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Preface

Welcome to the Seventh International Seabird Group Conference in Wilhelmshaven!

We are pleased that the Seabird Group will start the new millennium by holding its seventh international conference in Wilhelmshaven. This is the first time that the conference has been held outside the United Kingdom. It is fitting that this links with EXPO by the Sea, the maritime section of the EXPO 2000 in Hannover.

The Institut für Vogelforschung „Vogelwarte Helgoland“ is delighted to have the opportunity to host this conference. The institute was founded in 1910 on the island of Helgoland and is one of the oldest and largest ornithological research institutions in the world with a major focus on seabird research.

We welcome attendees from more than 15 countries. Many will present oral or poster papers on the conference's main theme of 'Seabird Reproduction' or other aspects of seabird biology. The programme reflects the wide diversity of research that is currently being carried out on marine birds and the rapid progress that has been made in recent years. With most, if not all, marine environments currently threatened by a wide range of anthropogenic activities, the need for research on seabirds has never been greater.

The Seabird Group, founded in 1966, promotes and helps co-ordinate the study and conservation of seabirds. It is a registered UK charity, is run by an elected committee and maintains close links with other national and international ornithological bodies. We urge those conference delegates who are not yet members to join, to read and contribute to the journal *Atlantic Seabirds* which is published with the Dutch Seabird Group, and to become regular attendees at the conferences.

We thank you for coming and contributing to the success of this meeting and all the sponsors and supporters of this conference for their generosity.

The Seabird Group and the Institut für Vogelforschung hope that you have an enjoyable and fruitful stay in Wilhelmshaven and the Stadthalle.

Sarah Wanless
Chair of the Seabird Group

Peter H. Becker
Chair of the Organising Committee

Local hosts

The conference is hosted on behalf of

the Seabird Group

by the

Institut für Vogelforschung „Vogelwarte Helgoland“ Wilhelmshaven

Local Organising Committee

Peter H. Becker (Chair)

Elke Wiechmann (Secretary)

Monika Enxing, Ommo Hüppop, Jan-Dieter Ludwigs, Rolf Nagel, Doris Peuckert,
Mareike Schmidt, Lothar Spath, Martin Wagener, Helmut Wendeln, Annette Wilms

Excursions:

Barbara Caspers, Volker Dierschke, Anne-Kathrin Heibges, Annette Wilms

Scientific Programme Committee

Peter H. Becker (Chair), Kees Camphuysen, Mark Tasker

Editor of Abstracts

Mark Tasker

7th Seabird Group Conference Homepage

<http://home.t-online.de/home/O.Hueppop-IfV/seab2000.htm>

General information

Conference venue

All events will take place in the Stadthalle, Wilhelmshaven.

Registration

The registration desk will be open in the Stadthalle

Friday	17 March	1600-2200
Saturday	18 March	0800-1900
Sunday	19 March	0830-1700

Phone/Fax

Telephone and fax messages for conference participants can be left at the registration desk:
Phone ++49 (0) 4421 771647; fax ++49 (0) 4421 927944

Meals and drinks

Coffee/tea/cookies during conference breaks, all meals, and some drinks are free of charge and served in the Stadthalle. The menu card gives you detailed information.

Cash machine

You find a cash dispenser on the ground floor near the entrance of the Stadthalle. Others are located at Peterstraße (BfG Bank, in a distance of 100m from the Stadthalle), Marktstraße (Sparkasse, 200m) and Nordseepassage (railway station).

Slide preview

There will be a slide preview at the small room on the left side of the Foyer. Slides should be previewed to ensure proper order and orientation. Speakers are requested to hand their slides to the projectionist during the break immediately preceding the session at which they will be presented.

Poster presentation

Presenters of posters should set up their materials in the Foyer on Friday 17 March. Posters are presented in alphabetical order of authors. For poster setting please use the material provided at the registration desk. Posters will be available for viewing all days of the conference, especially during the two poster sessions on Saturday after lunch (1330-1430) and Sunday after lunch (1345-1430). During these sessions authors of posters should be present for requests and discussions.

Excursions to Helgoland or Wangerooge

Participants will find detailed information in the conference materials, at the registration desk or by contacting the excursion guide.

Parking

We recommend that you do NOT use the STADTHALLE parking, as it is closed in the afternoon and on Sunday.

Programme

Friday 17 March

- | | |
|-------------|---|
| 1600 - 2200 | Arrival, registration |
| 1900 | <p><u>Welcome</u></p> <p><i>Ommo Hüppop:</i>
 The German Bight as a breeding, migration and resting area for seabirds</p> <p><i>Daniela Guicking:</i>
 The seabirds of the island Mocha, Chile</p> |
| 2000 | Bar |
| 2030 | 34th Annual general meeting of the Seabird Group |

Saturday 18 March

- | | |
|-----------|---|
| 0800-0900 | Registration |
| 0900-1000 | <p><u>Opening of the conference</u></p> <p>Chair: <i>Mark Tasker</i></p> |
| 0900-0920 | <p>Opening and welcome addresses</p> <p><i>Bläserkreis Jaderberg:</i> Overture by the brass
 <i>Eberhard Menzel</i>, Lord Mayor of Wilhelmshaven
 <i>Franz Bairlein</i>, Director of the Institut für Vogelforschung
 „Vogelwarte Helgoland“, Wilhelmshaven
 <i>Sarah Wanless</i>, Chair of the Seabird Group
 <i>Peter H. Becker</i>, Chair of the Organisers</p> |
| 0920-1000 | <p><i>Ian L. Jones:</i>
 Life history implications of mate choice, mating success and sexual selection in seabirds</p> |
| 1000-1030 | Refreshment break |

Saturday 18 March

- 1030-1230 **Reproductive strategies and parental condition**
 Chair: *Keith Hamer*
- 1030-1050 *Ruedi G. Nager, Pat Monaghan & David C. Houston:*
 Parental condition, family sex ratio and reproductive strategies in gulls
- 1050-1110 *Kat Jones & Pat Monaghan:*
 Dynamics of parenthood: parental investment and body condition in lesser black-backed gulls
- 1110-1130 *Mark Hipfner:*
 Fitness consequences of replacement egg-laying for arctic-nesting thick-billed murres
- 1130-1150 *Helmut Wendeln, Peter H. Becker & Jacob González-Solís:*
 Renesting strategies in common terns *Sterna hirundo*
- 1150-1210 *Ian C.T. Nisbet, Victor Apanius & Margaret S. Friar:*
 Breeding performance of very old common terns
- 1210-1230 *Ellen Kalmbach, Richard Griffiths & Robert W. Furness:*
 Sex allocation in a seabird with reversed size dimorphism
- 1230-1330 **Lunch**
- 1330-1430 **Poster session, refreshment**
- 1430-1630 **Reproduction and population ecology**
 Chair: *Robert W. Furness*
- 1430-1450 *Thierry Boulinier, Karen D. McCoy, Yvan Richard & Torkild Tveraa:*
 Habitat selection based on conspecifics: local reproductive success affects attendance and prospecting of future potential breeders
- 1450-1510 *Norman Ratcliffe, Steve Newton & Rhys Green:*
 Demography of the north-east Atlantic roseate tern *Sterna dougallii* metapopulation
- 1510-1530 *Robert Lindner, Tim R. Birkhead & Ben J. Hatchwell:*
 Guillemots on Skomer Island - the story of their success
- 1530-1550 *Gilles Chapdelaine & Jean-Francois Rail:*
 Population trends and breeding performance of gannet *Morus bassanus* at Bonaventure Island, Gulf of St. Lawrence, Canada, as a response to optimum breeding habitat

<i>Saturday 18 March</i>

- | | |
|-----------|---|
| 1550-1610 | <i>Steve C. Votier, Norman Ratcliffe & Robert W. Furness:</i>
Impact of great skua <i>Catharacta skua</i> on other seabird populations in Shetland |
| 1610-1630 | <i>Suzanne Finney, Sarah Wanless, Pat Monaghan & Mike P. Harris:</i>
The importance of interspecific breeding synchrony for kleptoparasite-host interactions: an experimental study |
| 1630-1700 | Refreshment break |
| 1700-1900 | <u>Breeding ecology of southern hemisphere seabirds</u>
<i>Chair: Sarah Wanless</i> |
| 1700-1720 | <i>Jeroen Creuwels & Jan Andries van Franeker:</i>
Constraints on egg laying in an unpredictable environment: different strategies in Antarctic petrel and southern fulmars in Antarctica |
| 1720-1740 | <i>Alejandro Simeone, Mariano Bernal & Roberto P. Schlatter:</i>
Partitioning of nesting areas among seabirds in central Chile: the roles of habitat selection and timing of breeding |
| 1740-1800 | <i>Janos Hennicke & Boris Culik:</i>
Foraging effort and reproductive success in Humboldt penguins and influences of oceanographic conditions |
| 1800-1820 | <i>Jacob González-Solís, John P. Croxall & Andy G. Wood:</i>
Sexual dimorphism and sexual segregation in foraging strategies of northern giant petrels <i>Macronectes halli</i> during incubation |
| 1820-1840 | <i>Daniela Guicking, Peter H. Becker, Roberto Schlatter, Peter Berthold & Ulrich Querner:</i>
Satellite tracking of pink-footed shearwaters <i>Puffinus creatopus</i> in Chile |
| 1840-1900 | <i>William R.P. Bourne:</i>
The birds of Ascension and the Atlantic equatorial counter-current and their susceptibility to ENSO events |
| 2000 | Conference dinner |

Sunday 19 March

- 0900-1020 **Reproductive strategies and parental condition**
(continued)
Chair: Ommo Hüppop
- 0900-0940 *Patricia Monaghan:*
Resource allocation and life history trade-offs in seabirds
- 0940-1000 *Andrea L. Fidgett, E. Jean Harper, David C. Houston, Pat Monaghan
& Ruedi G. Nager:*
Egg quality changes with increasing egg production effort
- 1000-1020 *Ingveig Langseth, Børge Moe & Claus Bech:*
**Body mass decrease in breeding female kittiwakes *Rissa tridactyla*:
an adaptation to reduce maintenance costs?**
- 1020-1045 **Refreshment break**
- 1045-1245 **Reproductive success**
Chair: Jan Veen
- 1045-1105 *Sarah Wanless, Mike P. Harris & Beth E. Scott:*
**Long term changes in reproductive parameters in the Isle of May
seabird community**
- 1105-1125 *Sergey V. Pyzhjanov, V.A. Podkovyrov & I.I. Tupichyn:*
Herring gull populations at Lakes Baikal and Khubsugul
- 1125-1145 *Monika Bukacińska & Dariusz Bukaciński:*
**The impact of mass outbreaks of black flies *Simuliidae* on the
behaviour and reproductive success of a riverine population
of the common gull *Larus canus***
- 1145-1205 *Steve Newton, Olivia Crowe & Norman Ratcliffe:*
**Irish Sea roseate tern project 1996-1999: the role of food supply,
foraging behaviour and weather on reproductive success**
- 1205-1225 *Jeroen Van Waeyenberge, Joeri Manhout, Jan Seys, Henk Offringa,
Patrick Meire & Eckhart Kuijken:*
**Reproductive success of common terns *Sterna hirundo* in colonies
on the Belgian coast and in the Westerschelde**
- 1225-1245 *Bernard Cadiou:*
**The breeding biology of storm petrel *Hydrobates pelagicus*
in Brittany, France**

