to study from land. Gannets exploit a number of different fish prey (ranging from large shoaling fish to small sandeels) and discards from commercial fisheries and do so by a number of very different foraging techniques. Feeding gannets are famous for their spectacular plunge dives, sometimes from great heights, when targeting shoaling fish. However, small near-surface shoaling fish is targeted in radically different ways. Besides, Northern Gannets frequently associate with other seabirds and cetaceans, apparently to enhance their foraging success. Recent technology has resulted into advanced possibilities to tag foraging birds with data loggers, GPS receivers, or with radio- or satellite transmitters. These techniques give fascinating and unprecedented insight into some of the most important aspects of their foraging behaviour and movements at sea, such as diving frequency and diving depth. However, these tools provide information on individual birds, and the interpretation of the collected data is often hindered by a lack of information about the foraging environment and the feeding interactions of individual birds with other species or with conspecifics. In order to obtain an idea of foraging options and feeding possibilities in combination with specific (individual or group) decisions, observers studying the ecology of these birds have little more options than joining the birds at sea. In the ideal world, obviously, logger data should be combined with data collected during visual observations. In this paper, data on the distribution and the foraging and feeding behaviour of Northern Gannets in the North Sea, collected between 1991 and 2004 during the breeding season are examined to see what evidence we have for any decisions made by individual gannets in situations where there is a choice between feeding techniques and prey types. As a major underlying question: is there evidence from field data that nesting gannets set off from the colony with a given plan which is not easily changed, or are these birds rather opportunistic feeders, changing behaviour easily in response to specific situations encountered on their feeding trips? Distribution patterns and frequency distributions of deployed foraging techniques will be shown, as well as detailed data on prey choice and performance as scavengers at commercial trawlers. The results will be compared with recent outcomes of data logger studies.

Dutch Great Cormorants invade an offshore area

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Continental Great Cormorants *Phalacrocorax carbo sinensis* have dramatically increased in numbers in Europe in the past decades, taking advantage of better protection, reduced aquatic pollution and in some areas, of eutrophication-induced increases in fish stocks. Numbers in many of the major traditional (fresh water) colonies have reached carrying capacity in the 1990's, resulting in reduced feeding conditions *per capita*. This probably enhanced dispersal, resulting in colonisation attempts along the coast. In the Netherlands Great Cormorants now breed along the entire North Sea coastline. Twenty years ago Great Cormorants were rare seabirds in the area, but today they can be found

feeding anywhere in Dutch coastal waters in the breeding season. At sea, the birds appear to have found a bonanza of new prey, ranging from demersal fish (including flatfishes) to schooling pelagic fish. Their large size and diving abilities helps the cormorants to out-compete the local gulls and terns. The cormorants have learnt to use several different feeding techniques, from feeding solitary on e.g. flatfish, to mass flock-feeding on pelagic schooling herring fry, to scavenging behind trawlers. Diet studies have shown that they take will any fish in the sea, from tiny pipefishes and sticklebacks to large mackerel or garfish. Staple diets mostly consist of 0- and 1-group flatfishes and sandeels. Dozens of cormorants use offshore shipping buoys and gas-production platforms to roost; an offshore breeding attempt will probably be the next step.

Status and long-term changes of seabird populations in the Estuary and Gulf of St. Lawrence, Canada (1980-2003)

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The seabird population of the Estuary and Gulf of St. Lawrence is about 425,000 pairs of seventeen species. A review of seabird counts across the region over the last two decades show different trends between surface feeders (represented by gulls and terns) and divers such as alcids, gannet and cormorants. Larids, such as Herring Gulls Larus argentatus and Black-legged Kittiwakes *Rissa tridactyla*, started to decline significantly while most of the diving species increased; although the number of Atlantic Puffins *Fratercula arctica* declined between 1993 and 1999. At some specific tern colonies, predation and human disturbance could explain the observed decreases. But overall, the evidence suggests that anthropogenic and natural factors came into play to explain the different trends shown by the surface feeders and divers. The most likely direct anthropogenic impact would be related to the management of commercial fisheries, but the variability and unpredictability in environmental conditions makes it difficult to assign any one cause to the observed trends.

Hormonal and metabolic correlates of parental effort in the Black-legged Kittiwake

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Parental effort, the extra energy expenditure above maintenance levels devoted to the care of offspring, has been postulated to incur fitness cost. Parent birds adjust their daily energy expenditure to the requirements of the brood and a negative correlation between daily energy expenditure during reproduction and subsequent adult survival is expected. However, the comprehension of the proximal mechanisms underlying such allocation processes remains poorly understood. Studying hormones can offer great insight into the mechanisms basis to life-history trade-offs. We present here results from a co-operative project between France and Norway on the physiological mechanisms (hormones and metabolic rate) involved in the regulation of parental effort in the Black-legged Kittiwake *Rissa tridactyla*. This project has been carried out in at Hornøya (Northern Norway) and in Ny Ålesund (Svalbard). We studied relationships between parental effort (brood size manipulation), subsequent adult survival and corticosterone, a hormone which plasma levels often mirror changes in body condition and foraging effort. We also studied the metabolic consequences of parental effort by measuring changes in basal metabolic rate (BMR) throughout the chick-rearing. To do so, we estimated individual variations in BMR through thyroid hormone levels, a method that reduces handling time imposed by the use of a respirometer.

Inter-annual variability in the breeding success of Northern Fulmar

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Attendance patterns, reproductive success and survival of adult Northern Fulmars *Fulmarus glacialis* are all influenced by large-scale climate variation, but the mechanisms driving these patterns remain unclear. To explore links between climate variation, food availability and reproductive success, we compared colony and individual measures of reproduction and chick growth in 2002 and 2003. Studies were carried out on Eynhallow, Orkney. In 2003 there were fewer occupied nests and eggs were significantly smaller and later hatching. Chick growth rates during the first two weeks of brooding were significantly lower in 2003, but there was less variability in the weight of fledglings. Passive-integrated-transponders and visual observations were used to record attendance patterns during the early chick rearing period. These data suggest that individual adults were making longer foraging trips in 2003. Within a year, there were also differences in foraging duration, and these were positively linked to chick growth rates. Differences in several measures of breeding performance therefore point to reduced food availability for birds from this colony in 2003. However, there was no difference in the overall reproductive output of occupied nests, possibly because more birds failed early or skipped breeding during the poorer conditions prevailing in 2003.

European Storm Petrel monitoring in North Scotland

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Between 51 and 65% of the world's population of European Storm Petrel *Hydrobates pelagicus* is estimated to breed in Britain and Ireland. Tape/response and mark/recapture methods are used to monitor the populations of breeding storm petrel on two RSPB island reserves in North Scotland. Tape/response surveys give estimated populations for Priest Island of 4370 Apparently Occupied Sites, and Eilean Hoan of 97 AOS. The differences in correction factors between years requires further examination to see if single visits to permanent plots are feasible. Two 18m mist nets are used for mark/recapture. Different ringing dates have been trialled and we recommend that the survey be carried out before 16 June, to avoid catching itinerant non-breeders. During one survey, nets were set up across Priest Island and it was found that birds were not mixing. The ringing on Priest Island, therefore, cannot produce a whole island population estimate, but mark/recapture at the core site on the island is being used to produce an index from which to measure change. Whether birds on Eilean Hoan, which is a much smaller island, are mixing, needs to be explored. Both the Jolly and Fisher and Ford methods produce survival rate estimates between 0.84 and 0.88, which is remarkably close to other published survival rates.

Migration of Great Skuas as shown by satellite telemetry

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In this study, migration routes and over wintering grounds of great skuas were investigated through satellite telemetry. It was assumed that there is a minimal effect of attachment of satellite transmitters on this movement. Eleven adult Great Skuas *Stercorarius skua* were trapped during the breeding season and satellite transmitters attached using Teflon ribbon to form a harness. The results from this study suggest that Great Skuas may travel further south during the winter than previously demonstrated through long term ringing studies.

The influence of food availability on life history parameters of Arctic Skuas

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Arctic Skuas *Stercorarius parasiticus* breeding in Shetland feed predominantly on sandeels *Ammodytes*. Empirical data suggest a strong influence of sandeel stock size on Arctic Skua breeding success. In 2001 sandeel abundance appeared to be low. We examined evidence that food shortage contributed to the poor breeding success of Arctic Skuas by a supplementary feeding experiment, carried out during chick rearing. Compared with marked controls, supplemented pairs showed higher attendance on the territory, increased breeding success and a higher return rate to breed the following season. Differences in carbon and nitrogen isotope ratios in natural and supplementary food allowed us to measure the amount of supplementary food contributing to chick tissues, by analysis of chick feathers. This showed that the adults fed some of the supplementary food to the chicks but kept most of it for themselves. The supplementary feeding experiment clearly demonstrates the importance of food availability on many life history parameters.

