

Workshop on the Conservation Status of Oystercatchers around the World

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Oystercatchers (Haematopidae) occur on all continents, except Antarctica. Of the 11 species currently recognized, eight have the most or all of their ranges in the southern hemisphere, with five in Australia and New Zealand. The Eurasian Oystercatcher *Haematopus ostralegus* has an estimated population size of about one million individuals which is 2–3 times that of all of the other 10 species combined. The next most numerous is the South Island Pied Oystercatcher *H. finschi* of New Zealand (c. 110,000) followed by three mainly S American species, each with populations estimated to be in the range 40,000–100,000 (*H. palliatus*, *H. leucopodus* and *H. ater*). The remaining six of the world's oystercatcher species have estimated populations of fewer than 12,000.

Many of the Haematopidae face common threats: ribbon development along coastlines, predation by both introduced species and human-subsidized native species, competition with humans for shellfish food, disturbance by humans and their pets, flood tide events of increasing severity due to global climate change, etc. They also have several life history traits in common (long incubation and fledging periods, delayed maturation, high survival rates, low productivity). The workshop aimed to provide a platform to discuss the conservation status and associated research requirements of each species so that common factors can be better understood leading to more effective conservation prescriptions. It is planned that the final outcome of the workshop will be a volume in the *International Wader Studies Series*.

Workshop Abstracts

Phylogeny of oystercatchers

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To construct a highly supported phylogeny of oystercatchers we sequenced eight mtDNA genes to obtain a total 6,310 bp. This large amount of sequence was necessary because many of the species are surprisingly closely related, and there are problems with unsorted ancestral lineages that are not reciprocally monophyletic. The tree clearly separates the Eurasian + Australasian versus New World species into two well-supported clades. However, within both clades some species identities are confused by hybridization which has transferred haplotypes across species boundaries. Cloning of PCR products showed that all the Old World species have a further complication with a nuclear copy of the control region, leading to double peaks in sequence traces. Hybridization between some species appears to be recent, indicating that they evolved too recently to have developed reproductive isolating mechanisms. DNA barcoding also obtained similar results to the multigene tree, and suggested that 9 or 10 species should be recognized.

A global overview of distribution, numbers and population trends of the world's oystercatcher populations

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Waterbird conservation takes place increasingly at the level of flyways of individual biogeographic populations. Wetlands

International provides triennial updates of waterbird population estimates at a global level on behalf of the Ramsar Convention on Wetlands and others. The last such review, *Waterbird Population Estimates – Fourth Edition*, appeared at the end of 2006, and this talk is a summary of the information presented on the world's oystercatchers.

Oystercatcher taxonomy is complex, and WPE4 recognises 5 pied species, 5 black species, and one species appearing in both pied and black forms. WPE4 recognises 21 separate biogeographic populations of these 11 species. One species, the Canarian Black Oystercatcher, has been extinct since the 1940s, one, the Chatham Oystercatcher, is Globally Threatened in the category "Endangered", and one, the African Black Oystercatcher is Near Threatened.

One species, the Eurasian Oystercatcher, has a larger population than the other 10 put together, but its population is decreasing. Its New World equivalents, the American Oystercatcher and the Australian Pied Oystercatcher, are much less numerous. All other species have more restricted ranges and much smaller populations. Of the 21 populations identified in WPE4, 11 have still unknown population trends. Of the remainder, four are estimated to be increasing in number, three are considered to be stable, two are decreasing and one is extinct.