Sunday 19 March

- 1245-1345 **Lunch**
- 1345-1430 **Poster session**, refreshment
- 1430-1630 **Food provisioning and foraging**
 Chair: Kees Camphuysen
- 1430-1450 *Eric W.M. Stienen:*
 **The drawbacks of breeding association between Sandwich terns
 and black-headed gulls**
- 1450-1510 *Keith Hamer, Richard Phillips, Sarah Wanless & Mike P. Harris:*
 **Foraging and food provisioning strategies of northern gannets:
 evidence from satellite telemetry**
- 1510-1530 *Stefan Garthe, Silvano Benvenuti & William A. Montevecchi:*
 Pursuit-diving in northern gannets feeding on capelin
- 1530-1550 *Catherine Gray & Keith Hamer*
 **Food provisioning and resource allocation strategies of Manx
 shearwaters: the roles of parent and chick condition**
- 1550-1610 *William A. Montevecchi & Gail K. Davoren:*
 **Diets of common murre chicks in Newfoundland: inter-annual
 variation in capelin characteristics and parental selectivity**
- 1610-1630 *Gail K. Davoren & William A. Montevecchi:*
 **A comparison of common murre time budgets and food habits
 at inshore and offshore colonies in Newfoundland, Canada**
- 1630 **Close of the Conference, coffee/tea**
- 1700 **Visit to the Institut für Vogelforschung „Vogelwarte Helgoland“,
 Wilhelmshaven**

Monday 20 March: Excursions to Wangerooge and Helgoland

Tuesday 21 March: Excursion to Wangerooge (continued)

Poster presentations

Peter H. Becker:

Objectives of the long-term population studies of common terns *Sterna hirundo* in Wilhelmshaven

Jonathan D. Blount, Peter F. Surai, David C. Houston, Anders Pape Møller, Ruedi G. Nager & Pat Monaghan:

Reproductive investment of carotenoids and antibody into egg yolk: effects on maternal condition in the lesser black-backed gull *Larus fuscus*

Jennifer Bull, Sue Lewis, Sarah Wanless, Mike P. Harris, David J. Hammond & Peter J. Wright:

Responses of black-legged kittiwakes *Rissa tridactyla* to seasonal variation in sandeel life history events

Esteban Frere & Patricia Gandini:

Breeding cycle and causes of nesting failure of the red-legged cormorant on the coast of Argentina

Stefan Garthe & Guillermo Luna-Jorquera:

The foraging behaviour of seabirds in an upwelling system in northern Chile

Michel Gauthier-Clerc, Yvon Le Maho, Yannick Clerquin, Samuel Drault & Yves Handrich

Incubating penguins are able to conserve food in the stomach for several weeks

Antonio Hernández, Xavier Ruiz & Lluís Jover:

No evidence of relationship between fluctuating asymmetry and environmental stress in common tern *Sterna hirundo* chicks

Ommo Hüppop & Anja Fründt:

Pellet production in free-living great cormorants *Phalacrocorax carbo*

Thorsten Krüger:

Coastal migration of seabirds in the southern North Sea

Jan Kube, Andreas J. Helbig, Risto Juvaste, Kjeld Pedersen, Carsten Rahbeck & Pertti Saurola:

Hop or jump: autumn migration strategies of lesser black-backed gulls *Larus fuscus* as revealed by satellite tracking

Ulrike Kubetzki, Stefan Garthe & Rory P. Wilson:

Thermal characteristics of puffin burrows in Shetland

Anja Liebert & Ommo Hüppop:

Diet of great cormorants *Phalacrocorax carbo* wintering at the island of Helgoland

Poster presentations

Jan-Dieter Ludwigs & Peter H. Becker:

The influence of fledgling number and hatching order on return rates of prospecting common terns *Sterna hirundo*

Karen D. McCoy, Claire Tirard, Thierry Boulinier & Yannis Michalakis:

Population genetic structure and dispersal of the seabird tick *Ixodes uriae* within and among multi-host colonies

Fridjof Mehlum, Y. Yutaka Watanuki & Akinori Takahashi:

Diving behaviour and foraging habitats of Brünnich's guillemots breeding in the High-Arctic

Susanne Mickstein & Daniela Guicking:

Nest types of the brown-hooded gull *Larus maculipennis*: adaptations to different environmental conditions

P. Ian Mitchell & Tim Dunn

Seabird 2000

Veronica C. Neves, Luis R. Monteiro & M.R. Clarke:

Squid prey of the Cory's shearwater *Calonectris diomedea borealis* in the sub-tropical mid-north Atlantic Ocean

Thomas Van Pelt & Pat Monaghan:

Costs of relaying in the common guillemot *Uria aalge* at a food-stressed Alaskan colony

Simone Pfeiffer, Steffen Hahn & Hans-Ulrich Peter:

The effects of human disturbance on breeding skuas on the Shetlands and South Shetlands

Simone Pfeiffer, Hans-Ulrich Peter, Kathrin Schuster & Bernard Stonehouse:

The effects of human disturbance on stress levels of the southern giant petrel *Macronectes giganteus*

Jordi Prieto, Xavier Ruiz & Lluís Jover:

Predation by black rats on Audouin's gull eggs: a potential risk for its productivity?

Flavio Quintana, O. Patricia Dell'Arciprete & Alfredo Lichter:

Foraging movements of southern giant petrels *Macronectes giganteus* in waters of the Argentine continental shelf

Jean-Francois Rail & Gilles Chapdelaine:

Breeding success and diet of black-legged kittiwakes and herring gulls at Corossol Island, Québec, Canada: implications to use as indicators of prey abundance

Poster presentations

Ulrich Steiner & Anthony J. Gaston:

Within-colony philopatry of Brünnich's guillemots

Stefan Thyen & Peter H. Becker:

Monitoring environmental chemicals in seabirds in the Wadden Sea

Verein Jordsand:

Results of long-term monitoring of seabird reproduction in nature reserves protected by Verein Jordsand

Jeroen Van Waeyenberge, Jan Seys, Henk Offringa, Patrick Meire & Eckhart Kuijken:

Terns in the harbour of Zeebrugge, Belgium

Tanja Weichler, Stefan Garthe & Guillermo Luna-Jorquera:

Seabird distribution in relation to an upwelling system in northern Chile

Jörg Welcker, Klaus-Michael Exo, Hans-Ulrich Peter & Frank Schurr:

Do kelp gulls care about skuas?

Francis K. Wiese & Pierre C. Ryan:

Increase in chronic oil pollution in the waters around south-eastern Newfoundland

Sabina I. Wilhelm, Carolyn J. Walsh & Anne E. Storey:

Pre-lay attendance of common murrelets: are males on the offence or defence?

Jürgen Witte, Annegret Büthe & Waldemar Ternes:

Toxaphene levels in eggs of common terns *Sterna hirundo* breeding at the North Sea coast of Germany - a temporal and spatial study

Abstracts

Objectives of the long-term population studies of common terns *Sterna hirundo* in Wilhelmshaven

PETER H. BECKER, Institut für Vogelforschung "Vogelwarte Helgoland", An der Vogelwarte 21, D 26386 Wilhelmshaven, Germany. Email: peter.becker@ifv.terramare.de

In order to investigate long-term aspects of population ecology of the common tern, methods of remote and automatic lifetime identification of individuals using transponders have been in use since 1992. All fledglings, and a few adults in a colony in Wilhelmshaven were marked with transponders each year. An automatic electronic system records the presence of not only all marked breeders, but also the marked non-breeders (including prospectors), at their native colony. Important population parameters and their inter-annual variation can be derived with high accuracy for this colony. This should give insight into the mechanisms of population regulation at the colony. Detailed data on condition, fate and reproductive output of many individual birds are gathered year by year and allow the study of individuals' quality, mate and nest site fidelity, lifetime reproductive success and even fitness. The focus of work in the near future will be on the processes of prospecting and recruitment, examining the 'quality' of birds and other factors. Further into the future, investigations of genealogy and population genetics are planned.

Reproductive investment of carotenoids and antibody into egg yolk: effects on maternal condition in the lesser black-backed gull *Larus fuscus*

JONATHAN D. BLOUNT¹, PETER F. SURAI², DAVID C. HOUSTON¹, ANDERS PAPE MØLLER³, RUEDI G. NAGER¹ & PAT MONAGHAN¹

1 Ornithology Group, Division of Environmental and Evolutionary Biology, Graham Kerr Building, University of Glasgow, Glasgow G12 8QQ, Scotland. Email: j.d.blount@udcf.gla.ac.uk

2 Department of Biochemistry and Nutrition, Scottish Agricultural College, Ayr KA6 5HW, Scotland;

3 Laboratoire d'Ecologie, CNRS URA 258, Université Pierre et Marie Curie, 7 quai St. Bernard, Case 237, F-75252 Paris Cedex 05, France

It has been hypothesised that carotenoid-based ornaments in birds may advertise health status, because of a trade-off in the allocation of carotenoids to signals or to alternative somatic demands. This idea is attractive, because there is increasing evidence from studies of humans, rodents and poultry that carotenoids play a crucial role as antioxidants and immuno-stimulants. However, there is no experimental evidence that immune function and the colour of carotenoid-based signals co-vary with carotenoid availability in a wild bird species. We investigated such a trade-off in a population of lesser black-backed gulls. Forty pairs were supplementally fed vegetable fat with additional carotenoids, and 39 pairs were given a control supplement of only vegetable fat, for several weeks during the pre-laying period. First-clutch eggs were removed and assayed for levels of fat-soluble antioxidants (carotenoids and α -tocopherol) and passively-transferred antibody (IgG). Females were caught on the nest within 1 day of completing their clutch, the colour of carotenoid-based traits (bill, bill spot, eye ring, gape, legs) was measured, and a small blood sample was collected for measurement of fat-soluble antioxidants and IgG. We report on correlations among these variables, and differences between carotenoid-fed and control birds.

Habitat selection based on conspecifics: local reproductive success affects attendance and prospecting of future potential breedersTHIERRY BOULINIER¹, KAREN D. MCCOY¹, YVAN RICHARD¹ & TORKILD TVERAA²¹ Laboratoire d'Ecologie, Université Pierre & Marie Curie, CNRS-UMR 7625, F-75252 Paris, France; Email: tboulini@snv.jussieu.fr² Division for Arctic Ecology, Norwegian Institute for Nature Research (NINA), The Polar Environmental Centre, N-9296 Tromsø, Norway

The importance of habitat selection processes and dispersal to the functioning of subdivided populations has been shown by theoretical approaches, but few empirical studies have dealt with the underlying behavioural mechanisms and their ecological implications. Breeding populations of seabirds are naturally subdivided at different spatial scales and represent good models to study these processes. In particular, detailed observations on a kittiwake *Rissa tridactyla* population in Brittany, France, suggested that individuals use the reproductive success of conspecifics for selecting among potential breeding patches. In particular, failed breeders and young prospecting birds were suspected to be attracted successful areas. The observational data used nevertheless did not permit to ascertain the causal nature of the associations observed. The aim of the present work was to test experimentally several predictions of this hypothesis. Specifically, we manipulated the local reproductive success of kittiwakes on a set of study plots in order to test the behavioural responses of the birds in terms of attendance of local breeders and prospecting individuals. The experiment was carried out on the island of Hornøya, Norway, and local success was manipulated by reducing or increasing brood size during incubation on a series of replicated plots. Lower attendance of local breeders following their breeding failure and lower prospecting by birds that did not breed on the plot was predicted for plots with reduced local reproductive success. Conversely, we predicted higher attendance of failed breeders and prospectors on plots where a high success was maintained. We also predicted that a higher proportion of failed breeders from unsuccessful plots would be recorded prospecting for sites compared to failed breeders from successful plots. Finally, behavioural responses were expected to be stronger on isolated cliffs compared to plots adjacent to productive areas. Our results are discussed in relation to factors determining heterogeneity among individuals, nest site availability and patch quality at different scales. Understanding the behavioural mechanisms behind differential dispersal and recruitment among breeding patches is crucial for studying the dynamics of subdivided populations and has direct conservation implications for species like seabirds.