Recruitment in the Great Skua

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Recruitment is influenced by several physiological and environmental factors. Birds in better body condition are expected to recruit faster into competitive colonies than birds in poorer condition. This study is being conducted on Foula, Shetland, on the biggest colony of Great Skuas *Stercorarius skua*. During May to July 2003 non-breeding birds attending club sites were trapped and colour-ringed. Several body measures were taken, including a profile of the pectoral muscle and a blood sample. Body condition was determined by body mass index, red blood cells size and flight muscle volume. Data collected in Foula over several years show breeders to have higher body condition than non-breeders. Great Skuas show high levels of site fidelity, they usually recruit very close to their born site. Next season we expect to find birds in better condition recruited into the colony and birds in poorer condition attending the clubs again.

Breeding site choice at different scales: colony attendance in prospecting Common Terns

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A substantial proportion of most seabird populations consist of young nonbreeders (prospectors). During the period of nonbreeding, prospectors are assumed to compare different potential breeding sites. Collecting sufficient data on prospecting behaviour is difficult as individuals are very mobile. From 1992 onwards, complete cohorts of the 'Banter See' Common Tern *Sterna hirundo* colony on the German North Sea coast have been marked individually with passive transponders. Sex has been determined by observations or by routine PCR methods for a high proportion of prospectors. The site consists of six subcolonies of equal shape and size and harbours a colony that has grown from 90 pairs in 1992 to 400 pairs in 2003. Transponders allow automatic registration of returning birds at the different subcolonies by antennas throughout the season. In 2001, a further antenna system was installed at an adjacent tern colony of about 30 pairs situated 4 km away from the Banter See colony. We compared spatial and temporal attendance patterns of birds at both colonies. We found that, on the colony and on the subcolony scale, males and females spent an increasing amount of time at a certain place within a season. Males showed a higher fidelity towards their place of birth than females. However, fidelity was also dependent on habitat quality, assessed as the number of breeding conspecifics. The most frequented place of attendance during prospecting for both males and females was favoured for a first breeding attempt in the following season at both the subcolony and the colony scale. As we found the same behavioural patterns at two different spatial scales, we assume that our results are general. (Supported by the Deutsche Forschungsgemeinschaft BE 916/5)

The status of petrels in Britain and Ireland

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European Storm Petrels *Hydrobates pelagicus* and Leach's Storm Petrels *Oceanodroma leucorhoa* nest in rock crevices or burrows, only returning to their colonies or appearing above ground at night. In Britain and Ireland, petrels nest on remote offshore islands where access during the hours of darkness is often difficult and hazardous. In the last two breeding seabird censuses of Britain and Ireland, namely, Operation Seafarer (1969-70) and the Seabird Colony Register Census (1985-88), the absence of an accepted method for surveying these species meant that estimates of colony size were imprecise. A principal aim of the Seabird 2000 Census (1998-2002) was to improve on these estimates using the recently developed taped call playback method, which generated the first quantitative population estimate of breeding European and Leach's Storm-petrels in Britain and Ireland. This paper will report on the findings of this census and will describe apparent trends.

Relaying by Arctic Terns in Greenland

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The Arctic Tern *Sterna paradisaea* in Greenland has been subject to an intensive exploitation in the form of egg harvest during the last five decades. This exploitation may have caused the marked population decline detected during the same period. A key question in future management and possible exploitation of the species is therefore if Arctic Terns can sustain a limited and controlled egg collection. In order to answer this question the present study has focused on the Arctic Terns capability of producing replacement clutches in case the first clutches are removed. The study, which was conducted in the largest Arctic Tern colony in Greenland, revealed that ten out of 16 (62.5 %) pairs relayed when the eggs where experimentally removed. The replacement nests were located after 8 to 15 (average: 9.8 days + 2.39) days after the removal in a distance of 3.1 to 46.3 m (average: 14.7 m + 16.5) to the original nest site. The average clutch size in replacement nests was reduced from 1.8 to 1.5 eggs. The results indicate that the overall reproductive outcome in harvested nests is reduced noteworthy.

Modelling the Isle of May Black-legged Kittiwake population

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On the Isle of May and elsewhere in the North Sea, Black-legged Kittiwake *Rissa tridactyla* breeding populations have declined by about 50% since 1990. We modelled population growth based on data collected on the Isle of May 1986-2002. Breeding success was high during the 1980s and low during the 1990s, and adult survival also declined over the study period. Modelling showed that the population decline was caused by the combination of low breeding success and low survival. The period of low breeding success coincided with a local industrial sandeel fishery, but a direct causal relation seemed unlikely. A sudden change in North Sea oceanography around 1988, with higher winter sea surface temperatures, may have affected food availability. Breeding success has improved in recent years, but without an improvement in survival this can only slow down the population decline. If Black-legged Kittiwakes have been adversely affected by increasing sea temperatures, the future is bleak for the species in the North Sea.

Spatio-temporal pattern of Black-legged Kittiwake nesting success

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Because of their surface-feeding habits, kittiwakes are considered very sensitive to changes in food availability, and they have often been used as indicators of the state of marine ecosystems. Furthermore, the species has declined dramatically in many areas of the British Isles since 1990, and the reasons for this decline remain unclear. The UK Joint Nature Conservation Committee has monitored breeding success of Black-legged Kittiwakes *Rissa tridactyla* at around 50 colonies in Britain and Ireland since 1986. We use these data to examine spatial and temporal patterns, trying to identify geographical regions where breeding success has varied synchronously. During the breeding season, Black-legged Kittiwakes feed mainly on Lesser Sandeels *Ammodytes marinus*, which occur in geographically structured stocks or aggregations showing independent dynamics. By relating the regional variation in kittiwake breeding success to these aggregations, we try to determine whether the local status of sandeels has affected the decline in Black-legged Kittiwake populations.

Variation in parental quality and the correlation between egg size, clutch size and the ability to produce a replacement clutch in Black-legged Kittiwakes

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Assessing differences in fitness among individuals is a central objective in evolutionary ecology. Many studies of fitness often use a parameter related to reproductive performance as a measure of individual quality. The chosen quality index is considered valid when it positively correlates with fitness. However, there are often many possible parameters for reproductive performance and the covariance among these different components needs to be considered. In this study, we investigated the sign of the relationship between three competing components of quality associated with egg production within a breeding population of Black-legged Kittiwake *Rissa tridactyla*. On the island of Hornøya (Northern Norway), we measured the variation in egg size, clutch size and in the capacity to produce a replacement clutch after an experimental removal of the first one during two breeding seasons (1999 and 2000) in a series of nests. In addition, we examined the consistency of egg size of breeding pairs both within and between breeding seasons in order to understand whether observed variation in egg production depended on individual factors. We found a positive relationship between egg size, clutch size and capacity to produce a replacement clutch. These results suggest that a large part of the variation observed in egg production could represent parental quality. Egg size was consistent within a clutch, between the first clutch and the replacement clutch and between first clutches of two successive years. Nevertheless, within a pair, we found that egg sizes of first clutches were on average larger than those of replacement clutches and that the mean egg size of the first clutches in 1999 was larger than in 2000. Thus, mean egg size represents a consistent, but relative, index of parental quality. Moreover, it provides information on within- and between-breeding seasons changes in the investment in egg production. This study underlines the importance of taking into account the heterogeneity among individuals when investigating trade-offs between life history traits. It notably stresses the need for field studies combining experimental approaches with detailed information on individuals.

Ice, seabirds and climate change, in the Canadian Arctic

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Global warming is having a strong impact on the extent and duration of seasonal sea-ice cover in the Arctic. Making use of research carried out in the eastern Canadian Arctic since 1975, we compare the breeding biology of several seabird species at two colonies – Coats Island, in Low Arctic waters and Prince Leopold Island, in the High Arctic. At Coats Island, in northern Hudson Bay, spring and summer ice cover has decreased significantly over the past 3 decades, causing changes in marine food webs and consequent adjustments to seabird diets and reproduction. Conversely, at Prince Leopold Island, in the High Arctic, there has been no detectable trend in the timing of ice break-up since 1970 and, correspondingly, we have seen no trends in seabird breeding biology. However, the timing and/or success of breeding at this colony are strongly affected by year-to-year variation in ice conditions, which are correlated to winter and spring temperatures in the region. The resulting correlations allow us to predict the effect on seabird breeding biology of earlier ice break-up, which should develop as a result of current climate trends.