Variable oystercatcher *Haematopus unicolor*

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The Variable Oystercatcher *Haematopus unicolor* is endemic



to New Zealand. It is the second-rarest oystercatcher globally, with a population of 4,000–4,500 individuals. Numbers are increasing, at least in some areas. It is almost entirely coastal in distribution and is found around the three main islands of New Zealand. The species shows polymorphic plumage, ranging from a pied phase through variable 'smudgy' stages to an all black phase. There is a cline in these morphs, with an increase in frequency of black birds with increasing latitude. Maturation is delayed, with some birds not breeding until 7 years of age. The usual clutch contains 1–3 eggs (mean 2.4), and the mean incubation time is 28 days. The fledging period is 6–7 weeks, and juveniles may remain with their parents for up to 7 months. Relatively little is known about movement patterns of pre-breeding birds. Adult life expectancy is high (mean 19–20 years) and one bird is known to have reached 32 years. Productivity is often low. The main threats to the taxon are predation, flooding and crushing of nests, loss or degradation of habitat, and disturbance during breeding.

Status and ecology of the Magellanic Oystercatcher *Haematopus leucopodus* in South America

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The distribution of the Magellanic Oystercatcher is restricted to the southern part of Patagonia where it is regarded as a common species. It is also a permanent resident on the Falkland Islands, breeding mainly on sand beaches which are backed by low grassy slopes.

On the South American mainland, Magellanic Oystercatchers winter along the Atlantic coast from Tierra del Fuego to Peninsula Valdes in Argentina and along the Pacific coast from Tierra del Fuego to Chiloe Island and Llanquihue Province, Chile. They breed on inland wetlands and swamps on the Magellanic and Patagonian Steppe in the north of Tierra del Fuego, the south and west of Santa Cruz Province, Argentina, the west of Chubut Province, Argentina, and in Regions XII, XI and the south of Region X in Chile. Flocks of several thousands birds can be found along the Patagonian shore during the non-breeding season (Feb/Mar to Aug) while during the nesting season (Sep to Jan/Feb) pairs are spread around inland wetlands but small flocks of non-breeders remain along the shore of the entire winter range.

As yet there have been no studies of connectivity between wintering and breeding populations of Magellanic Oystercatchers, neither have global population trends been quantified. In spite of being the most distinct member of the *Haematopodidae*, the only published data relating specifically to *leucopodus* are reports on its diet, seasonal distribution and

reproductive habits and vocalizations; other literature provide partial accounts of its biology.

We identify the following potentially major threats to the species in the non-breeding areas: urbanization of the shoreline and pollution (mainly due to oil exploitation and transport activities). In the breeding areas the main problems are cattle grazing and desertification.

As the Magellanic Oystercatcher is such a little-known species, we urgently recommend an effort to increase basic knowledge of its general biology and to establish priorities for conservation. Especially important are studies to estimate population size and trends, and to map and assess the breeding areas. Conservation efforts will also benefit from public outreach and education campaigns in areas that are important for the species.

Australian Oystercatchers: their biology and conservation

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Two species of oystercatcher occur on rocky and sandy shores in Australia, the Pied Oystercatcher and the endemic Sooty Oystercatcher. The Australasian Wader Studies Group and the Victorian Wader Study Group have monitored both species in SE and NW Australia since the 1980s. Data collected over some 25 years from both banding activities and counts of breeding and non-breeding birds has provided important insights into inter- and intraspecific biometric variation and the habitat requirements of each species. For example, we have determined that both oystercatchers have a prolonged duration of primary moult compared with other wader species, which may reflect their relatively sedentary lifestyle. Moreover, it is known that breeding Pied Oystercatchers are sensitive to disturbance, especially from introduced predators like the Red Fox *Vulpes vulpes*. Coordinated eradication efforts of foxes in the Corner Inlet complex in southern Victoria have resulted in subsequent increases in breeding success. Birds in NW Australia are much smaller than their southern counterparts and populations in these regions appear relatively stable. Data from counts of southern shores has revealed fluctuating numbers of Pied and Sooty Oystercatchers. Given the massive alteration of coastal landscapes as a result of both increasing anthropogenic activity and predicted climate change scenarios, ongoing and targeted monitoring of both species is highly desirable.