The birds of Ascension and the Atlantic Equatorial Counter-current and their susceptibility to ENSO events

WILLIAM R.P. BOURNE, Department of Zoology, University of Aberdeen, Tillydrone Avenue, Aberdeen AB24 2TZ, Scotland

Ascension once held one of the greatest seabird breeding colonies in the world, comparable to the largest in the Pacific and Indian Oceans, in the apparently barren centre of the tropical South Atlantic, until it was devastated by introduced rats and cats over the last three centuries. The ecological basis for the existence of such a large bird population has remained uncertain. Surviving guano and bones suggest that most of the seabirds once bred in the north of the island, and observations at sea indicate that while some may feed offshore and in an area of marine turbulence to the lee of the island to the west, and others over eddies in the South Equatorial Current, most fly north towards the Equatorial Counter-current some 200nm to the north, where there is a raised bird density now chiefly involving winter visitors from elsewhere. At intervals there is increased rain associated with breeding failures of the surviving seabirds on Ascension, as in 1876, 1924, 1958-59, 1963, 1991-92, and 1997, possibly associated with fluctuations in the current and (but not always simultaneously with) El Niño/Southern Oscillation (ENSO) events elsewhere.

The impact of mass outbreaks of black flies *Simuliidae* on the behaviour and reproductive success of a riverine population of the common gull *Larus canus*

MONIKA BUKACIŃSKA & DARIUSZ BUKACIŃSKI, Institute of Ecology, Polish Academy of Sciences, Dziekanów Lecny, 05-092 Łomianki, Poland

Massive, repeated outbreaks of black flies during two-three weeks in May and/or June has been reported in Poland every 1-2 years since 1993, especially in large areas along rivers. Studies in colonies of common gull show that massive occurrence of these blood-feeding insects have negative effect on parental behaviour and breeding success in colonial waterbirds. During black fly outbreaks, many pairs deserted their nests, both during the incubation and after hatching. Many birds, both adults (up to 10% in colonies) and chicks died because of physical harassment and direct blood and body fluids loss from biting flies. Remaining pairs exhibited less parental care, spent less time at their territories, and when present, often wheeled above their nests instead of incubating, brooding or feeding their chicks. Increased absence of adults resulted in increased nest predation by crows *Corvus corvus* and magpies *Pica pica* and frequent starvation of broods. During black fly outbreak years, loss of clutches and broods increased by 40-60%. Low breeding success in these years may limit recruitment of young birds to the colony resulting in long term population decreases.

Responses of black-legged kittiwakes *Rissa tridactyla* to seasonal variation in sandeel life history events

JENNIFER BULL¹, SUE LEWIS¹, SARAH WANLESS¹, MIKE P. HARRIS¹, DAVID J. HAMMOND¹ & PETER J. WRIGHT²; Email: jbull@wpo.nerc.ac.uk

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Lesser sandeels *Ammodytes marinus* are known to be an important component of the diet of black-legged kittiwakes breeding in the north-western North Sea. There is evidence that breeding success is positively correlated with sandeel availability but there have been few intensive studies that examine responses of kittiwakes to annual variation in the timing of sandeel life history events and variations in the size of prey available. We investigated these effects in two ways:

- 1) we caught large numbers of adult kittiwakes at the colony on the Isle of May, south-east Scotland, and obtained diet samples from them during the 1997, 1998 and 1999 breeding seasons;
- 2) we concurrently monitored the breeding performance in this population.

The breeding biology of storm petrels *Hydrobates pelagicus* in Brittany, France

BERNARD CADIOU, Bretagne Vivante-SEPNEB, 186 rue Anatole France, BP 32, F-29276 Brest cedex, France; Email: sepnb.brest@wanadoo.fr

Data were collected in recent years on storm petrels at colonies on the coast of Brittany in order to investigate different breeding parameters, especially laying period, hatching success and breeding success. Data were obtained by regular examination of breeding sites, and by estimating chick age at the time of ringing. Adults first returned to colonies in March-April. Laying period extended from the end of April to the beginning of August and showed high annual variability, with 50% of laying ranging from mid May to early July. The pattern of egg laying in Brittany appeared to be very similar between northern and southern colonies. Annual variability in the timing of laying was probably due to variations in oceanographic conditions and food resources just before laying and had important implications for accurate censusing of breeding colonies. Data obtained from single visits at the same time in different years should be interpreted carefully, especially when using only tape-playback methods, as the proportion of occupied nest sites may be very different. Estimates of hatching and breeding success were about 65 to 90% (over three years) and 0.53 (one year) respectively. First chicks fledged in mid August, and the latest not until late October, or even occasionally November. The impact of predation by gulls, especially great black-backed gulls *Larus marinus* was also investigated.

Population trends and breeding performance of gannet *Morus bassanus* at Bonaventure Island, Gulf of St. Lawrence, Canada, as a response to optimum breeding habitat

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Population estimates and breeding performance of gannets at Bonaventure Island have been recorded over the last 33 years (1966-1999) at approximately 4 to 5 year intervals. From 1969 to 1976 the population decreased from 20,511 to 16,400 pairs and thereafter increased to reach 37,000 pairs in 1999. The overall net productivity of this population was only 30% between 1966-70, after which it slightly improved to 45% in 1974 and then varied from 69% to 74% up to 1999. Hatching and fledging success were measured in study plots located in cliff-face and upper plateau habitat. Hatching success at the end of the 60s and beginning of 70s was low in both habitats and has been related to high concentrations of DDE residues in their eggs. At that time, breeding pairs were more abundant on the cliff-face than on the upper plateau. Following the improvement of breeding performance after reduction in use of organochlorines, hatching success, fledging success and net productivity were higher on the upper plateau than on cliff-face, though most differences were not statistically significant. At the start of this millennium, the breeding population nesting on the upper plateau is almost double the size of the cliff-face group suggesting that topography influences breeding performance of gannets on Bonaventure Island and probably at Anticosti Island and Bird Rocks, two other colonies in the Gulf of St. Lawrence.

Constraints on egg laying in an unpredictable environment: different strategies in Antarctic petrel and southern fulmars in Antarctica.

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On Ardery Island (Antarctica) the breeding biology of four species of fulmarine petrels has been studied over three consecutive years (1996-99). In this paper a comparison is made in the inter- and intraspecific variability in egg laying date and egg size between two species, which lay their single eggs respectively as earliest and latest in the breeding season. Antarctic summers are short and therefore the early-breeding Antarctic petrel *Thalassoica antarctica* might face losses especially during egg phase of the reproduction, whereas the in the late-breeding southern fulmar *Fulmarus glacialis* the chicks might be more vulnerable. We investigated whether any reproductive benefit was gained by laying the eggs earlier or later than the median date for the two contrasting breeding strategies. The relationship between the annual variation in the date and numbers of eggs laid with weather and other factors was investigated. Highly synchronised egg-laying in both species may be related to a strategy against egg-predation by south polar skuas *Catharacta maccormackii*, although this predation pressure might differ between the two species. Furthermore the importance of the size of the egg on the hatching and fledging success was investigated. Thus relationships of egg size with nest characteristics, breeding experience, site and mate fidelity, and structural size of the parents are analysed.

A comparison of common murre time budgets and food habits at inshore and offshore colonies in Newfoundland, Canada

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We compared colony-based time budgets and food habits of individually marked murrelets *Uria aalge* during chick rearing at an inshore (Great Island) and an offshore colony (Funk Island) in a cold ocean regime in the Northwest Atlantic. Gravid capelin was the primary food (> 95 %) delivered to chicks at both colonies, suggesting that murrelets foraged inshore where high biomasses of capelin *Mallotus villosus* spawn during the summer in Newfoundland. Foraging trip durations were significantly longer at Funk Island (220 ± 19 min) compared to Great Island (154 ± 11 min). Time spent at the colony with mates, however, did not differ among colonies (Funk: 32 ± 5 min; Great: 31 ±

3 min). This resulted in a lower number of fish delivered to chicks per day at Funk Island (3.1 ± 0.2) compared to Great Island (3.7 ± 0.2). Most murrelets land on the water around the colony before departing on a foraging trip. Systematic scans revealed that murrelets rested longer in this area at Great Island than at Funk Island. Overall, murrelets breeding farther from a predictable food source worked harder and, consequently, were unable to buffer the negative effects of longer foraging trips on chick-feeding rates. Paradoxically, Funk Island is the largest colony of common murrelets in the region, containing about 80 % of the breeding population in the Northwest Atlantic. The effect of colony size on time-buffering capabilities of seabirds is evaluated.

Egg quality changes with increasing egg production effort

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There is good evidence in lesser black-backed gulls *Larus fuscus* that there is a trade-off between the number and the quality of eggs. By removing eggs as they were laid we were able to experimentally increase the number produced by lesser black-backed gulls beyond the normal clutch size of three eggs, at the expense of egg hatchability and chick viability. However, it is unclear which aspects of the eggs are involved in this trade-off. Egg quality was evaluated in terms of composition, by analyses performed at the Central Nutritional Laboratory of Waltham Centre for Pet Nutrition. Composition factors measured were water, lipid, crude protein, ash, selected essential amino and fatty acids, and fat-soluble vitamins. We were particularly interested in compositional changes between first and third eggs (representing a 'normal' clutch), and last eggs of extended sequences. These changes will also be related to absolute sequence length, to examine whether birds that laid longer sequences were able to maintain proportionally the same investment of resources throughout the sequence as those that laid shorter extended clutches.

The importance of interspecific breeding synchrony for kleptoparasite-host interactions: an experimental study

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Kleptoparasitic interactions can have important consequences for the reproductive success of both the kleptoparasite and host species. Kleptoparasitism frequency is predicted to be highest when the kleptoparasites and hosts breed synchronously, as the peak energy demand of kleptoparasite offspring will coincide with the maximum availability of hosts. We studied kleptoparasitism by gulls Laridae on puffins *Fratercula arctica* in populations with synchronous breeding periods and evaluated the effect of experimentally altering the relative timing of breeding. Gull breeding was delayed by removal of the first clutch and we investigated the effect of this change on kleptoparasitism rates, gull reproductive success and puffin chick growth rates and survival.

Breeding cycle and causes of nesting failure of the red-legged cormorant on the coast of Argentina

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Red-legged cormorants *Phalacrocorax gaimardi* breed in Argentina, Chile and Peru. In Argentina its breeding range is restricted a short portion of coast in southern Patagonia. This paper describes the breeding biology and causes of egg and chick mortality of this little known species. We worked at two colonies, Isla Elena and Cañadón del Puerto located at Ria Puerto Deseado, Argentina. Nests were located on high rocky cliffs 2 to 4 m from the high tide line. At Cañadón del Puerto the nests avoid prevailing winds whereas at Isla Elena most of the nests were oriented in the same direction as the wind. Mean clutch size was 3.04 ± 0.47 eggs per nest, and mean egg size was $6.03 \pm 0.24 \times 3.71 \pm 0.14$ mm. Incubation period varied between 34 to 38 days with chicks hatching between mid November to the first week of December. Clutch and egg size differed with two sympatric cormorant species, probably as a result of differences in foraging ranges. Egg mortality and the number of nests that suffered predation were higher at Isla Elena where predation pressure by aerial predators was higher. Our results suggested that predation seems to be the main factor of egg loss and extreme weather conditions result in high chick mortality for the red-legged cormorant in Argentina.

Pursuit-diving in northern gannets feeding on capelin

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It is generally considered that northern gannets *Morus bassanus* obtain prey usually by rapid, relatively vertical shallow plunge-dives. We studied diving characteristics of gannets using two types of data-logging systems attached to either the leg, tail or the back of the birds at Funk Island in the Northwest Atlantic during July/August 1999. Preliminary analyses of more than 300 dives revealed: mean dive depth = 5 m, maximum dive depth = 22 m, mean dive duration = 12 s, maximum dive duration = 41 s. Diving activity was highest in the early morning and late afternoon. Deepest and longest dives occurred between late morning and mid-day, a period when capelin *Mallotus villosus*, the staple prey of gannets during our study, tend to be deeper and light penetration greatest in the water column. Short and shallow dives were usually V-shaped, and dives deeper than 8 m and longer than 10 s were usually U-shaped, including a "bottom" time. From motion sensors in the loggers and observations we conclude that extended and deep dives were targeted at capelin which were caught using wing-flapping under-water flight. A brief video of gannets using this foraging technique will be shown during the talk.