Winter distribution of British and Irish Common Guillemots and the oil spill threat

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Following several recent major oil spills affecting British and Irish breeding Common Guillemots *Uria aalge*, the BTO has carried out analyses of the origin of ringed birds recovered following these incidents to describe the importance of different wintering areas for this species. The results show significant differences in the age structure and natal origin of birds affected in the different oil spills, indicating the existence of different wintering areas for different breeding populations of Common Guillemots. Birds wintering in the south-western approaches to the English Channel and south into the Bay of Biscay (affected by the *Prestige* spill) tended to be immature birds from colonies in the west of Britain and Ireland, whereas birds wintering in the English Channel and North Sea (affected by the *Tricolor* spill) tended to be adults from colonies in eastern Britain. A more general analysis of Common Guillemot ring recoveries shows a similar pattern, with birds from western breeding colonies wintering further south than birds from northern and eastern colonies. In general, immatures appear to winter further from their natal colony than adults. By understanding the dispersal patterns and winter distribution of such birds, we can assess the likely impacts on bird populations of such pollution incidents.

The Seabird Ecological Assessment Network (SEANET): a citizen science initiative for marine ecosystem health

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Numerous threats contribute to the mortality of seabirds and waterbirds, such as diseases, fisheries operations, persistent organic pollutants and metals, and oil pollution. Unlike the ongoing beach monitoring projects in Atlantic Canada, where significant chronic oiling problems have been detected, the northeastern coast of the United States has not been monitored regularly for seabird mortality. Since 1983 the Wildlife Clinic of Tufts School of Veterinary Medicine has been involved in research on aquatic birds as environmental sentinels. Studies on Bald Eagles *Haliaeetus leucocephalus* and Great Northern Divers *Gavia immer* uncovered significant problems associated with heavy metals, and lead to the recent initiation of our Seabird Ecological Assessment Network (SEANET http://www.tufts.edu/vet/seanet/). SEANET is a large-scale, collaborative program focusing on seabirds as indicators of marine and coastal ecological health. We are developing a network of seabird and ecological health organizations from Canada to New Jersey, launching 'citizen-scientist' beached bird surveys, and collecting data on seabird mortality, population distribution, ocean contamination, and coastal land use. We report on trends and results so far and directions for the future.

A field test of food information transfer through local enhancement in a colonial seabird

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Coloniality is often associated with patchy food resources and social foraging. We tested whether colony members increase their food location efficiency through local enhancement, a form of social facilitation where individuals may cue each other as to the location of food, in a Common Tern *Sterna hirundo* colony located in Wilhelmshaven, Germany. We set up a two-factor design, where we manipulated both the presence of conspecifics displaying feeding behaviours over a feeding patch and the distance from the colony to this feeding patch (100, 300 and 500 m). To do this, we used a floating structure that contained a large amount of fish prey during local enhancement trials, but not during control (i.e. individual foraging) trials. Response variable was the number of individuals recruited every minute into the feeding patch. During control trials, we assumed that the number of birds that flew over the floating structure reflected the number of birds that would discover the prey by foraging individually if prey were present. The rate of food patch location was higher when local enhancement operated. Moreover, this rate had similar values within the range of distances during local enhancement trials, but it decreased as distance to colony increased when only individual foraging occurred.

Social attraction and habitat quality influence breeding habitat selection in marshland Common Terns

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Individuals may use both intrinsic features of the habitat and conspecific-based cues as proximate stimuli in breeding habitat choice. Here, we studied these topics in Common Terns *Sterna hirundo* breeding in a NW Mediterranean marshland. The study area consisted in various breeding patches occupied by groups of different sizes, and where quality of nesting sites varied within patches according to flooding risk. We used both observational data about characteristics of nest sites and field experiments through manipulation of conspecific presence by using decoys simulating breeding terns. At a breeding-patch scale, we assessed whether terns selected occupied patches (experiment 1) and also whether group size influenced patch choice (observational approach). Results from experiment 1 support the selection of already occupied patches, whereas observational data suggests selection for large and medium groups. We also assessed, at the nest-site scale, whether terns showed a preference for nesting close to an already breeding tern, or in high quality breeding sites, or both (observational approach and experiment 2). Observational data suggests that both nest-site quality and proximity of conspecifics were preferred features. In contrast, results from experiment 2 do not suggest any preference for breeding close to conspecifics, although there appears to be a clear preference for high quality sites, i.e. with low flooding risk.

Are changes in food supply responsible for the decline in Herring Gull numbers?

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In common with the rest of the Herring Gull *Larus argentatus* population in the UK, the Walney population has decreased dramatically during the last two decades. 'Natural' colonies are particularly affected, whereas in contrast colonies in urban areas, though much smaller, have continued to expand. Interestingly, the closely related Lesser Black-backed Gull *Larus fuscus* does not show the same pattern of decline. We have investigated the diet and reproductive performance of the two species at Walney, and compared this with data from earlier studies. Herring and Lesser Black-backed Gulls showed different profiles with respect to diet, feeding sites and distance travelled. We therefore suggest that the differences in the demographic trends in the two species are linked to differences in the sensitivity to changes in feeding opportunities.

Winter movements of Northern Gannets

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Fifteen adult Northern Gannets *Morus bassanus* breeding on Bass Rock, Scotland, were equipped in August 2002 with daylight loggers (GeoLT, earth & ocean technologies, Kiel). The loggers were fit to a metal plate which also consisted of two metal rings which were attached to one leg like ordinary bird rings. Thirteen out fifteen gannets were recaptured between April and June 2003. Data were downloaded after retrieval and stored on a computer. Data were analysed by software using the principle of geolocation. By the light measurements and an internal clock, approximate times of dawn and dusk can be calculated. From these timings, geographic positions could be derived. From eight birds on which data were collected until at least December, the following areas were determined as winter regions: Atlantic off Senegal (3), Atlantic off Morocco/Spain (1), Mediterranean Sea (1), Bay of Biscay (2) and North Sea / English Channel (1). All birds moved south through the southern North Sea and the English Channel. It is most striking that three out of eight birds stayed over winter in nearly the same area off Senegal.

Demography of the Razorbill at the Gannet Islands, Labrador

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Recent advances have been made in ecological modelling in long-lived species, such as seabirds. Razorbills *Alca torda* are a long-lived seabird, which respond to a variety of environmental perturbations. As a result, an ecological model for this species is needed. Although Razorbills are a relatively well-studied species in Europe, many areas of Razorbill demography in North America remain unknown. Therefore, the goal of this project is to measure Razorbill demographic parameters to determine what factors ultimately regulate Razorbill populations. To do this, I address 3 main objectives: (1) to quantify Razorbill demographic parameters including annual survival, age of first breeding, and natal philopatry and dispersal at their largest colony (2) to quantify and examine the effects of breeding density and intraspecific kleptoparasitism on Razorbill hatchling success, and (3) ultimately to develop a predictive population model to help asses the impact of hunting, egging, mortality in fishing gear, oil pollution, arctic fox invasions of remote islands, and climate change on the North American Razorbill population.

Tern conservation in Brittany

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Four species of terns breed annually in Brittany: Sandwich *Sterna sandvicensis*, Common *S. hirundo*, Roseate *S. dougallii* and Little Tern *S. albifrons*. Since the 1950s, data were regularly collected on their breeding numbers and distribution and Bretagne Vivante - SEPNB has established an important network of protected colonies. Since 1989, Bretagne Vivante coordinates the 'Observatoire des sternes de Bretagne', which allows all managers of colonies to share their data. The 'Observatoire' is financed by the Regional Council of Brittany and the County Councils of Finistère and Côtes d'Armor. The field-work was mainly conducted by tens of volunteers. A comparison of the demographical trends of each species highlights a huge decrease in the 1970s, especially for Roseate and Sandwich Terns, and probably also for Common Terns. The consequences of reserves creation on terns in Brittany are presented. These reserves have not always led to an increase in breeding numbers. At the beginning of the 21st century, virtually all Roseate (80 pairs) and Sandwich (1700 pairs) Terns breed on reserves, and around 60% and 50% of the Common (1300 pairs) and Little Terns (65 pairs) respectively. Importance of management actions (vegetation management, control of predators, wardening, etc.) is illustrated.