Chatham Island Oystercatcher population responds to conservation management

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The Chatham Island Oystercatcher *Haematopus chathamensis* is an endangered species that breeds only on four islands of the Chatham Islands. One of the main factors limiting population growth is low productivity – as few as 0.22–0.44 chicks per pair per year. Of 19 nest failures seen on film, 13 were caused by cats eating the eggs. The population was estimated at 103 birds in 1987 and 142 in 1998. In 1998–2004 intensive



trapping of introduced predators (mainly feral cats and weka) occurred each summer along 16 km of northern Chatham Island coast. Sheep and cattle were also excluded from areas and nests were moved up the beach to protect them from high seas. An increasing breeding population (16–35 pairs) in the managed areas produced 18–35 chicks per year (at an average of 1.04 chicks per pair) and an increasing population (9–19 pairs) in nearby areas produced 0–12 chicks (0.34 chicks per pair). This boost to productivity, high juvenile survival and early recruitment at 2–5 years of age accelerated population growth (15% p.a.) and the population more than doubled in 6 years. In 2004 there were approximately 316–340 birds, including 89 pairs. In this short time frame northern Chatham Island was the main beneficiary of the increase, however previous and current recruitment movements indicates a longer term benefit to the whole range. Although management shifted to Pitt Island in 2005, few chicks were produced, and although the proportion of breeders has continued to increase (109 pairs in 2006), the total population is now stabilising. The Recovery Plan goal of exceeding 250 (mature) individuals requires further management input. A longer term goal to maintain the population with minimal intervention will require improving nesting habitat through dune restoration.

Conservation assessment of the nominate subspecies of Eurasian Oystercatchers
Haematopus ostralegus ostralegus

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The nominate subspecies of the Eurasian Oystercatcher *Haematopus ostralegus ostralegus* is well studied and the most abundant of all oystercatchers. The main breeding and wintering areas are centred on the North Sea, but the distribution covers the entire European Atlantic coast down to Liberia. Numbers have increased strongly from the 1960s to the 1990s to just over one million birds. Although part of this expansion may have been caused by an ongoing successful adaptation to breeding inland, the main driving forces behind

this increase are not well understood. More recently numbers have decreased substantially by about 200,000, mainly due to strong declines in the Dutch–German–Danish Wadden Sea area. This decline is largely due to overexploitation by mechanical shell-fisheries; additional factors such as agricultural intensification and reduced eutrophication are likely to also have contributed. In other areas numbers seem to be fairly stable, but good data for the Nordic countries is lacking. The global and national conservation status of *H. o. ostralegus* is mostly classified as of ‘Least Concern’, and numbers are expected to increase again as mechanical shell-fishery is becoming more restricted. We discuss other known threats, such as habitat loss, climate change, hunting, disturbance, and make recommendations for research and management.

South Island Oystercatcher *Haematopus finschi* – an expansive species

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The South Island Oystercatcher *Haematopus finschi* breeds primarily on inland rivers and pastures of South Island, New Zealand, and migrates during the non-breeding season to coastal areas and North Island. Originally breeding primarily on gravel river-beds, it has expanded its breeding habitat onto farmland. A clutch of 1–3 eggs is laid, with up to two replacement clutches if earlier ones fail. It is now an abundant species with no immediate threat to its continued wellbeing. Before 1940, it was hunted as a table bird, but is now fully protected. Since about 1960, the population has increased remarkably but that increase may now have peaked at a population of about 113,000 individuals. It is classified by IUCN as a Species of Least Concern, given its distribution and recent increase in numbers. Introduced mammalian predators and changes in land-use probably pose the greatest threats, although climate change could result in reduced feeding opportunities in estuarine areas.