The foraging behaviour of seabirds in an upwelling system in northern Chile

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The upwelling system of the Humboldt Current is one of the most productive regions of the world. The cold, nutrient-rich waters support several endemic seabird species, mainly through a short trophic chain whose main component is the anchoveta *Engraulis ringens*. In a research project started recently we investigate the foraging behaviour of different species of seabirds considered characteristic of the study area near Coquimbo, northern Chile. Two aspects will be presented in this

paper. First, species composition, duration and causality of multi-species feeding associations. Peruvian boobies *Sula variegata* make up the majority of birds in feeding flocks over fish schools whereas grey gulls *Larus modestus* and Franklin's gulls *Larus pipixcan* are main contributors to flocks of surface-feeders. Second, the individual performance of foraging by Peruvian boobies and Peruvian diving-petrels *Pelecanoides garnotii* is to be studied by novel data-logging systems. These two species represent the two extremes of body size of seabirds breeding in the study area and thus exhibit completely different foraging modes (piscivory by plunge-diving and planktivory by pursuit diving, respectively).

Incubating penguins are able to conserve food in the stomach for several weeks

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As with most birds, king penguin *Aptenodytes patagonicus* mates relieve each other in the task of incubation. The incubating adult then fasts for several weeks while its partner feeds at sea on myctophid fishes as far as 400 km or more from their breeding colony. Accordingly, foraging trips are particularly long and have variable duration. During the incubation period of 1996, at Possession Island (46°25'S, 51°45'E), Crozet Archipelago, we measured adult stomach contents upon their arrival from the sea and departure from the colony. The birds carried food from the sea in their stomach only when hatching might occur during their incubation shift. Despite their undergoing a long-term fast, the males conserved food in their stomach for as long as three weeks before hatching was to occur. The stomach contents were most often not used because the female returned before hatching. However, when she was delayed, the stored food enabled the males to feed the newly hatched chick, which then increased the chances of successful breeding. We suggest that this adaptation evolved in response of the variations in the duration of foraging trips resulting from irregular and unpredictable fluctuations in the location and availability of marine resources.

Sexual dimorphism and sexual segregation in foraging strategies of northern giant petrels *Macronectes halli* during incubation

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Giant petrels *Macronectes spp.* are the most sexually dimorphic of all seabirds. We used satellite-tracking and mass change during incubation to investigate the influence of sexual size dimorphism, in terms of the intersexual food competition hypothesis, on foraging and fasting strategies of northern giant petrels at South Georgia. Females foraged at sea whereas males foraged mainly on the South Georgia coast, scavenging on seal and penguin carcasses. Foraging effort (flight speed, distance covered, duration of foraging trips) was greater for females than for males. In contrast, foraging efficiency (proportionate daily mass gain while foraging) was significantly greater for males than for females. Females were significantly closer to the desertion mass threshold than males and could not compensate for the mass loss during the incubation fast while foraging, suggesting greater incubation costs for females than for males. Both sexes regulated the duration and food intake of foraging trips depending on the depletion of the body reserves. In males the total mass gain was best explained by mass at departure and body size, indicating that sexual size dimorphism is important in segregation of foraging strategies - and presumably reduction of competition - between sexes. The importance of fasting endurance, contest competition over food and flight metabolic rates are likely to differ between sexes owing to differences in foraging strategies, maintaining sexual size dimorphism. We suggest that sexual segregation of foraging strategies arose from size-related dominance at carcasses, promoting sexual size dimorphism.

Food provisioning and resource allocation strategies of Manx shearwaters: the roles of parent and chick condition

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For many birds the provision of food for offspring is a major component of reproductive effort. This is particularly true of pelagic seabirds, which often need to travel considerable distances in search of sparse, patchy and unpredictable prey. For this reason, the food provisioning strategies of pelagic seabirds have received much recent attention. However the processes by which parents allocate resources between themselves and their offspring remain poorly understood. We carried out a series of investigations to examine these processes in Manx shearwaters *Puffinus puffinus*, concentrating particularly on the roles of parent and chick condition in determining the pattern of food supply to the nest. This work included radio telemetry to monitor food provisioning by individual males and females, and chick-switching to examine whether feeding is controlled by chick demand, by an intrinsic pattern of provisioning in parents, or by interactions between parent and chick requirements. The results of this work will be presented in the context of nestling obesity and life-history theory.

Satellite tracking of pink-footed shearwaters *Puffinus creatopus* in Chile

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During the chick rearing period 1998, we were able to satellite track three individuals of the threatened pink-footed shearwater *Puffinus creatopus* from Island Mocha in Chile. The three male birds, one breeder, one bird of unknown status, and one non-breeder, were tracked for 15, 23, and 28 days, respectively. Whereas the first two performed foraging flights, the flight route of the non-breeding bird suggests that it had started migration towards the wintering grounds in the North Pacific. A main foraging zone was determined 250-300 km north of Island Mocha in an area with extensive fishing industry. This raises the question of whether the pink-footed shearwater is affected by interactions with the fishery. Slow average travel speeds and small daily distances covered by the migrating bird suggest that the birds feed or rest even when on their way to and from the foraging zones or when migrating along the mainland coast. Most extensive resting apparently takes place during the night as is indicated by slower travel speeds than by day. Supported by the Volkswagen-Stiftung, Germany.

The seabirds of the Island Mocha, Chile

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Island Mocha (38°22'S 73°56'W), located about 35 km from the Chilean mainland in the South Pacific, is inhabited by the largest colony of the threatened pink-footed shearwater *Puffinus creatopus*, that otherwise breeds only on islands of the Juan Fernández Archipelago about 700 km north-west of the Island Mocha. Besides the shearwaters, very few seabirds breed on the main island. However, there are two rocky islets at the southern end of Island Mocha, and those are regularly visited by seabirds. Due to human disturbance and massive egg collecting in the past, one of the two islets, Islote Quechol, is no longer used as breeding site. The other, Islote Muertos, is less accessible and therefore almost free from human disturbance. On this islet, every year hundreds to thousands of Chilean pelicans *Pelecanus thagus*, Peruvian boobies *Sula variegata*, blue-eyed cormorants *Phalacrocorax atriceps*, kelp gulls *Larus dominicanus* and other species breed.

Foraging and food provisioning strategies of northern gannets: evidence from satellite telemetryKEITH HAMER¹, RICHARD PHILLIPS¹, SARAH WANLESS & MIKE P. HARRIS¹ Biological Sciences, University of Durham, South Road, Durham DM1 3LE, England;

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For many birds, obtaining food for offspring is a major component of reproductive effort. Yet for seabirds, the strategies that adults employ to obtain food resources and the rules that they apply to allocate those resource between themselves and their offspring are among the least well understood aspects of their breeding ecology. This study uses satellite telemetry to investigate the foraging locations and food provisioning strategies of chick-rearing gannets *Morus bassanus* in two contrasting oceanographic regions: the North Sea and the Celtic Sea. Detailed data will be presented on diets, durations and destinations of foraging trips in each region. The exploitation of particular bathymetric features and the consistent use of particular foraging locations by individual adults will also be discussed in the context of strategies for exploiting patchy and unpredictable marine prey.

Foraging effort and reproductive success in Humboldt penguins and influences of oceanographic conditions

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The Humboldt penguin, *Spheniscus humboldti*, is endemic to the cold, nutrient-rich Humboldt current off the coast of South America. Its population is constantly declining and the bird is considered as vulnerable (IUCN). Due to its large distributional range which stretches over 4500 km from Northern Peru to Southern Chile, the Humboldt penguin is exposed to extremely different ecological conditions in its habitat. We investigated the relationship between the foraging ecology and the reproductive biology of this penguin within the framework of oceanographic differences (e.g. temperature, depth, prey species) at two sites: Pan de Azúcar in Central Chile and Puñihuil, the southernmost breeding colony of the Humboldt penguin, about 1700 km south of Pan de Azúcar. We will present data on diving behaviour, time-energy-budgets and reproductive success of the penguins under the different oceanographic conditions. In Pan de Azúcar the penguins spent significantly more time at sea, dived deeper, undertook more distant foraging trips and had a lower reproductive success than the birds of Puñihuil. The data will elucidate the Humboldt penguin's behavioural adaptations to the different marine environments and their impact on its reproductive success.

No evidence of relationship between fluctuating asymmetry and environmental stress in common tern *Sterna hirundo* chicks

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Fluctuating asymmetry (stress-induced random deviations from perfect bilateral symmetry that arise in the development of bilaterally symmetrical traits) has been widely used as an indicator of either genetic or environmental stress. In order to investigate relationship between fluctuating asymmetry levels and environmental stress we studied common terns in late chick stage at the Ebro Delta colony. Two methods were used. First, we compared body condition of the chicks and levels of asymmetry. We took account of several factors which might be considered to be related with possible environmental stress (sub-colony, clutch size, hatching order of the chick and number of chicks that fledged from the nest). During 1999, we took repeated measures of tarsus and wing length of chicks between 18 and 28 days old in three sub-colonies. Only tarsus measurements matched the statistical properties of fluctuating asymmetry. The analysis of fluctuating asymmetry levels did not show significant differences for any of possible environmental stress factors. Chick condition was estimated using residuals of regression analyses of body size against body mass. No correlation was found between body condition and level of asymmetry. We also tested for differences in body condition between levels of the possible environmental stress factors. Significant differences were detected for

number of reared chicks, clutch size and sub-colony. Our results showed no evidence of any relationship between levels of tarsus fluctuating asymmetry and environmental stress. Possible explanations are discussed.

Fitness consequences of replacement egg-laying for arctic-nesting thick-billed murres

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In the thick-billed murre *Uria lomvia*, a long-lived, arctic-nesting seabird that lays a one-egg clutch, the proportion of pairs that relays after losing their egg declines sharply with the date of loss. However, in experiments carried out at two low-arctic colonies, early-laying pairs (typically, older and more experienced birds) that had their first eggs removed continued to produce replacement eggs until late in the laying period. This suggests that the fitness benefits obtained by relaying and raising young, even very late in the season, exceed the fitness costs for the more capable members of thick-billed murre populations. Early-laying females that were experimentally induced to relay spent as much time incubating their eggs, and delivered as much food to their chicks, as did unmanipulated early-laying females. Replacement-egg chicks grew as well, and were as likely to survive to depart the colony, as were first-egg chicks when both groups were raised by early-laying parents. Moreover, first- and replacement-egg chicks were equally likely to be resighted at the colony at 4-5 yr old, the age of recruitment for thick-billed murres. Combined with key predictions of life-history theory, the absence of within-season trade-offs between relaying and other phases of reproduction suggests that producing a replacement egg is not a particularly demanding process for more capable thick-billed murres. In addition, these birds experience direct fitness benefits by relaying, despite the lateness of their chicks' departure from the colony.

The German Bight as a breeding, migration and resting area for seabirds

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The German part of the south-eastern North Sea covers a variety of habitats which are of great importance to birds for reproduction, resting, moulting and feeding. With a very few exceptions the whole area is geologically very young, formed during the last ice age or more recently. The Waddensea saltmarshes on the mainland, the 'Halligen' (saltmarsh islands) and the larger islands with their sand dunes house thousands of breeding gulls, terns and waders, whereas intertidal mudflats and saltmarshes are also used as feeding and resting areas by millions of waders and geese using the East-Atlantic-Flyway. The areas offshore the Waddensea Nationalparks are important as feeding grounds for e.g. Sandwich terns *Sterna sandvicensis* and lesser black-backed gulls *Larus fuscus* breeding on the Waddensea islands and as resting areas for moulting and wintering divers (> 20,000 individuals, mainly red-throated diver *Gavia stellata*) and seaduck (mainly common eider *Somateria mollissima* and 10,000 to 20,000 black scoters *Melanitta nigra*). They are preferably found in waters less than 20 m deep. The island of Helgoland is the only site in the German Bight that is suited for cliff nesting birds. In its Triassic sandstone rocks, roughly 10,000 pairs of black-legged kittiwakes *Rissa tridactyla*, common guillemots *Uria aalge*, northern fulmars *Fulmarus glacialis*, herring gulls *Larus argentatus*, northern gannets *Morus bassanus* (since 1991) and other seabirds breed. In winter, the island is used as an 'offshore resting platform' for large gulls that profit from the fisheries around the island.