Body mass change with age in adult Common Terns

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In Common Terns *Sterna hirundo* body mass is a consistent individual trait which characterises the state of an adult and which is positively related to long-term reproductive success. In this paper, we show that body mass increases during the early breeding career of an individual, and we separate effects of age and experience. The study was conducted in a Common Tern colony in the harbour area of Wilhelmshaven on the German Wadden Sea coast. Transponders allowed registration of individuals throughout the breeding season and throughout consecutive years by a system of antennae, combined with electronic balances recording individual body mass within and between years. Individual body mass was measured during three stages of the breeding season: at arrival, during incubation and during chick rearing when mass is lowest in both sexes. Longitudinal analyses of individual data clearly showed that body mass during incubation and chick rearing increased up to an age of five years. Furthermore, a significantly lower body mass was found in first time breeders compared to experienced breeders. We assume that increasing experience enables the birds to cope better with the physiological constraints during migration and reproduction. Explaining the general phenomenon of higher body mass in older birds, our results support the constraint hypothesis and refute the selection hypothesis (Supported by the Deutsche Forschungsgemeinschaft BE 916/5).

Trawlers, Balearic Shearwaters and Shags: new insights from the Balearic Islands

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Consumption of discards by scavenging seabirds is a well known phenomenon, but less attention has been paid to the exploitation of this resource by more specialised and often threatened seabirds. We studied attendance to trawling by two seabird taxa of particular conservation concern, the endemic Balearic shearwater *Puffinus mauretanicus* and the Mediterranean Shag *Phalacrocorax aristotelis desmarestii*, in the Balearic Islands (W Mediterranean). Balearic shearwaters were regular (65% by occurrence) but very scarce (1% by numbers), although trawlers operated around the colonies. This is in contrast with observations off E mainland Spain, where the species makes extensive use of trawling discards. We observed lower numbers of shearwaters attending trawlers outside the breeding period. Shags occurred in low numbers (0.3%), but their presence was quite regular (28% of hauls), involving both immature and adult birds. These figures are higher than those previously reported, and suggest that the species has recently incorporated this feeding technique. Although shags are considered strictly coastal in feeding habits, we observed birds attending trawlers at up to 11 nm offshore.

Assortative mating in relation to age and body condition in Common Terns

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Assortative mating in relation to age or breeding experience is widespread among long-lived, monogamous seabirds, including the Common Tern *Sterna hirundo*, which shows assortative mating as well in relation to body mass. In order to take a closer look at the causes and benefits of assortative mating, we analysed data from a long-term study (1992-2003) at a breeding colony of Common Terns in the harbour area of Wilhelmshaven, Germany. All native breeders born since 1992 have been marked as chicks with passive transponders and are therefore well-known concerning their age and life-history. Using antennae distributed within the colony site, we recorded arrival dates, attendance and body mass of the marked terns remotely and automatically. To determine the breeding pair members, we placed antennas around each nest. We analysed the availability of potential mates in the different age classes to estimate, whether assortative mating is an active decision in the Common Tern or just a side-affect due to age- or mass-dependent arrival dates at the colony site. Interaction between the two factors age and body mass was considered. This study is supported by the Deutsche Forschungsgemeinschaft BE 916/5-2.

Pairing for the first time: Causes and consequences of mate choice in recruiting Common Terns

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We investigated the patterns of primary mates in Common Terns *Sterna hirundo* recruiting their natal colony (Wilhelmshaven; NW-Germany). We marked all fledged Common Terns with transponders allowing automatic identification of breeders and non-breeders for lifetime throughout each breeding season at their natal colony site. In this way we are able to identify the recruitment year of each individual, as well as age and status of their mates, as far as they also originate from the "Banter See" colony. We present pair bonds of more than 300 recruits and found sex-specific differences in age: male recruits showed mainly the same age as their mates, whereas female recruits predominantly had the lower age within their first pair bonds. Furthermore we focus on variation in reproductive performance between paired recruits (42%) in comparison with recruits mated with experienced breeders (15%; 43% of the recruits were mated with a tern of unknown origin). Recruit/recruit pairs laid significantly smaller clutches than pairs with one experienced bird, who also produced more fledglings. Only for male recruits it was necessary to arrive early in the year of recruitment to mate with experienced females. In addition, only male recruits characterized by high body mass were able mate with females of ≥2 years of breeding experience. These sex-specific different requirements to obtain an experienced mate did not result in different consequences in terms of reproductive success between the sexes. Our results suggest that "good partners" are available only for some first time breeders (in males probably the birds of high quality), and imply a fitness benefit: in the year of first breeding recruit-experienced breeder pairs had a higher reproductive success (Supported by the Deutsche Forschungsgemeinschaft; BE 916/5).

Influence of hydrographic features on the distribution of seabirds in the southeastern North Sea

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The German Seabirds at Sea Group has conducted ship-based surveys in the southeastern North Sea since 1990, recording data on seabird occurrence often simultaneously with hydrological parameters. A selection of these studies that took place during the non-breeding season was analysed to investigate the relationships between seabird distribution and hydrography. For this purpose the distribution of all common species in the southeastern North Sea was related to horizontal and vertical profiles of different hydrographic parameters. The analysis revealed the following results: large gulls never showed a relationship with hydrography. Most of the other common species showed a significant or at least a positive correlation to a selection of different hydrological structures. On the larger scale, these hydrographic phenomena consisted of distinct water masses with differing salinity, temperature and Secchi depth readings. At a smaller scale, frontal structures which were created e.g. by local upwellings or river plume fronts, were important. Just like the distribution of seabirds and hydrological patterns themselves the nature of their relationship exposed variability over different time spans. Though many other studies already revealed that the main link between the distribution of seabirds and hydrology is their prey, the exact mechanisms behind their relationship in the southeastern North Sea have yet to be investigated.

Extending the boundaries of terrestrial breeding seabird colony protected areas into the marine environment

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Special Protection Areas (SPAs) provide protection and management of naturally occurring wild birds in the European Union, under the provision of the EC Birds Directive. Currently, UK SPAs are mostly limited to terrestrial, freshwater and estuarine environments. However, the Directive also applies to marine areas. The Joint Nature Conservation Committee (JNCC) is undertaking surveys and analyses to provide advice to support the designation of SPAs in the marine environment. As part of this project, in 2001 we carried out boat-based surveys of seabirds at sea up to five kilometres from the coast of six important UK breeding seabird colonies (Skokholm and Skomer, Grassholm, the Farne Islands, the Bass Rock, the Isle of May and Fowlsheugh). Geostatistical analyses revealed that significant numbers of Northern Gannet *Morus bassanus*, Common Guillemot *Uria aalge*, Razorbill *Alca torda*, and Atlantic Puffin *Fratercula arctica* used waters around these colonies for maintenance behaviour such as preening and bathing, and for courtship behaviour. Consistent aggregations of the auk species were identified within one kilometre from the shore, and consistent aggregations of Northern Gannet were identified within two kilometres from the shore. We propose a one kilometre seaward boundary extension of Common Guillemot, Razorbill and Northern Puffin colony SPAs, and a two kilometre seaward boundary extension for Northern Gannet colony SPAs.

Seabird populations of Britain and Ireland: the last 30 years.

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April 2004 will see the publication of Seabird Populations of Britain and Ireland (T. & A. D. Poyser, London), which summarises the results of Seabird 2000, a census of all 25 species of seabird breeding in Britain and Ireland. Britain and Ireland hold internationally important breeding populations (i.e. more than 1% of the global population) of 21 and 11 species seabird respectively, including 90% of the world's Manx Shearwaters *Puffinus puffinus*, 68% of Northern Gannets *Morus bassanus* and 60% of Great Skuas *Stercorarius skua*.

Seabird 2000 is a partnership between JNCC and nine other governmental and non-governmental conservation organizations in the UK and the Republic of Ireland, including the Seabird Group. Over 1000 surveyors took part between 1999 and 2002 and censused over 8 million seabirds breeding at 3,200 colonies along 40,000 km of coastline and at 900 inland sites. It follows on from two previous censuses: Operation Seafarer in 1969-70 and The Seabird Colony Register in 1985-88, thus allowing population trends over 15-30 years to be assessed. The results of Seabird 2000 also provide an accurate baseline on which to compare future monitoring. For the first time, accurate baseline estimates were obtained for populations of nocturnal species (i.e. petrels and shearwaters) breeding on the remotest of the British Isles. This paper will concentrate on the major trends identified over the last 30 years and will identify the key factors driving these changes and will highlight those changes which warrant further explanation.

How important is the timing of breeding in Cape Gannets?