Coordinated research and monitoring of breeding American Oystercatchers in the United States

Theodore R. Simons and members of the American Oystercatcher Working Group

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<http://www.ncsu.edu/project/grsmgis/AMOY/Research.htm>

The American Oystercatcher has become a shorebird conservation target across its breeding range on the Atlantic and Gulf coasts of the United States. The birds are thought to be sensitive indicators of coastal environments that are currently experiencing high rates of habitat loss and increasing rates of disturbance from humans and introduced predators. An informal working group formed in 2001 meets annually to coordinate research and monitoring activities aimed at understanding the species’ biology, and ensuring the conservation of remaining populations. Working group members represent a diverse mix of academic, State, Federal, and private researchers and wildlife conservation practitioners. Current efforts are focused primarily on understanding factors affect-



ing reproductive success, patterns of habitat use and movement, and estimating survival rates. A coordinated mark-resight program involving six states is currently in place and banding, resight, and productivity data are maintained on a publicly accessible website.

Status, ecology and conservation of the Pied Oystercatcher in Australia

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This presentation is an overview of the main aspects of the status, ecology and conservation of the Pied Oystercatcher *Haematopus longirostris* in Australia. Total population size has not been estimated since the 1980s when a figure of 11,000 individuals was given. This probably equates to about 3,500 breeding pairs. The validity of these estimates is considered. The highest concentration occurs in Tasmania, which supports about a third of the species' total population. The species breeds on ocean beaches and has a low natural breeding success. It feeds on a wide variety of soft-sediment intertidal habitats and its diet varies according to habitat. Unlike other pied oystercatchers *longirostris* does not hammer the shells of molluscs, which places constraints on its foraging. In most habitats it is a tide-line follower. On estuaries and coastal bays it feeds mainly on bivalve molluscs. In many coastal breeding areas it also depends mainly on bivalves but in more southern areas it is strongly associated with beach cast kelp, taking amphipods and larval beetles that feed on the decaying kelp. Foraging in terrestrial habitats has rarely been recorded. The main conservation threats to the species are human disturbance at breeding sites, predation from exotic predators, excessive clam harvesting and loss of feeding and roosting habitat for coastal development and oyster farming. Rising sea levels from global climate change will become a serious threat to the extent of foraging and breeding areas.

Black Oystercatcher regional ecological assessment: breeding biology, demographics, productivity, interseasonal movements, and threats in British Columbia and Alaska

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Due to a small population, restricted range, threats to preferred habitat, and susceptibility to human-related disturbances, the Black Oystercatcher *Haematopus bachmani* is listed as a species of high concern within the U.S., Canadian, Alaskan, and Northern and Southern Pacific shorebird conservation plans and is a featured species in the Comprehensive Wildlife Conservation Strategies for Alaska, Washington, Oregon, and California. However, direct conservation efforts for this species have been limited by a general lack of basic ecological information. This cooperatively funded and administered project explores breeding ecology, productivity, local threats, survival, mate and site fidelity, natal philopatry, important wintering areas, interseasonal movements, and genetic popu-

lation structure at multiple sites across the heart of this species' range. Since 2003, we have banded 415 oystercatchers in Alaska, monitored 413 territory-seasons, and collected 616 genetic samples. Clutch size, hatching and fledging success, productivity, and causes of loss vary widely both between study areas and between years. When study areas and years are considered together, the average clutch is 2.34 eggs; 27% of eggs survive to hatch; 13% of eggs laid successfully fledge. Overall productivity (fledglings per pair per season) is 0.42. Depredation and tidal flooding each account for over 28% of egg and chick losses. Apparent overwinter adult mortality is 13%, with 92% of surviving banded birds returning to the same mate and nesting territory. Analyses of the genetic structure of the population are forthcoming. An interseasonal movement investigation utilizing satellite and VHF radio telemetry commences in summer 2007.

African Black Oystercatcher *Haematopus moquini*: current conservation status and future prospects

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The African Black Oystercatcher is currently classified as *Near-threatened* by virtue of the fact that the population size is small. Due to the importance of certain key sites on the Namibian coast as 'nursery areas' for pre-breeding birds from South Africa, the species' legal status in Namibia has recently been elevated to that of a *Specially Protected Vertebrate*.