Pellet production in free-living great cormorants *Phalacrocorax carbo*

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The food consumption of fish-eating birds can be assessed from their pellet production. For this it is essential to know the average number of pellets produced per bird per day and to estimate the number and size of the prey items from remains in the pellets. However, the knowledge of pellet production in wild birds is extremely limited, especially in seabirds. In cormorants, several feeding

trials on captive birds (fully grown) rendered quite contradictory results ranging from 0.3 to 1.75 pellets per day. In the only study on free living cormorants, (Russell, Wanless & Harris 1995, Seabird 17: 44-49) found that adult shags *Phalacrocorax aristotelis* produced less than 0.3 pellets per day during the breeding season. Pellet production in cormorants outside the breeding season is virtually unknown. Hence, we investigated the pellet production of great cormorants at a large winter roost on the island of Helgoland (south-eastern North Sea). With the aid of video equipment and with an image intensifier we recorded the time and amount of pellet production throughout the whole day. The study was supported by Hensoldt AG, ZEISS Gruppe.

Life history implications of mate choice, mating success and sexual selection in seabirds

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In addition to being long-lived, seabirds postpone reproduction until they are several years old. Young seabirds may be unable to reproduce due to energetic constraints related to their incompetence in foraging. Here I evaluate the possibility that delayed breeding and other aspects of seabird life history are adaptations to the competitive social environment at seabird colonies, principally related to mate choice and sexual selection. Auklets (family Alcidae, tribe Aethiini) include five small planktivorous species. This group provide an example of how sexual selection and life history evolution interlock in seabirds. Young auklets are unable to reproduce because they have low mating success and are socially subordinate and thus unable to compete for nest sites. As in other seabirds, the process of obtaining the first mate is protracted, and mates are retained for more than one breeding season. Nevertheless, relative to other seabird species, auklets maximise mating success by changing mates frequently and much activity, time and energy is invested by mated and un-mated individuals evaluating potential future partners. Together, social factors are paramount in determining reproductive success of individuals and must be considered in management schemes to recover threatened seabird populations.

Dynamics of parenthood: parental investment and body condition in lesser black-backed gulls

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In iteroparous species like seabirds, condition is an important factor determining how much parental investment an individual can expend in a breeding event. Where both parents care for the offspring, the parental behaviour of the partner will influence an individual's allocation decisions. In this study, we investigated how female condition influences the allocation of parental care by both pair members. We experimentally altered expenditure of female lesser black-backed gulls *Larus fuscus* during egg laying, and examined the parental care of the pair during the rest of the breeding attempt. We found that manipulated females spent less time brooding the chicks and less time foraging for the chicks. Under the conditions during the year of study, males were able to fully compensate for the manipulated females' change in behaviour and there was no subsequent decrease in the pair's reproductive output.

Sex allocation in a seabird with reversed size dimorphism

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Genetic theory predicts a 1:1 ratio of male to female offspring. Sex allocation is the capacity of the parent to change this ratio. According to sex allocation theory, where differential fitness of the sexes occurs, parents should adjust the sex ratio in favour of the more beneficial sex. It has long been thought that birds were restricted in their ability to display sex allocation. This is because the chromosomal sex determination system which is found in birds and mammals is generally difficult to manipulate. It is further complicated in birds because the egg carries the sex determining chromosome rather than the sperm. Despite this, evidence is now growing that sex allocation is more widespread amongst birds than expected. In our study on great skuas *Catharacta skua*, a predatory seabird with reversed sexual size dimorphism, we examine whether these birds use sex allocation in response to changing conditions. We conducted an experiment in which we stressed the adults and monitored sex ratio changes in relation to the stress. Our results show that skuas are able to skew the primary sex ratio of their offspring. Additionally, they give strong indications about the influence of gender and size on viability of chicks, as the skew shown by skuas is opposite to that shown by gulls which exhibit normal sexual size dimorphism.

Coastal migration of seabirds in the southern North Sea

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While standardised observations of seabirds have been carried out for decades in several countries adjacent to the North Sea and several comprehensive articles have been published, interest in migration of seabirds in the German Bight has been low. Exceptions have been at Helgoland and Norderney where seabirds have been counted regularly since 1987 and some results published. This study aimed to examine the occurrence of seabirds in the months September–November (1995–99, 418 observation hours) at the East Frisian island of Wangerooge with special interest in phenology, diurnal rhythms, intensity of migration and flight behaviour in relation to weather conditions. Results of two species are presented for example: Leach's petrels *Oceanodroma leucorhoa* (n = 211) occurred only during onshore winds (94,5% at winds from NW) over 8 m/s; highest numbers occurred in the late afternoon. Migration of common scoters *Melanitta nigra* (n = 20,115) reached a peak in early October; with 50% of the daily totals passing the island within 1.75h after sunrise. Winds from the east with moderate force produced the strongest migration. With tail winds and increasing force flight altitude above sea level increased, flight into the wind resulted in low flight altitudes.

Hop or jump: autumn migration strategies of lesser black-backed gulls *Larus fuscus* as revealed by satellite tracking

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The lesser black-backed gull is a long-distance migrant breeding only in northern and western Europe from the White Sea to the Iberian peninsula and wintering in Africa. The species is subdivided into three subspecies: *L. f. fuscus* (N Norway and eastwards), *L. f. intermedius* (S Scandinavia), and *L. f. graellsii* (W Wadden Sea and westwards), with *L. f. graellsii* being only a short distance migrant wintering along the E Atlantic coast between Britain and Morocco. Three breeding males of the subspecies *L. f. intermedius* in Denmark (Salthølm Island, Øresund) and another three breeding males of the subspecies *Larus f. fuscus* in Finland (Iso-Roinevesi, freshwater lake near Tampere) were fitted with satellite transmitters during the hatching period to follow their autumn migration. Three birds,

one from Denmark and two from Finland could be tracked until December 1999. All three birds remained in their breeding areas until 29 August. The Danish *L. f. intermedius* migrated westwards. The bird stayed in the Wadden Sea until late September. It passed through the Channel, across Brittany and along the coast of the Iberian Peninsula during October. The wintering quarter north of Banc d'Arguin, Mauritania, was reached in late November. The Finnish *Larus f. fuscus* migrated southwards. They spent a week in the Gulf of Finland before flying non-stop to the northwestern Black Sea on 10 September. Both birds stayed offshore there for ten days. The Nile delta, Egypt, was reached in late September. One individual stayed near Alexandria, apparently its final destination. The other bird went further south to Lake Victoria. It reached its wintering ground near Kampala, Uganda, on 29 September. Its final non-stop journey of about 3500 km lasted for 92 hours (38 km/h).

Thermal characteristics of puffin burrows in Shetland

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The reproductive period is a challenging time for seabirds because the birds, being well-adapted to stay and feed at sea, have to cope with different and often highly variable climates on land. The breeding distributions of seabirds are likely to depend, therefore, inter alia on suitable thermal breeding conditions. We investigated the thermal characteristics of Puffin *Fratercula arctica* burrows during the chick-rearing period at Foula, July 1998, and Hermaness, June/July 1999, Shetland, U.K.. Temperature sensors were placed in regular distances (e.g. every 20 cm) inside the burrows between the entrance and the inner end and data were stored in logging units. Puffin burrows reduce the range of temperature substantially, e.g. from a diel range of up to 34°C outside the burrow towards less than 4°C at the nest site in the burrow. On the basis of temperature profiles we compare different parts of the colonies as well as different types of burrows. We hypothesise that the temperatures in the burrows are within the thermoneutral range of the chicks, and thus serve to save energy although further studies are needed in order to establish whether this is the case.

Body mass decrease in breeding female kittiwakes *Rissa tridactyla*; an adaptation to reduce maintenance costs?

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We studied the relationship between body mass, body composition and basal metabolic rates (BMR) in breeding female kittiwakes on Svalbard (79°N 12°E). Body masses were obtained frequently from laying until the end of the chick-rearing period. Analysis of body composition and measurements of BMR were obtained two weeks before the time of hatching, at hatching and two to three weeks into the chick-rearing period. During the incubation period the body mass increases mainly because of an increase in the fat content. During the first half of the chick rearing period there is a decrease, by 16 %, in the body mass. This is due to a reduction in both fat and body proteins, and the internal organs, especially the liver, reduces their masses. The body mass decrease coincides with a reduction in both total and mass specific BMR. During the second half of the chick rearing period the body mass seems to stabilise. Because of the reduction in both fat reserves and body proteins (both skeletal muscles and internal organs), it seems unlikely that the body mass reduction is an adaptation to reduce the costs of flying in the chick rearing period, as stated in the flight adaptation hypothesis. A body mass reduction might, however, be an adaptation to reduce the maintenance costs of the parents, because it is paralleled by a reduction of the BMR. This would hence enable the parents to allocate more energy into chick growth. The body mass level reached during the second half of the chick rearing period may be a consequence of a trade-off between the parents own survival and future reproduction and the survival and growth of their chicks.

Diet of great cormorants *Phalacrocorax carbo* wintering at the island of Helgoland

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The offshore island of Helgoland in the south-eastern North Sea houses a large winter roost of great cormorants. Highest numbers (> 700) are found in late autumn and winter. This stands in contrast to other resting sites in Denmark and northern Germany where maxima occur during autumn and spring migration. Reasons for this diverging phenology may be: (1) differences in food choice and / or availability, (2) lower thermoregulatory costs in the 'more marine' habitat at Helgoland, or (3) the higher proportion of 'Atlantic' cormorants *P. c. carbo* compared to the resting sites at the mainland. To test these three hypotheses we studied food, time-budgets and energetics of great cormorants in autumn and winter. In this poster we present the diet based on pellet analyses. Main species found are: cod *Gadus morhua*, bull-rout *Myoxocephalus scorpius*, sea scorpion *Taurulus bubalis*, hooknose *Agonus cataphractus* and goldsinny *Ctenolabrus rupestris*. The proportions changed significantly throughout the study period.

Guillemots on Skomer Island - the story of their success

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The population of common guillemots *Uria aalge* on Skomer Island has undergone dramatic changes over the last century and reached its all time low at the beginning of the 1970s. Since 1980 the population has increased at a rate of 5% annually. Using a long term data set (1985-99) based on observations of over 4600 individually marked birds this study investigates the demographic background that facilitated this increase. Most birds started breeding at the age of 6 years and 90% of surviving offspring had bred at least once by the end of their 10th summer. Age and experience significantly influenced breeding success, with high "adult" breeding success attained at the age of ten years, on average. The reproductive output of the population has increased as the population has grown, showing a clear positive density dependence. Guillemots of all age groups also showed high survival rates. A detailed demographic model will be presented to show how these parameters give a proximate explanation for the dynamics of this well-studied population of guillemots.

The influence of fledgling number and hatching order on return rates of prospecting common terns *Sterna hirundo*.

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During the stage of prospecting seabirds explore their future breeding place and obtain information about the colony. Common Terns start breeding at the age of 3-4 years, and most subadult individuals are prospecting colony sites already when two years old. This paper addresses the question if return rates of prospecting common terns depend on hatching order and number of fledged siblings within a brood. The results are based on prospectors of the year classes 1992-1996, when all fledglings have been marked with passive transponders. At the native colony site Banter See in Wilhelmshaven on the German North Sea coast resighting probabilities are very high, as terns are automatically registered by antennas placed at resting sites in the colony. By means of this new methodological approach we were able to record all subadults returning to the native colony site. Differences in return rates between hatching position were small. We found increasing return probabilities with higher number of fledged siblings, indicating the importance of parental quality for survival of their young also after fledging. Supported by the Deutsche Forschungsgemeinschaft.