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The onset of breeding can differ significantly between individuals of the same species and localities. In the breeding colony of Cape Gannets *Morus capensis* at Malgas Island (South Africa) a difference in the start of breeding of several months can occur between individuals. These large differences can result in some birds having a fully-grown chick ready to fledge where other birds are still incubating their egg. The gannets of Malgas Island feed in the Benguela ecosystem, which provides abundant food due to up welling of nutrient-rich food. The long breeding season suggests that the period of peak food availability is less predictable in the Benguela upwelling-system. Due to the differences in onset of breeding, the oceanographic conditions of the feeding grounds can differ largely between early and late breeders. Both early and late breeders need to supply their growing chicks with approximately the same amount of food. Therefore, changes in the oceanic conditions might also require changes in feeding behaviour to sustain these required needs of the young. In this study we are interested in possible different strategies early and late breeders apply in order to rear their young successfully under different conditions. By studying the foraging behaviour of the adults and the growth rates of their chicks, possible differences in strategies and their effects might be found.

A survey of the Manx Shearwater colony on Rum, Inner Hebrides in 2001

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A sample survey of the breeding numbers of Manx Shearwaters *Puffinus puffinus* was carried out on Rum in 2001, based on 658 circular quadrats randomly positioned throughout the colony. All burrows in the quadrats were checked for occupancy during the late incubation period, by playing a tape of a male shearwater call at burrow entrances. The resulting estimate of the number of responding burrows was combined with a correction factor for non-responding occupants of 2.16, which was estimated by a separate calibration study in 2003. This gives an estimate of 76,310 occupied burrows (95% confidence limits 61,160 - 95,740). Additionally, burrows were checked visually for signs of occupancy and this gave a higher total of 119,550 occupied burrows (95% confidence limits 106,730 - 133,550). Further study of the response rate at this colony is needed before it is possible to interpret the apparent discrepancy between these findings. The estimate based on signs of occupancy is comparable with earlier studies and little evidence has been found to indicate that the colony is decreasing, as had been suggested in the 1990s.

Present Status of Roseate Tern in the Azores

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Roseate Terns *Sterna dougallii* are one of the rarest seabirds breeding in northwestern Europe and are listed as a species of conservation concern. The Azores still holds the stronghold of the European population (54% in 2002). Regular annual surveys were initiated in 1989 and since then the population has fluctuated substantially, reaching a minimum of 379 pairs in 1993 and a maximum of 1249 in 1991. Despite these fluctuations, the Azores population has remained generally stable and the sites of long-term importance for the terns have been clearly identified. The main threats to the Azores population are predation and human disturbance. Recently, European Starlings *Sturnus vulgaris* have been identified as a main predator of Roseate Terns on one of the main colonies (Vila islet, holding 20% of the breeding population). This predatory behaviour has not been observed in other colonies but it is vital to continuously monitor the situation as starlings roosting areas overlap extensively with tern breeding areas. Additionally, gulls have recently been detected breeding in sites that were previously only occupied by terns. Regardless of all the conservation projects developed in the past decade Roseate Terns in the Azores are not yet sufficiently protected from human disturbance. In 2003 only one of the five main colonies had a warden. Practical conservation measures need to be put in place if the Azores population of roseate terns is to be maintained. These could include (1) wardening of the main colonies, (2) controlling the impact of European Starlings and (3) preventing gulls from expanding and breeding at tern historical colonies.

Herring and Lesser Black-backed Gulls: a tale of contrasting fortunes

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Herring Gulls *Larus argentatus*, at the time of Operation Seafarer (1969-70), were one of the most widespread and numerous breeding seabirds in Britain and Ireland. Subsequently, population declines were recorded in all countries by the time of the Seabird Colony Register (1985-88). In the last 15 years a slight recovery has taken place in England and Wales but declines have continued in Scotland and Ireland. The number of roof-nesting pairs has increased considerably though such gains have not compensated for the losses in natural coastal habitats. With an overall 50% loss of nesting pairs in Britain and a 90% loss in Ireland, Herring Gulls are conservatively placed on the Amber List in the UK and are heading for the Red List in the upcoming review of Birds of Conservation Concern in Ireland. This talk will discuss factors behind these status changes and will open the debate on what sort of a Conservation Action Plan is required for the species. In marked contrast, the breeding population of Lesser Black-backed Gulls *Larus fuscus* has increased over the last 30 years in all countries, though the timing and pattern have varied. The roof-nesting habit has also increased in parallel with Herring Gulls. The numbers of Lesser Black-backed Gulls wintering in southern parts of Britain and Ireland have also risen throughout the 30 year period; these changes and other aspects of their ecology will be considered.

Apparent trends in the Black-legged Kittiwake in Greenland

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There is little information on the status and trends of the Black-legged Kittiwake *Rissa tridactyla* colonies in Greenland. This study analyses and evaluates historical counts from 1920-1999 of Black-legged Kittiwake colonies which have had >1000 breeding pairs and have been counted twice or more. Fifty colonies fulfilled these criteria. Thirty-four of these colonies declined by between 50-100%. Data suggest that the decline have occurred throughout most of the country. Only five colonies had increased and eleven had remained stable or had been fluctuating with no clear trend. The increasing colonies do not compensate for the overall decline. Despite the heterogeneity of the count years and varying degree of count quality the data suggest a dramatic decline within the last century. Data analysis does not suggest that local hunting, egg collecting or disturbance at the breeding colonies have been major causes for the decline and other causes should be considered. Actual causes for the decline remain unknown.

Common Guillemots in the Faroes over 30 years

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The Faroese Common Guillemot *Uria aalge* population has been declining since late in the 1950s. All the old colonies still exist, but egging results indicate that the breeding population was down at 25% in 1986. The total population was censused for the first time in 1972 and this census was repeated in 1987 and 1997-99. From 1972 to 1987 there was a decline in all the colonies, and it continued from 1987 to 1997-99 and some parts of colonies were totally empty. However, in a few colonies there was an increase in some areas. In a study plot, 300 ledges have been censused separately once a year since 1972. Of these 300 ledges, 80 were without Common Guillemots in 2003 and the number of birds has declined by 52 %. The main reason for the decline in the Common Guillemot population is probably a reduction in the production of food on the Faroe Shelf. Since 1990 the primary production in the shelf water has been measured each year and there is a high correlation with the number of Common Guillemots attending the study plot.

Influence of food availability on demography and population dynamics in a Mediterranean seabird

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Few studies have addressed the effects of food availability as a proximate factor affecting local adult survival in long-lived organisms and their consequences at local population dynamics. We used capture–recapture analysis of resightings of 10 cohorts of ringed Audouin's gulls *Larus audouinii* to estimate adult survival and dispersal (both emigration and immigration). A trawling moratorium established since 1991 was used as a natural experiment of food availability to assess its effects on adult survival and emigration. These and other demographic parameters were used in a projection modelling to assess the probabilities of extinction of the colony under two scenarios of lower and higher food availability. Food availability (together with the age of individuals) influenced emigration probabilities, but not adult survival, which was estimated at 0.91 (SE = 0.02). When food was in shorter supply during the chick-rearing period, emigration was very high (ca. 65%) for younger breeders, although this rate decreased sharply with age. Probabilities of extinction were very high when food availability was low, and when environmental stochasticity was introduced, and only stochastic immigration from the outside seemed to prevent extinction. The results highlight the importance of dispersal processes in the population dynamics of long-lived organisms.

Exploring the impact of climate on the distribution of Great Skuas breeding in the UK

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The Great Skua *Stercorarius skua* has a breeding distribution throughout the UK that is consistent with climatic constraints imposed by mean air temperature during the breeding season. Results from metapopulation and dispersal models are explored to illustrate the effects climate has had on the spread of Great Skuas from a bottleneck Shetland population in the early twentieth century and the degree to which the observed spread is driven by climatic processes. The most important factors affecting the distributions of skuas are discussed within the context of conservation and the applicability of the models for use with other European seabird species is outlined.

The Seabird Monitoring Programme of the United Kingdom

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The Joint Nature Conservation Committee's Seabird Monitoring Programme (SMP) facilitates the co-ordination of seabird monitoring on a UK-wide basis. It has, since 1986, maintained a programme of monitoring the numbers and aspects of the biology of 26 species of breeding seabirds. The aim of the SMP is to ensure that sufficient data on breeding numbers and breeding success of seabirds are collected both regionally and nationally to enable their conservation status to be assessed. The programme assists JNCC and partner organisations in monitoring aspects of the health of the wider marine environment and to provide advice relevant to the conservation needs of breeding seabirds. The poster presents data on trends of UK seabird populations from a sample of colonies during the course of the SMP, along with information on changes in their breeding success and adult survival. The varying fortunes of species with different feeding strategies are presented and discussed. Recent results of monitoring the largest population of Leach's storm petrels *Oceanodroma leucorhoa* in the eastern Atlantic - on St Kilda, western Scotland and a forward-looking review of the aims and methods of the SMP, 18 years after its inception, will be presented.

Using First-Passage Time analysis to assess the scales of interaction with marine environment

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Oceans are assumed to be very variable habitats, where patchy resources are distributed over a large range of spatial scales. Understanding changes in seabird populations need to know how they use their environment. We expect that these long-range predators change their foraging movement pattern according to prey density and increase their search effort in high profitability zones. Finding these foraging areas at the correct scales of interaction is an important clue to understand relations between seabirds and their environment. Here, we apply a new analysis described by Fauchald & Tveraa (2003) to assess foraging zones at the correct interaction scales, on 26 satellite tracked Yellow-nosed Albatrosses *Thalassarche carteri*. Twenty-two of twenty-six birds adopted an area-restricted search at a large-scale of 150km, and 11 of 16 adopted this behaviour at a nested small-scale. In the same time, wet-dry loggers were used to confirm that diurnal landings, which are associated with feeding behaviour, were more frequent in the selected zones. Finally, we illustrated these interactions with ocean by performing habitat selection using compositional analysis.

Successes and failures to artificially increase seabird numbers

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Many seabird populations worldwide are in decline due to a host of various anthropogenic factors. As a response to these declines there have been some attempts made to reverse these declines or to stabilize these populations. The focus here will be on the use of social attraction using decoys and broadcasting of courtship vocalizations to influence nest site selection and thereby reproductive success. In some cases, social attraction is used in combination with translocation of seabirds in an effort to either restore them to former sites or guide them to new and presumably safer sites. Results of these efforts have been mixed ranging from highly successful reestablishment of seabirds to extirpated sites to cases where the populations do not respond in any significant way. Nevertheless, as seabirds continue to decline in the face of human activity that impacts ocean systems it will be increasingly necessary for seabird biologists to take an active role in reversing population decline. A close examination of the past performance of efforts to achieve this end should prove useful in the designing of future seabird management programmes.

Review of divers, grebes and seaduck distribution and abundance in the SEA 5 area

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As part of the ongoing Strategic Environmental Assessment (SEA) programme for offshore energy on the UK continental shelf, Cork Ecology reviewed the distribution and abundance of divers, grebes and seaduck in the SEA 5 area, at the request of the Department of Trade and Industry (DTI). The SEA 5 area includes the east coast of Scotland, Orkney and Shetland (see www.offshore-sea.org.uk) and the review is an update and an extension of an earlier (1985) JNCC document. Thirteen species were considered in this review, using data from a variety of sources including land-based and at-sea counts between 1991 and 2003. Relevant data for the SEA 5 area from the European Seabirds at Sea (ESAS) database were analysed on a fine scale and compared to data supplied by the Wildfowl and Wetlands Trust (WWT), Shetland Biological Records Centre, Shetland Oil Terminal Environmental Advisory Group (SOTEAG), Orkney Biological Records Centre and the Royal Society for the Protection of Birds (RSPB). Several bird reports were also reviewed for relevant counts and records. A brief summary of the most important areas for each species group is presented in a national and international context. Gaps in coverage are highlighted and suggestions for future work are made.

Distribution of Common Guillemots and Razorbills in relation to abundance of pelagic fish in a part of the Dutch North Sea

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Hardly any information is available about the distribution of wintering seabirds in the Dutch part of the North Sea in relation to ecological and physical parameters. In November 2003 a ship-based survey was conducted in a part of the Dutch North Sea. This survey focussed on the distribution of Common Guillemots *Uria aalge* and Razorbills *Alca torda* in relation to the pelagic fish abundance and physical parameters of the seawater. In this poster a first explorative analysis of the results is presented. A fishing vessel was used as research vessel during two weeks of observations in which six transects perpendicular to the coast were surveyed (to a maximum of 55 nautical miles offshore). Two observers counted the seabirds using standard ESAS strip transect methodology. At the same time distribution of pelagic fish was estimated by means of echo integration, using a scientific echosounder and a splitbeam transducer. Fish were sampled with a pelagic trawl to validate the acoustic observations. Temperature and salinity were measured with a CTD measuring device, and turbidity using a Secchi disc. This study was conducted within the framework of a long-term monitoring program on seabirds at the Dutch North Sea of the National Institute for Coastal and Marine Management (RIKZ).

The Prestige incident: assessing the impact of a major oil spill

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The sinking of the oil tanker Prestige on 19th November 2003 in deep waters off Galicia caused considerable oil pollution and over subsequent months approximately 23,000 oiled seabirds were found dead or dying on the coasts of northern Portugal, northern Spain and south-west France. The effect of an oil spill on seabird populations cannot be properly evaluated without detailed information on the species composition and age structure of casualties. The authors established a programme of systematic autopsies, to collect information on the origin of the casualties (ringing recoveries and biometrics), sex-ratio, physical condition, age structure and, as a scientific bonus, the diet of the casualties. A total of 6,171 birds were examined, the most numerous species being Common Guillemot *Uria aalge* (35.3% of the total), Atlantic Puffin *Fratercula arctica* (29.4%), Razorbill *Alca torda* (16.2%), Yellow-legged Gull *Larus michahellis* (5.4%), European Shag *Phalacrocorax aristotelis* (2.9%), and Northern Gannet *Morus bassanus* (2.7%). Mass mortality of adult seabirds is more likely to have an impact on breeding populations than mortality of immatures. Some 5,073 seabirds could be aged and in the above species, the proportion of adult birds among the casualties ranged from only 3.0% (n = 921) in Razorbills to 73.8% (n = 84) in Northern Gannets. Of European Shags, 57.6% (n = 144) were mature birds and the local breeding population must have suffered considerable losses. Razorbills, Atlantic Puffins and Common Guillemots mainly originated from British and Irish breeding colonies. Several very small, adult Common Guillemots were probably representatives of the endangered population of Iberian Guillemots. The analysis of diets based on stomach contents is currently under way, but some preliminary results will be shown.

Diagnosis of the decline of the Arctic Skua population in the Northern Isles

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Complete censuses of Arctic Skuas *Stercorarius parasiticus* in the Northern Isles have been conducted in the 1982 (Orkney), 1985-86 (Shetland), 1992 and 2000-2003. Annual monitoring of numbers and productivity at a sample of colonies throughout the two archipelagos was collected between 1990 and 1999. The Arctic Skua population on the Northern Isles was roughly stable at around 2940 pairs between the mid 1980s and 1992, but declined by 37% to 1840 pairs between 1992 and 2000-2003. These declines were evident throughout both archipelagos, although the rates varied among islands and regions. Annual monitoring of study colonies between 1990 and 1999 demonstrated a consistent long-term decline in numbers during this period. The decline could be explained by poor recruitment following breeding failures caused by poor food availability or by increased territory competition and juvenile predation by the expanding Great Skua *Stercorarius skua* population. Annual monitoring data are used to parameterise population models to test whether variations in productivity are sufficient to explain the change in numbers. Data on changes in the relative distribution of Great and Arctic Skuas between 1992 and 2000-2003 are used to examine whether competition for nesting territory has contributed to the decline.

Oil spill and seabird conservation: using population genetics to assess the geographic impact of the Erika oil spill on Common Guillemot populations

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Determining the origins of seabirds caught in an oil spill is a critical conservation issue as the spatial scale of the impact may be much larger than the polluted area. Following the wreck of the Erika oil tanker in the Bay of Biscay in December 1999, more than 80 000 seabirds were washed ashore along the west coast of France. The most heavily affected species (80% of all birds) was the Common Guillemot *Uria aalge*, a widespread long-lived colonial seabird. In an attempt to evaluate the 'true' geographic extent of this accident, we carried out population genetic analyses using six microsatellite markers and samples from 20 breeding colonies in the North Atlantic and individuals collected after the oil spill. A pattern of isolation by distance was detected among Common Guillemot populations, but despite a supposedly extreme rate of philopatry, we found weak population genetic structure, even at large spatial scales. The low level of genetic differentiation between colonies prevented pertinent assignments to the area of origin using only the genetic information, despite the fact that the recovered birds came from a wide area including many colonies situated along the British and Irish coastlines. In addition to stressing the potentially large geographical scale of the impact of oil spills, the study underlines the need to combine different approaches to assess their conservation implications.