Population genetic structure and dispersal of the seabird tick *Ixodes uriae* within and among multi-host colonies

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The tick *Ixodes uriae* is a common ectoparasite of seabirds in both hemispheres. It is considered to negatively impact its hosts through its effects on host reproduction success and habitat selection decisions, and to transmit tick-borne diseases. During the seabird-breeding season this tick normally takes a single blood meal from its host that lasts from 3 to 10 days. After this short meal, it returns to the nest substrate where it moults and becomes inactive until the following season. Because of the limited movements of bird hosts on and among colonies during the breeding period, opportunities for tick dispersal and the frequency and extent of such events are unknown. It has been suggested that most dispersal events of this parasite occur at the end of the breeding season when failed breeders and fledgling are prospecting for nesting sites. However, as direct studies on the dispersal of *I. uriae* in the field are limited, indirect methods need to be employed if we are to better understand the mechanisms and frequency of its dispersal. To this end, we have used highly polymorphic microsatellite markers to determine the population genetic structure of this ectoparasite among several multi-species seabird colonies in the Northern Hemisphere. From this data, we are able to determine the likely dispersal patterns of this parasite at different spatial scales and among different host species. This type of data has direct implications for the epidemiology of tick-borne disease (e.g. *Borrelia burgdorferi*). Further, as dispersal of the tick at large scales must be through its seabird hosts, this data can also be used as an independent test of observed dispersal patterns of seabirds among colonies.

Diving behaviour and foraging habitats of Brünnich's guillemots breeding in the High-Arctic

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We studied the foraging behaviour of Brünnich's guillemots in a high-arctic fjord system (Kongsfjorden) in western Spitsbergen. The physical oceanographic characteristics of the water differ from the head of the fjord and westward into the Greenland Sea, which is reflected in the vertical profiles of water temperatures in different parts of the area. We fitted nine Brünnich's guillemots with temperature-depth recorders, which generated vertical temperature profiles of the dives that were compared to synoptic measurements of the water temperature characteristics of the region. This method was used to locate the foraging areas of chick-rearing Brünnich's guillemots and to study the foraging site fidelity of individual birds. The results showed that only three of the nine birds foraged outside Kongsfjorden during the study period, and only 26 of the 186 dive bouts (14%) were conducted outside the fjord, 48-58km from the colony. Most dives were probably made only a few kilometres from the colony. The data indicated that the birds showed strong fidelity to foraging areas, at least at a spatial scale of some kilometres. However, the birds sometimes changed feeding areas characterised by different vertical temperature profiles. The guillemots made 2229 dives during the study period and spent about 10% of their time under water. The diving depth averaged 45m, and the dive duration averaged 97 sec. The deepest dive recorded was 136m and lasted 196 sec. We did not find any diel rhythm in the diving depths of the Brünnich's guillemots. Also, we found no diel pattern in diving intensity. These findings contradict the predominance of night-time diving observed in studies further south.

Nest types of the brown-hooded gull *Larus maculipennis*: adaptations to different environmental conditions

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We observed five different nest types of the brown-hooded gull in south Chilean tule marshes. In the years 1994 - 1996, these nest types were investigated under varying conditions at five colony sites Isla Teja, Santo Domingo, La Laja, Huelmo, and Coluco. Anchored floating nests were connected to living tule stems and were the most common and widely distributed type. Free floating nests, which floated freely with the currents, and nests in vegetation, which were built in the tules above the water level, dominated at the tidally influenced sites Santo Domingo and Isla Teja. At Santo Domingo, where the percentage of tules at nest sites was higher than at Isla Teja, nests in vegetation were the most abundant nest type. Free floating nests were most common at Isla Teja, where flotsam predominated at nest sites. At both colonies the most abundant nest type lost least eggs through nest damage, but most eggs to predators. At Coluco, two further rare nest types were observed, "ground nests" and "nests on windrow", which were built on windrow above the tule. The study was supported by the Volkswagen-Stiftung, the DAAD, the Graduiertenförderung of the University of Oldenburg, and the Heinz Neumüller Stiftung, and is part of a co-operation between the Institut für Vogelforschung and the Instituto de Zoología, Universidad Austral de Chile, Valdivia.

Seabird 2000

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Seabird 2000 is a major new initiative to census all breeding seabirds in Britain and Ireland. The project is a partnership between the British Government's conservation advisor, the Joint Nature Conservation Committee (JNCC) and nine other conservation bodies in Britain and Ireland, including the Seabird Group. The aim of Seabird 2000 is to obtain as accurately as possible, an estimate of the populations and distributions of each of the 24 species of seabird that breed regularly in Britain and Ireland. Seabird 2000 follows on from two previous surveys conducted in 1969-70 ('Operation Seafarer') and in 1985-87 (the Seabird Colony Register). Following the last survey, the JNCC has been co-ordinating the Seabird Monitoring Programme (SMP). The SMP has been used to identify significant trends within regional populations since 1987. However, there is considerable variation in the trends seen, both within and between species. It is therefore necessary to re-establish new baseline figures for all species across the whole of their range within Britain and Ireland. Survey work for Seabird 2000 began in 1999 and will continue in 2000 and 2001. Counts are being conducted by hundreds of volunteers as well as staff from the project's partners. There is still a great deal of work to complete and future contributions from volunteers are welcomed. This applies also to seabird enthusiasts outside the UK and Ireland!

Resource allocation and life history trade-offs in seabirds

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Seabird life history strategies, which are characterised by high survival and low reproductive rates, are a consequence of the pattern of resource allocation to growth, self maintenance and reproduction. With respect to reproductive investment, life history theory leads us to expect trade-offs in the allocation of resources both between and within reproductive events. However, such trade-offs are difficult to demonstrate, and positive, rather than the expected negative, relationships are often found. This is largely due to the confounding effects of adult quality. Experimental manipulations are thus important in such studies, and can be used in demonstrating which components of reproduction are expensive, and in examining whether the expected trade-offs do occur. In this talk I shall focus on within brood trade-offs and on the important role of maternal condition in determining optimal patterns of reproductive investment.

Diets of common murre chicks in Newfoundland: inter-annual variation in capelin characteristics and parental selectivity

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We present a 10-year data series of the diets of common murre *Uria aalge* chicks on Funk Island, the largest colony in the north-west Atlantic. Chick diets were dominated by female capelin *Mallotus villosus*, primarily gravid females which have higher energy densities than males or spent females and immatures; larger males can, however, provide larger meals for chicks. Parents also delivered small percentages of sandeels and other prey to chicks. Inter-annual variation in capelin sizes and ages are related to changing oceanographic conditions and to the abundances and spatial and temporal distributions of prey. At the same colony, multi-prey loading northern gannets *Morus bassanus* take much higher proportions of male capelin. Systematic scans revealed that murre and gannets returned to the colony from similar directions, suggesting that they forage in similar areas. Gannets do not dive as deeply as murre, showing that murre have access to male capelin but as single-prey loaders select gravid capelin as food for chicks. Comparisons of the burst-speeds of male and female are used to evaluate if one sex is slower and hence potentially easier to capture. Underwater video of foraging common murre shows predation success is virtually ensured when birds encounter large inshore schools of spawning capelin, and that the birds spend considerable time swimming near the school before selecting a fish. Finally, the trophic implications of sex- (female) and conditioned- (gravid) biased predation by common murre, the dominant seabird consumer of capelin in the north-west Atlantic, is considered.

Parental condition, family sex ratio and reproductive strategies in gulls

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There is growing empirical evidence that the offspring sex ratio in birds is biased in relation to the environmental circumstances their parents experience during breeding. An important requirement to understand sex ratio biases is information how these environmental circumstances affecting the survival prospects of male and female offspring. We provide experimental demonstration for lesser black-backed gulls *Larus fuscus* that two processes occur independent of each other. We have shown previously that male offspring that hatch from eggs produced by mothers in poor condition have poorer survival prospects than female offspring even when raised under favourable conditions and factors operating through the egg itself are involved. In this contribution we now want to show that parental condition during chick rearing also differentially affect pre-fledging survival of males and female offspring. In particular male offspring from broods reared by parents in poor condition and males in male-biased broods had poorer survival and growth than female offspring. Cross-fostering experiments show that this effect acts through the parental rearing ability independent of egg effects. Obviously under natural conditions the two independent effects of parental condition on sex-specific mortality, one through egg quality and the other through chick rearing capacity will act in concert in determining the optimal size and sex composition of a gull family.

Squid prey of the Cory's shearwater *Calonectris diomedea borealis* in the sub-tropical mid-North Atlantic Ocean

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The species, distribution and abundance of squids in the sub-tropical mid-North Atlantic are difficult to assess by conventional oceanographic means. We are studying the food and feeding ecology of the squid-eating Cory's shearwater as a supplemental way to collect information on squid biology. We examined the diet from March to September 1998 and squid were present in 58% of the regurgitations from adults (n=533). Preliminary results (n=202 lower beaks) showed that 24 species of oceanic squid occurred and those species with a frequency higher than 5% were: *Taonius pavo* (21.8%), *Todarodes* sp. (16.8%), *Histioteuthis* sp. (14.4%), *Gonatopus* sp. (7.4%), *Ommastrephes* sp.

(6.9%). Of the species present, most have a mesopelagic distribution and would not be expected to occur at the sea surface, on the basis of present knowledge from net captures. Although most beaks represent specimens that could probably be attacked and consumed by a Cory's shearwater, those from *Haliphron atlanticus* (over 2m long) are impossible to have been swallowed whole by a bird. These results pose some interesting questions about how squid are made available to Cory's shearwaters and how they catch squid: night or day, dead or alive? The results highlight the limitations of squid sampling by trawl surveys, particularly close to the surface, and the value of Cory's shearwater as an indicator of abundance and distribution of squid stocks.

Irish Sea roseate tern project 1996-1999: the role of food supply, foraging behaviour and weather on reproductive success

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Pre-requisites for successful seabird reproduction are secure nesting sites, reliable food supply and in the NE Atlantic, reasonable weather. This paper reviews research and conservation action on the core European population of roseate terns *Sterna dougallii* nesting in the Irish Sea. This population has slowly recovered to about 730 pairs following serious declines in the early 1970s, and 80-90% of the sub-population currently nest on Rockabill Island, off County Dublin, despite intensive conservation action at several other formerly well used colonies in Wales and Ireland. Lady's Island Lake in SE Ireland remains the only other viable colony. At Rockabill, productivity has varied in the past four years between 0.87 (1998) and 1.43 (1999) fledged chicks per pair. During poor years, wet weather around the time of hatching appeared to result in high chick mortality, and in most cases adults were only able to provide food for one chick and B-chicks died. Sprats and sandeels predominated food presented by terns to mates and chicks. In 1998 and 1999 surveys were conducted at sea over a radius of 15km from Rockabill to map the distribution of terns and identify oceanographic or biological features associated with their feeding areas. During the chick provisioning period, 98% of adult terns ranged no further than 9.5km from colony, but during incubation a substantial proportion appeared to fly distances >15km. In 1998 terns tended to forage in larger groups in association with other seabirds, whereas in 1999 most foraged singly or with one or two other terns. In both years, most foraged over relatively deep water in contrast to described behaviour in New England, USA.

Breeding performance of very old common terns

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This is part of a long-term study of common terns *Sterna hirundo* at Bird Island, Massachusetts, USA (41°40'N, 70°43'W). In 1999, we located 25 birds aged 18-23 years; birds of these ages comprise the oldest 5% of the ringed birds at this site. We measured the breeding performance of these very old birds, including laying dates, clutch-size, egg-size, hatching success, parental behaviour, chick growth, and chick survival. We compared their performance with that of several control groups, including date-matched young birds aged 6-9 years. The very old birds were more successful in raising chicks than any of the control groups. Even within the group of very old birds, the performance of those aged 21-23 years was at least as good as that of those aged 18-20 years. If common terns experience any senescent decline in breeding performance, this is offset either by increased reproductive effort or by selective survival of high quality individuals.