Interactions between vertebrate predators and mussel longline aquaculture at an Atlantic sea loch

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Concerns about the environmental implications of mariculture activities have grown in recent years in response to the rapid expansion of the industry. The Blue Mussel *Mytilus edulis* is the main product from shellfish mariculture in the Northeast Atlantic and Baltic Sea, with approximately one third of the harvest cultured using suspended longlines in sheltered marine areas. The main aim of this study was to assess the impacts (if any) of mussel suspension culture on the seabird and seal community employing a simultaneous study of culture and control sites. The study spanned a 20-month period (from November 2001 to August 2003) and encompassed six sites in Bantry Bay (Southwest Ireland). Species richness was higher in mussel sites than in control sites, however control sites were more diverse. Community composition differed between mussel and control sites with the Laridae family dominating communities in mussel sites. Significantly higher numbers of Phalacrocoracidae, Laridae and Alcidae (ANOVA repeated measures, $P<0.05$) were recorded in mussel sites than in control sites. However, no significant difference was found between Gaviidae or Common Seal *Phoca vitulina* numbers in mussel and control sites. Seasonal patterns of abundance were similar in mussel and control sites, with peak numbers of most species groups occurring in winter or spring. Mussel suspension culture does not appear to have an adverse effect on the abundance of seabirds or common seals in this area. The safe perching platforms provided by suspension culture floats contribute to an increased abundance of a number of seabird species, particularly Laridae.

The possible effects of contaminants on the survival, breeding dispersal and natal dispersal of Red-tailed Tropicbirds nesting on Johnston Atoll

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Annual survival and dispersal rates of adult and juvenile Red-tailed Tropicbirds *Phaethon rubricauda* were examined in connection with exposure to heavy metals. The incineration of chemical weapons stored at Johnston Atoll, central Pacific Ocean, exposed tropicbirds nesting in the vicinity of the plant to increased levels of human disturbance, smoke stack emissions of heavy metals and potential leaks. Birds nesting downwind of the plant were compared to those nesting in a reference site, upwind of the plant, with less human disturbance, and no exposure to incinerator emissions. We did not find any effect of the incineration activities on survival of adults or juveniles between the two sites. Adult breeding dispersal rates did not differ between the sites but we did find differences in the age-specific natal dispersal rates. Birds fledged from downwind areas were less likely to return to their natal area to nest and more likely to immigrate to the upwind area than vice-versa. We believe this asymmetry in natal dispersal rates is most likely due to differing vegetation densities and disturbance regimes. These results have significant implications for vegetation management in relation to tropicbird nest success and population size.

Survival and determinants of population size in a multi-species seabird colony over 35 years: Johnston Atoll, central Pacific Ocean

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Thirteen seabird species breed on Johnston Atoll and the population sizes of each of these were tracked from 1964 – 1969 and 1984 - 2003. Extensive banding and recapture was carried out to determine annual survival, movement rates and other individual breeding biology traits. The Atoll has 4 islands, with a military base housing from 300-1500 people over the years on the largest island. Various military activities, including nuclear missile testing, nerve gas storage and burning, and leaking agent orange containers, all had the potential to effect bird populations. In spite of all this, population sizes of all species grew significantly over 35 years. Major effects on population size were those of one seabird species on another and not due to man. For instance, roosting Red-footed Boobies *Sula sula* and Great Frigatebirds *Fregata minor* killed hundreds of bushes that once housed Red-tailed Tropicbird *Phaethon rubricauda* nest sites. Other annual factors affecting population size to a small degree were the occurrence of El Niño events and the clearing of vegetation by humans. Adult survival in Red-tailed Tropicbirds between 1984 and 2002 averaged 90% and juvenile survival to breeding averaged 78%. Adult survival rates were significantly higher during non- El Niño years than during El Niño years. This same trend is detected for pre-breeders but is not significant.

At-sea distribution and activities of Lesser Black-backed Gulls in the German Bight - a reflection of the exponential population growth?

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The Lesser Black-backed Gull *Larus fuscus* is a typical surface-feeding seabird with a widespread, patchy distribution in the south-eastern North Sea. During the 1990s, breeding numbers along the German North Sea coast increased exponentially. Up to now it still remains unclear what might have caused this strong population growth. In order to answer those questions multiple-year data from seabird at sea cruises have been analysed and behaviour at sea as well as diet and flight activity in a lesser black-backed gull colony have been studied. It was found, that distribution patterns at sea were changing during the 1990s. Both observations at sea and dietary analysis revealed that swimming crabs *Liocarcinus* spp. are of major importance for this gull species. The utilisation of this 'natural' food source primarily took place close to the shore, while Lesser Black-backed Gulls at larger distances from the coast were mainly feeding on other 'natural' prey items or discarded fish from trawlers, avoiding competition with other breeding gull species. During July-August (data set for 1990-1995), densities of Lesser Black-backed Gulls were significantly correlated to fishing effort, while during May-June no such correlation could be found. Time of day was found as major stimulus influencing the gulls' flight activity, indicating associations between activity and availability of its major 'natural' prey, swimming crabs. In conclusion, far ranging offshore distribution and utilization of different food sources as well as super-abundance of swimming crabs might have enabled the avoidance of interspecific competition and thus played a major role for the exponential growth of Lesser Black-backed Gull population along the German North Sea coast.

Statistical power to detect trends in abundance of Common Guillemots using monitoring plot counts

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Seabird monitoring at colonies throughout the UK provides information on long-term trends in population abundance. Assessing the power of the monitoring scheme is necessary to determine the effectiveness of the sampling design and decide how best to allocate sampling effort were changes to be made. Increasing power (the probability of detecting a trend given one exists) can be achieved by reducing the count variability about a trend. This variability is attributable to various sources and identifying their size and influence will have an important role in decisions on how to optimise sampling effort. Using data on counts of Common Guillemots *Uria aalge* collected for the Seabird Monitoring Programme, we present a method to investigate power to detect trends at national and colony scales. Data was analysed as a linear mixed model with the underlying population trend as a fixed effect and random effects to describe the sources of variability, such as variation in trend between plots. Variance components were estimated using REML and power was computed using a Monte Carlo approach for various sampling designs. Results are discussed in the context of the probability of detecting declines in population abundance for different numbers of colonies, plots, revisits and number of survey years.

Natal dispersal and demography of Yellow-legged Gull from north Adriatic Sea colonies

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Dispersal and fidelity are important traits of avian life-history that affect the structure and the dynamics of populations. Dispersal events are generally greater for young birds from natal sites than for breeding adults from nesting sites. In the Mediterranean basin the Yellow-legged Gull *Larus michahellis* has undergone a widespread population increase in recent decades. The flexible, opportunistic and gregarious nature of this species makes it highly adaptable to living in man-modified habitats. We used eight years (1995-2003) of capture-recapture data from 1779 Yellow-legged gulls colour-ringed as chicks, from the largest colonies of the northern Italian Adriatic coasts. Dispersal movement differences of each class of age have been emphasised by computing PCA and cluster analysis of the resighting data. This process permitted us to distinguish three age groups (juvenile, immature and adult) and their typical movements. We also applied the capture-recapture model to wintering and breeding period observations. We considered observations at the colony area and at other nearby sites, such as harbours and refuse dumps. The wintering period analysis indicated a low level of survival that is thought to be due to dispersal movements rather than a real result as senescence begins after the fifth year. Immature and juvenile recoveries are less frequent than adults in the area around colonies. We consider that dispersal movements confirm varying tendancies to explore and competition avoidance between different classes of age.

The Pomeranian Bight – a hotspot for seabirds in the southern Baltic Sea

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The Pomeranian Bight is the most important area for seabirds in the southern Baltic Sea. With two expanded shallow banks it is a hotspot especially for sea ducks. Large concentrations of Long-tailed Ducks *Clangula hyemalis* and of Velvet Scoters *Mellanitta fusca* are present during winter and spring. Common Scoters *Mellanitta nigra* predominantly occur in more western parts of the German Baltic Sea in winter, but distribution changes in spring, when up to 18% of the biogeographic population rest in the German part of the Pomeranian Bight alone. High densities of Red-necked Grebes *Podiceps grisegena* and Slavonian Grebes *Podiceps auritus* winter in the area, the latter in internationally important numbers. In the northern part of the Pomeranian Bight an international important concentration of Black Guillemots *Cepphus grylle* can be found in winter and spring. From July until September, the area serves as a moulting site for Common Scoters and grebes and is the southernmost summer and probably also moulting area for Velvet Scoters. Birds in the Baltic Sea are mainly threatened by large set-net fisheries, ship traffic and the construction of windmill farms. We therefore suggest a large protected area in the Pomeranian Bight to preserve this unique habitat.

Detecting warning signs of trouble within population fluctuations: using capture-recapture modelling to uncover changes in population dynamics leading to declines

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An intensive mark-recapture/resighting program has been carried out on the Roseate Terns *Sterna dougallii* nesting at Falkner Island, Connecticut, USA since the late 1980s. Substantial losses of tern eggs and chicks to predation at this colony site began in 1996 when Black-crowned Night-Herons *Nycticocorax nycticocorax* started nocturnal raids. This depredation has been a major factor in the reduction of productivity from about 1.0 chicks/pair during the 10 years before night-heron predation began to as low as about 0.2 chicks/pair in 2002. Capture-recapture modelling has revealed other effects on the population dynamics of Roseate Terns at this site, including a large reduction in the 'development of residency' rates of first-time breeders, and a decline in the local 'survival-and-fidelity' rates of experienced breeders, probably due to increased emigration rates.

A drastic decline in Ivory Gulls breeding in Canada

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The Ivory Gull *Pagophila eburnea* breeds in the circumpolar Arctic and winters amongst pack ice in northern oceans. The world population is estimated at around 14,000 breeding pairs, and, in the early 1980s, Canada was believed to host up to 1,200 breeding pairs. In response to concerns raised by Inuit residents in northern Canada, who reported fewer sightings of Ivory Gulls around their communities, the Canadian Wildlife Service initiated an aerial survey of known nesting colonies in 2002 and 2003. We found that many colony locations had been completely abandoned, and, although 10 new colonies were found, they were all small. Results indicate a decline of up to 85% in Ivory Gulls breeding in Canada. Although legally protected, some Ivory Gulls are still shot during migration in west Greenland and Canada, and there are several potential risks to breeding habitat in Canada. Disturbance due to exploratory drilling for mineral resources may be detrimental to annual breeding success of Ivory Gulls in Canada. The influence of changes in the distribution, seasonal extent, and depth of polar pack ice on Ivory Gulls remains unknown. We suggest that international efforts should be directed at assessing population status and trends throughout the circumpolar Arctic.

Seabirds in Svalbard, Franz Josef Land and Novaya Zemlya: status and trends

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The high Artic archipelagos of the northern and eastern Barents Sea; Svalbard (Norway), Franz Josef Land and Novaya Zemlya (Russia) support more than 3.5 million pairs of breeding seabirds including large populations of Black-legged Kittiwakes *Rissa tridactyla*, Brünnich's Guillemots *Uria lomvia* and Little Auks *Alle alle*. Political changes in Russia in the 1990s made it possible to survey colonies in these highly militarised and formerly closed regions. Key results of the monitoring programme initiated in 1988 in Svalbard are summarized and discussed, and results of surveys and censuses over the last decade in Franz Josef Land and Novaya Zemlya are reported. The monitoring programme for seabirds in Svalbard currently addresses six species at 13 sites, of which Bjørnøya is the key site. Whereas the Brünnich's Guillemot and the Common Eider *Somateria mollissima* populations have been relatively stable, the Glaucous Gulls *Larus hyperboreus* on Bjørnøya are decreasing, in part due to decreased reproductive rate and adult survival caused by high levels of contaminants. In contrast to much of mainland Norway, the Common Guillemot *Uria aalge* population in Svalbard (incl. Bjørnøya) is recovering after its collapse in 1986-87. More than 150 colonies are currently known in Franz Josef Land and Novaya Zemlya. Of these >50 have been surveyed in the last decade, including some of the largest colonies in both regions. The surveys documented large population changes compared to historical data, e.g. the Brünnich's Guillemot population in Novaya Zemlya is today only one third of that estimated in the 1940s.

Differences in eggshell characteristics and laying order in the Lesser Black-backed Gull

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Eggs within the same clutch often differ in size and egg composition. In this study we investigated the characteristics of eggshell in relation to laying order in the Lesser Black-backed Gull *Larus fuscus*. We looked at shell colouration, shell weight, shell thickness, porosity, calcium content and shell ultrastructure, using a Scanning Electron Microscope. There are marked differences between eggs of the same clutch, often with the last egg having different characteristics from the earlier laid eggs.

Temporal and spatial variation in discard utilisation by Great Skuas

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We recently showed that discards are an important part of the diet of Great Skuas *Stercorarius skua* at Foula, Shetland, during July, that diet composition tracked long-term changes in discard rates and that predation on seabirds reflected availability of discards. Here we extend this analysis to investigate seasonal and spatial variation in the discard component of Great Skuas diets throughout the Shetland archipelago. These data reveal that discard consumption varies among different colonies, which relates to spatial differences in commercial fishery catches. These results provide further evidence that discards are an important food resource to scavenging seabirds, but also show that exploitation of discards is a local process. The results have implications for estimating the impact of changes in fisheries management policy on seabird communities.

Wing- and foot-propulsion of seabirds diving to deep water: comparison between Common Guillemots and European Shags

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Seabirds dive with air in their feathers and lungs. Thus, while descending in deep water, seabirds have to adjust their diving due to changes in buoyancy with depth by regulating stroke and glide. We studied the wing and foot propulsion of vertically diving wing-propellers (Common Guillemots *Uria aalge*) and foot-propellers (European Shags *Phalacrocorax aristotelis*) breeding at Isle of May, Scotland. Surge (tail-to-head) and heave (ventral-to-dorsal) accelerations were sampled at rate of 64Hz with small bird-borne data-loggers. Dive angle was estimated with the low frequency component of surge. Forward thrust and wing or foot strokes were estimated with high frequency components of surge and heave accelerations, respectively. Guillemots descended with the body angled at 80-90 degrees from horizantal, while shags with angle angle of 60-80 degrees. While descending, shags increased swimming speed until 20 m depth but maintained 1.6 m/s in deeper water. Guillemots increased swimming speed to 40m depth and maintained 1.8 m/s in deeper water. At the start of descents, guillemots produced a thrust during each of up-stroke and down-stroke of the wings, while shags produced thrust only during the power strokes of the foot. Both species reduced the frequency of thrust as they were descending deeper by prolonging glide duration or decreasing up-stroke based surges while keeping the duration of power stroke.

Evaluation and prevention of the impact of deliberate oil discharges on seabirds in the Canadian North Atlantic

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The Grand Banks off Canada's east coast supports an estimated 40 million seabirds per year, and is one of the busiest shipping grounds in the world. Due to low fines, limited prosecution and inadequate aerial surveillance this area has become a dumping ground for bilge oil, illegally discharged by ships passing through or doing business in Canada's exclusive economic zone. Beach bird surveys conducted by the Canadian Wildlife Service since 1984 indicate overall oiling rates of 62% with an average of 0.77 oiled birds per kilometre. Auks, especially Brunnich's Guillemot *Uria lomvia* are the most affected. An estimated 300,000 seabirds are killed every year in the waters of Canada's North Atlantic due to this deliberate dumping of oil. Chronic pollution, in conjunction with the Newfoundland guillemot hunt, has reduced the population growth rate of Brunnich's Guillemot in the eastern Canadian Arctic by 4.7%. As a result public education campaigns (e.g. pamphlets, websites, videos) and strong political lobbying efforts are being used in Canada to mitigate this deplorable practice and comprehensive international strategies are being developed to the same effect.

Ammonia emissions from UK seabird colonies

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Seabird colonies accumulate large quantities of nitrogen-rich guano and, as such, are a major natural source of ammonia (NH_3). Previous research has focused on quantifying NH_3 emissions from anthropogenic sources, whilst those from natural sources have received much less attention and considered relatively unimportant in the national inventory. Until now, NH_3 emissions from seabird colonies have not been accurately quantified. We used simple bioenergetics models to derive estimates of the potential NH_3 emissions from each seabird species in the UK and combined these with population distribution data to produce a GIS map of the spatial distribution of NH_3 emissions from seabird colonies in Britain. Around two-thirds of total emissions come from just three species (Northern Gannet *Morus bassanus*, Northern Fulmar *Fulmarus glacialis* and Common Guillemot *Uria aalge*). We show that emissions from seabirds are largely concentrated in remote parts of Britain, where agricultural and other anthropogenic emissions are smallest. Although seabirds account for less than 1% of total UK NH_3 emissions (~370 kt yr-1), their occurrence in remote areas and frequently large colony sizes results in seabirds providing a major fraction of the atmospheric nitrogen deposition for many remote ecosystems.

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