Costs of relaying in the common guillemot *Uria aalge* at a food-stressed Alaskan colony

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We conducted a manipulative experiment to investigate fitness costs arising from relaying in common guillemots. Other workers have shown no apparent within-season trade-offs resulting from production of a replacement egg in common guillemots or in the closely-related Brunnich's guillemot *Uria lomvia*, but most previous studies have been carried out at colonies experiencing relatively favourable feeding conditions. Working at a severely food-stressed colony in Alaska, we removed eggs from early and late-laying pairs, and documented a sharp decline in relaying probability as the initial lay date increased. We compared size, yolk:albumen ratio, and yolk lipid densities of first eggs and relaid eggs from the same parents. Condition and growth of chicks from first eggs are compared to chicks from relaid eggs, and we investigated the link between early-season maternal condition and subsequent relaying capability. None of our experimentally relaying pairs were able to raise a chick to fledging age, and we discuss the relative impact that egg loss and relaying can have on population dynamics of a food-stressed guillemot colony.

The effects of human disturbance on breeding skuas on the Shetlands and South Shetlands

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Several studies have demonstrated adverse effects of human disturbance on reproductive success in seabirds. Great skuas *Catharacta skua* on Foula, Shetland Islands, Scotland showed different responses to humans depending on the degree of prior disturbance. Breeding pairs in a highly disturbed area allowed the observer a closer approach before flying off and returned earlier to the nests than birds in undisturbed parts of the colony. We suggest that these skuas habituate to reduce the effects of disturbance. In addition to skuas from the north hemisphere, we also studied brown skuas *Catharacta antarctica lonnbergi* and south polar skuas *Catharacta maccormicki* on the South Shetland Islands, Antarctica. Behavioural responses and levels of aggression are compared under different disturbance regimes.

The effects of human disturbance on stress levels of the southern giant petrel *Macronectes giganteus*

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Studies have shown that human impacts have influenced the breeding success and the number of breeding pairs of southern giant petrel in recent years on King George Island. These birds are very sensitive to disturbance, and experimental studies are necessary to identify the reactions of the birds to various distances of human interference. In 1999/2000, studies will be carried out on Penguin Island, south of King George Island, (South Shetland Islands, Antarctic) which is regularly visited by tourists mainly due to the high numbers of giant petrels breeding on this Island. Their behavioural responses to human intrusion will be analysed by video recordings and data of a physiological parameter of the birds. For the first time, the non-invasive technique of artificial eggs to measure heart rates, which has been successfully used in several penguin studies, will be applied to southern giant petrels.

Predation by black rats on Audouin's gull eggs: a potential risk for its productivity?JORDI PRIETO¹, XAVIER RUIZ¹ & LLUÍS JOVER²

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The second largest colony of the threatened Audouin's gull *Larus audouinii* is on the Chafarinas Islands in the western Mediterranean. During 1999 we undertook an experiment to examine predation by black rats *Rattus rattus* on Audouin's gull eggs. The experiment was carried out towards the end of the incubation period. Twenty three plastic boxes were placed on the island and were prebaited daily for ten days. After this period two Audouin's gull eggs were placed in each box, one of them intact and the other one broken. We checked the boxes every morning for six days, recording any changes. A fur sampler was used to assess the rat activity. In boxes with rat activity 100% of broken and 16.7% intact eggs disappeared when both eggs were available. At the end of the experiment, Audouin's gull eggs 63% of the broken and 50% of the intact eggs had been eaten by the rats. The probability of an broken egg being depredated by rats was significantly higher after the second day. The experiment shows that rats, being opportunists, profit from easily available food. However, on Chafarinas islands black rats can also depredate intact Audouin's gull eggs. We suggest that high densities of rat population on small islands can affect the productivity of Audouin's gull through egg predation. We suggest that despite the artificial conditions of the experiment (no parental protection, artificial environment) black rat behaviour and their effect could be similar in natural conditions.

Herring gull populations at Lakes Baikal and Khubsugul

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Most of the Mongolian subspecies of herring gull *Larus argentatus mongolicus* nest at Lakes Baikal and Khubsugul. Despite differences in natural conditions and earlier human pressure, there are no differences in the reproductive biology of these two populations: breeding success is very high and numbers are increasing. At both Lake Khubsugul and Lake Baikal there has been recent a great increase in human pressure. At Baikal, gulls have suffered from food shortages, both for adults and especially chicks, however there is a low level of disturbance during egg-laying and incubation time. In contrast, at Lake Khubsugul, food appears to be adequate, but local people collect eggs in all gull colonies. In both cases, breeding success fluctuates. At Baikal, breeding failures happen during chick rearing, due to high chick mortality. As failure happens at an earlier stage at Khubsugul, birds can relay. However, the breeding period becomes longer and many birds change nesting site. Many new colonies thus appear, while old ones are abandoned. At Lake Baikal, many new colonies also appear, but for different reasons. Here, most breeding sites are full, with a high nesting density, and there is no room for young recruits. Most old colonies have stopped increasing, or are fluctuating in size.

Foraging movements of southern giant petrels *Macronectes giganteus* in waters of the Argentine continental shelfFLAVIO QUINTANA^{1,2}, O.PATRICIA DELL'ARCIPRETE¹ & ALFREDO LICHTER²

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The foraging tracks and range of two southern giant petrels, rearing chicks at Isla Gran Robredo, Patagonia, Argentina, were determined by satellite telemetry. Both petrels, which could not be sexed, showed a distinctive behaviour while at sea. Bird 1 flew consistently eastwards. It was tracked for 44 days and performed a minimum of 11 foraging trips totalling 7,700 km. In contrast,

bird 2 made one long foraging trip to the south, covering a total distance of 2,500 km in 15.5 days. Maximum trip duration for bird 1 was seven days. Maximum foraging ranges were 463 and 683 km for bird 1 and 2, respectively. The percentage of distance travelled during the daylight hours was similar between birds (~70% of the total distance). Even though both birds fed in waters within the continental shelf, bird 1 showed a more pelagic behaviour than bird 2, which foraged in coastal waters. These are the first records at-sea of one of the main scavengers of the Patagonian coast of Argentina and contribute to the understanding of the importance of the Argentine continental shelf as a foraging ground for seabirds breeding both at temperate and subantarctic waters of the South Atlantic.

Breeding success and diet of black-legged kittiwakes and herring gulls at Corossol Island, Québec, Canada : implications to use as indicators of prey abundance

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Populations of black-legged kittiwakes *Rissa tridactyla* and herring gulls *Larus argentatus* at Corrossol Island increased greatly between 1970 and 1985 but then declined dramatically until recently. To identify the main factors of these population declines we investigated the relationship between their diets and reproductive success over two years. Overall breeding success was low for both species in 1997 and 1998. However, clutch size and hatching success appeared normal, suggesting that food abundance was sufficient in the early part of the nesting season. On the other hand, fledging success was poor, and was mainly responsible for the low productivity of both species. Young kittiwakes and herring gulls were fed mostly sandlance *Ammodytes* sp. and capelin *Mallotus villosus*, respectively. Our observations suggest that a large part of the high kittiwake chick mortality resulted from intense predation by gulls. Also, our data tend to demonstrate that food shortage in the vicinity of the colony during chick-rearing period leads to increased predation by the gulls. In this particular case, breeding success of kittiwakes does not appear as a good indicator for food availability.

Demography of the north-east Atlantic roseate tern *Sterna dougallii* metapopulation

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The breeding roseate tern population in Britain and Ireland decreased by 81% between 1969 and 1983, stabilised in the mid 1980s and staged a slow, halting recovery in the 1990s. Roseate terns are now the rarest seabird breeding in north-western Europe and is listed as a bird of conservation concern. In order to improve the conservation status of this species, a study of the population dynamics is underway to elucidate the factors limiting population growth. Roseate terns have been ringed at most colonies in Britain and Ireland throughout the last three decades and resighting of these birds has been conducted during the 1990s at the three largest colonies; Rockabill (Co. Dublin), Lady's Island Lake (Wexford) and Coquet Island (Northumberland). This work has been facilitated by developing field-readable metal rings that are easier to see again than the standard BTO rings. A demographic model has been used to estimate mean age of first return to the colony, adult and first-year survival rates and recruitment probabilities from other colonies at which birds were ringed. These parameters are used to explain the observed trends at the different colonies within the metapopulation and to predict likely population trajectories in the future. The factors likely to limit the growth of the roseate tern population are discussed and recommendations are made for further research.

Partitioning of nesting areas among seabirds in central Chile: the roles of habitat selection and timing of breeding

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Many seabird species form breeding colonies at inaccessible sites (*e.g.* islands, cliffs) so as to ensure the best chances of securing mates, nesting and raising young. As these sites are generally scarce, birds have developed strategies to facilitate its partitioning and thus coexistence. During three consecutive seasons we studied the breeding activity and habitat use of Humboldt penguins *Spheniscus humboldti*, Chilean pelicans *Pelicanus thagus*, and Kelp gulls *Larus dominicanus* on Pajaro Nino Island (33°21'S 71°41'W), central Chile. Penguins bred mainly in rock crevices at rocky cliffs and under boulders near the shoreline. Pelicans bred almost exclusively on vegetation-free dirt plains with smooth slopes (3°-4°) forming dense mono-specific sub-colonies. Gulls bred mainly between rocks on dirt plains with steeper slopes (10°-11°) and in bush-protected nests on vegetated plains. Penguins bred throughout the year showing two egg-laying peaks in May and October. Gulls started laying in November and went on breeding up to March. Pelicans bred very asynchronously, starting to lay in December with the last fledglings abandoning the colony in June. We propose that the successful breeding of these three co-occurring species is based mainly on the differential use of the nesting habitats and secondarily on the timing of breeding.

Within-colony philopatry of Brünnich's guillemots

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Brünnich's guillemots *Uria lomvia* are highly philopatric to their natal colony. Resightings of individually marked birds were used to examine philopatry and movement within the colony at Coats Island, Nunavut, Canada. Philopatry was measured as distance between resightings and breeding sites and the hatching site. Between 1986 and 1997 we banded 9963 chicks at known locations on the Coats Island colony. During the breeding seasons 1989-1999, we made 9868 resightings of 1368 birds. The median distance between hatching sites and resightings in the first year that birds were resighted was 4.34 m (for sexed birds – a smaller sample - males 3.05 m, females 3.17 m). The median distance between hatching sites and sites of first breeding was 2.6 m (males 1.8 m, females 3.3 m). In the years prior to the first breeding attempt, males were resighted near their future breeding sites more often than females. During a single year movements between successive sightings of the same individual became progressively shorter. Over the years prior to breeding, the position of resightings became progressively closer to the first breeding site. After the first breeding attempt most birds remained at the same site in successive years (54%). Breeding females were less philopatric than males and, if they left their breeding site, tended to move further (0.88 m versus 0.25 m). Males showed a greater interest than females in their first breeding site during the years prior to first breeding. This suggests that males may select the breeding site. In general males seemed to be more philopatric than females. Guillemots do not become more philopatric with age.

The drawbacks of breeding association between Sandwich terns and black-headed gulls

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In Northern Europe, Sandwich terns *Sterna sandvicensis*, typically breed in association with black-headed gulls *Larus ridibundus*. By nesting in proximity of the gulls, the terns benefit from the aggressive anti-predator behaviour of their neighbours. Until hatching of the eggs, the advantages of breeding near the gulls outweigh the disadvantages of egg predation by the gulls themselves. However, post-hatching the advantages of associative nesting become less important because predation decreases, but the gulls steal an increasing part of the food brought to the chicks. Since

gulls selected mainly larger prey items, energy intake of the tern chicks is limited to a critical level. Of the two major prey items, sandeel *Ammodytes* sp., was robbed more often than smaller herring *Clupea harengus*. If the chicks were to be fed exclusively on sandeel and if the chicks were attended by one parent, energy intake would be too low for chick survival. By provisioning an increasing proportion of herring with as the chicks grow larger, the terns could theoretically avoid food shortage. However, diet composition did not change significantly with the age of the chicks. Instead, parents increased their foraging efforts as their offspring grew. When herring was scarce, parents left their chicks more often unattended at the nest. Parents were thus largely able to counterbalance the food shortage of their offspring. Because of this, differences in diet composition between years had only small effect on chick growth and chick survival. Another mechanism the terns use to avoid high losses inflicted by the gulls is to lead the chicks away from the robbing gulls. In this way the incidence of robbery could be greatly reduced, resulting in faster growth and earlier fledging.

Monitoring environmental chemicals in seabirds of the Wadden Sea

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Eggs of common terns *Sterna hirundo* and oystercatchers *Haematopus ostralegus* breeding at five sites along the North Sea coast in 1998 were investigated for residues of Σ PCBs, Σ DDT, HCB, Σ HCHs, and mercury. Except for HCHs, common tern eggs were more polluted than those of oystercatchers at nearly all study sites. This may be explained by differing mechanisms of bioaccumulation and a different foraging behaviour of the birds. Common terns eggs collected from colonies on the Elbe estuary had higher chemical loads than those from other regions. Except for Lindane, time trends of contamination from 1981–1998 show significantly decreasing pollutant concentrations since the end of the 1980s at most study sites. Reproductive success of birds breeding in the Wadden Sea appears to be not affected by the current pollutant concentrations in eggs. However, embryotoxic effects of the contamination found at the Elbe estuary cannot be ultimately ruled out. The results reveal the Elbe estuary to be still a European hot spot of contamination (PCBs, mercury) alongside the Lower Rhine (PCBs) and Baltic Sea coasts (DDT). Data were collected within the framework of the "Monitoring Pollutants in Coastal Bird Eggs in the Wadden Sea" project initiated in 1981 by the Institut für Vogelforschung "Vogelwarte Helgoland" and implemented since 1998 within the "Trilateral Monitoring and Assessment Program" of the Wadden Sea.

Results of long-term monitoring of seabird reproduction in nature reserves protected by Verein Jordsand

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The Verein Jordsand was founded in Hamburg in 1907. The name derived from its first protected area, the "Hallig Jordsand" (nowadays part of Denmark). As early as 1909 the Verein Jordsand acquired "Hallig Norderoog". With its natural salt marshes it is one of the most important breeding sites for terns in the North Sea. Until now it is the only island in Germany as a nature reserve in private property. Among other research projects Verein Jordsand co-ordinates long-term monitoring of environmental changes and population dynamics of birds. The paper will show the results of long-term monitoring of seabird reproduction in several nature reserves protected by Verein Jordsand. Its main subject will be the population development of Sandwich tern *Sterna sandvicensis* on Hallig Norderoog from 1909 until today .

Impact of great skua *Catharacta skua* on other seabird populations in ShetlandSTEVE C. VOTIER¹, NORMAN RATCLIFFE² & ROBERT W. FURNESS¹

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The rapid increase in numbers of great skuas in Shetland over the past 100 years seems, in part, due to their ability to exploit a range of different food sources. They feed on discarded fish from commercial fisheries, on sandeels *Ammodytes marinus* and seabirds. A dramatic reduction in the abundance of sandeels in Shetland during the late 1980s resulted in large numbers of seabirds suffering reduction in breeding success. Great skuas responded to this by increasing the proportion of bird meat in their diet. Despite subsequent recovery of sandeel stock, seabird predation by skuas has continued at a high level causing localised extirpation at certain colonies. EU proposals that will reduce the amount of discards heightens the need to monitor the impact of great skuas on other seabird populations, since discards have been a major part of great skua diet. In this presentation we review skua dietary assessment techniques as a basis for estimating the numbers of seabirds eaten by skuas. We also present evidence that predation on seabirds is density dependent and that those skuas with a specialised diet are highest quality pairs. These issues have important implications for any future management plan to maintain biodiversity at Shetland colonies.

Reproductive success of common terns *Sterna hirundo* in colonies on the Belgian coast and in the WesterscheldeJEROEN VAN WAEYENBERGE¹, JOERI MANHOUT¹, JAN SEYS¹, HENK OFFRINGA², PATRICK MEIRE³ & ECKHART KUIJKEN¹

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The reproductive success of common terns is used as an tool for monitoring the state of the environment. The breeding success and other parameters of this species in colonies within the study area provide indirect information on the quality of the North Sea and the Westerschelde. In the outer harbour of Zeebrugge breeding success of common terns has been determined in several years and at different breeding sites within the colony. Success varies within the colony due to differing local circumstances such as predation pressure. Chick growth was investigated at different colonies (Zeebrugge, Terneuzen and Saeftinghe) in one year and at different breeding sites within the colony of Zeebrugge over several years. Food composition and food supply of chicks was obtained for several years at Zeebrugge. One of the major feeding areas of common terns at Zeebrugge is situated inside the harbour. They catch fish in the wash of ships, especially ferries. Flocks of more than 500 individuals diving behind ferries are not uncommon. We do not know how important this behaviour is for the reproductive success of common terns at Zeebrugge. We are researching factors which are important during the breeding cycle in determining reproductive success in the Zeebrugge colony.

Terns in the harbour of Zeebrugge, Belgium

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The outer harbour of Zeebrugge, located at east coast of Belgium, is presently the major breeding site of Sandwich *Sterna sandvicensis*, common *S. hirundo* and little terns *S. albifrons* in Belgium. Land claim in the early eighties created a vast area (150 ha) of flat, suitable land for breeding terns and gulls. As a result of changes during the process of developing the outer harbour, breeding sites changed almost every year and breeding numbers fluctuated considerably. The breeding population of the three tern species in Zeebrugge are of international importance (1-2 % of the international population). Today, more than 95% of the Belgian breeding population of common terns breeds in Zeebrugge. Zeebrugge is the only Belgian breeding site of Sandwich and little terns. The future for nesting terns in Belgium is unsure due to plans to develop of the harbour of Zeebrugge and uncertainties in other newly created or planned areas along the Belgian coast..

Long term changes in reproductive parameters in the Isle of May seabird community

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Environmental conditions in the North Sea have changed over the past 20 years due to changes in fishing practice and climate change. We have been monitoring the breeding performance of five seabird species at the Isle of May in the north-western North Sea over this period to investigate the consequences of these changes on reproductive output.

Seabird distribution in relation to an upwelling system in northern Chile

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Seabird distribution and possible determinants were studied in the Humboldt current upwelling system in northern Chile during January 1999 using ship transects (Tasker et al. 1984), where bird distribution and hydrographic parameters (temperature, salinity, chlorophyll) were measured simultaneously. Of the 24 species recorded, Peruvian booby *Sula variegata*, kelp gull *Larus dominicanus* and Humboldt penguin *Spheniscus humboldti* were the most abundant. Species composition differed substantially across the upwelling area from coastal waters to warm waters farther offshore. Some species showed clear links to hydrographic features, for instance antarctic prion *Pachyptila desolata* and Peruvian booby concentrated directly over cold, upwelled water, while other species, such as kelp and Franklin's gulls *Larus picxan*, were more related to the coastline and fish trawlers. Distances to the nearest colony were estimated from the distribution patterns of the local breeding sites for Peruvian diving-petrels *Pelecanoides garnotii*, Peruvian boobies and Humboldt penguins.

Do kelp gulls care about skuas?

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Brown skuas *Catharacta antarctica lonnbergi* and south polar skuas *C. maccormicki* are the only predators that regularly take kelp gull eggs and chicks on King George Island. In other areas it has been suggested that kelp gulls only nest at sites not used by skuas. Skuas have already been found to be the main cause of reduced hatching success while fledging success has been presumed to depend mainly on food abundance. The objectives of our study were: (1) is nest site choice in antarctic kelp gulls influenced by skua nest distribution and (2) do skuas affect their breeding success? The data indicates that (1) nest site choice in kelp gulls is not influenced by skua distribution and (2) starvation rather than predation appeared to cause the high rate of mortality in gull chicks on King George Island.

Renesting strategies in common terns *Sterna hirundo*

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In long-lived seabirds, the decision whether or not to renest after breeding failure is critical, and the parents have to weigh benefits of replacement clutches against possible future reproductive costs. In this study, we investigated factors influencing renesting decisions in common terns and compared different parameters of breeding biology and body mass between two breeding attempts by the same pairs in each of four years. Renesting birds were characterised by early laying dates and by high ages. Among early breeders, high egg mass reduced the renesting probability. Evidence was found that foraging conditions affected both egg mass and relaying interval: long relaying intervals coincided with low mass of replacement eggs in one year, and short intervals with high egg mass in another. Further, egg mass decreased and relaying intervals increased the later the predation events occurred. Evidence of high levels of parental care of replacement clutches came from body mass data: female mass increase prior to egg laying was higher in the second attempt than in the first, whereas male mass was lower during the second courtship period than during the first. Male mass also affected relaying intervals and mass of replacement eggs. From body mass data and from the relatively high fledging success of replacement breeder we conclude that common terns expended high levels of parental care of replacement clutches. Supported by the Deutsche Forschungsgemeinschaft.

Increase in chronic oil pollution in the waters around south-eastern Newfoundland

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The waters around Newfoundland are a cross-roads between high activity shipping lanes and up to 30 million seabirds which reside and/or migrate through this area annually. Small and large oil spills are recorded in this region every year and countless seabirds die after coming in contact with the oil from hypothermia, starvation, and/or physiological damages. An analysis of systematic beached bird surveys conducted by the Canadian Wildlife Service around the Avalon Peninsula since 1984 showed an overall oiling rate of 71% and a yearly increase in the proportion of oiled birds found of 3.2%. It further revealed that winter (Oct. - Mar.) has a much greater oiling rate than summer (71.8% vs. 9.4%), and that alcids are the most affected by this pollution, making up 89% of all birds found since 1984. Reasons for this increase may include changing seabird distributions, increased shipping activities and/or larger proportions of vessels illegally discharging oil at sea. Future research to determine the causes, as well as to determine annual seabird mortalities due to oil are outlined.

Pre-lay attendance of common murrelets: are males on the offence or defence?

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Murre *Uria spp.* breeding sites vary in quality due to group anti-predator defence, where reproductive success (RS) increases with colony density. Nest site location within a breeding colony also influences individual RS. While murre nesting in the interior of dense colonies may experience less predation during the chick rearing period, departure success is higher for chicks of exterior-nesting murre. We tested the hypothesis that males should spend more time defending exterior over interior sites as chicks from exterior nest sites have higher departure success. Attendance patterns of male and female common murre *U. aalge* at interior and exterior nest sites were compared during the 1998 and 1999 pre-laying periods on Great Island, Newfoundland. Exterior nesting males had higher attendance rates than interior nesting males after the first egg of the study site was laid, suggesting that common murre may preferentially occupy and defend exterior sites over interior sites to increase chick departure success. Although one function of males spending so much time at the site prior to egg laying is site-defence, high levels of attendance may also promote intra- and extra-pair copulation (EPC) opportunities. Both hypotheses are discussed and evaluated in relation to site attendance and EPC data.

Toxaphene levels in eggs of common terns *Sterna hirundo* breeding on the North Sea coast of Germany - a temporal and spatial study

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Common terns are top predators and well-qualified for the monitoring of environmental chemicals; spatial and temporal trends of toxaphene contamination can be demonstrated and indicate a microgeographic contamination pattern. Using the Parlar 22 components standard, 14 toxaphenes with Parlar numbers could be quantified, but more than 60 detected toxaphenes with a chlorine level from seven to nine are still unknown. The toxaphene levels decreased from 1981 to 1997, and from the south to the north. The method for the congener specific analyses of the complex toxaphene mixture using HRGC/MS-NCI/SIM was optimised in most steps of the procedure.

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