Aspects considered to be of conservation concern to the species are (a) its inherently low and variable breeding success; (b) its ground-nesting habit, making it vulnerable to numerous direct and indirect impacts of human disturbance; and (c) its occasional susceptibility to mass mortalities, particularly of adult birds in high-density breeding populations on off-shore islands. Factors that may help it to survive are its longevity (estimated at >30 years in some cases) and, potentially, a degree of connectivity between local populations. While human activity has increased in many mainland areas of the species' breeding range, levels of human disturbance have decreased drastically on the offshore islands, and populations on most islands, where breeding success is highest due to absence of mammalian predators, have increased in recent decades. In 2002, a ban on beach driving also helped reduce human disturbance, especially in isolated areas. A key factor driving population increases in many areas is an improved food supply in the form of an alien mussel species, *Mytilus galloprovincialis*. Some populations are benefiting from an increase in the number of Marine Protected Areas.

Recent studies have shown that there has been a marked improvement in the species' conservation status over the past two decades, partly as a result of improved coastal conservation measures and partly as a result of an increased food supply. Although the global population is still less than 10,000, the overall trend is increasing, and the Top Predators Project of the Benguela Current Large Marine Ecosystem Programme has recommended that the species be reclassified from *Near-threatened* to *Least concern*.



**Modeling nest success for the American
Oystercatcher *Haematopus palliatus palliatus*
using Program MARK**

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American oystercatcher populations breeding along urbanized coastlines of eastern North America face significant anthropogenic pressures often resulting in reduced reproductive success. Loss and alteration of critical breeding habitat on barrier islands has forced populations to move to alternative habitats such as saltmarsh and inlet or riverine islands. Furthermore, recreational disturbance on the remaining available breeding grounds may be limiting productivity. Predation pressure from growing native and non-native mammal and gull *Larus* spp. populations – which are being facilitated by humans living in the coastal zone – has also become an important factor affecting reproductive success. In an effort to understand the

interactions among these variables and their effects on reproductive success we have modelled nest success using Program MARK. We included covariates for habitat, mammal density, gull density, human disturbance, nest heights and year in our models in an attempt to identify the most important factors influencing nest success. We also ran stage-specific models to determine the principle factors affecting nest success during the incubation and nestling periods and whether these factors differ between stages. Our results indicate that for both nesting stages those models including mammal density as a covariate are the best-supported. In fact, oystercatchers breeding on isolated islands with an absence of mammalian predators experienced the highest daily survival probabilities during both nest stages even in the presence of large gull populations. Contrary to our expectations, human disturbance was not a significant factor influencing nest success. Our results show that it is most appropriate to focus management efforts on mammalian predator control measures. This can be done most efficiently and cost-effectively, and with the greatest impact on nest success, on isolated inlet or riverine islands rather than on large barrier islands.



African Black Oystercatchers with chick. Photo by Les Underhill



Workshop on the Conservation of the Black-tailed Godwit Populations of NW Europe

Two subspecies of the Black-tailed Godwit *Limosa limosa* occur in W Europe. One, *limosa*, has shown an alarming decline; the other, *islandica*, is increasing. The purpose of this workshop was to explore the similarities and differences between the ecology of the two populations and to reach a better understanding of their conservation needs. The outcome of the workshop is largely comprised in the paper by Jennifer Gill *et al.* on *Contrasting trends in two Black-tailed Godwit populations: a review of causes and recommendations* that appears elsewhere in this volume.

Workshop Abstracts

Historical changes in the non-breeding distribution of Icelandic Black-tailed Godwits

Limosa limosa islandica

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Icelandic Black-tailed Godwits have shown an increasing population trend over the last 15 years. While this tendency is clearly observed on the breeding grounds, where godwits have colonized new areas, the trend is much more difficult to access in the non-breeding areas, where *islandica* overlaps with the nominate subspecies *limosa*. During the non-breeding period, when birds are moulting or in winter plumage, it is extremely difficult to tell the subspecies apart.

It was formerly thought that where the non-breeding ranges of the two Black-tailed Godwit subspecies overlap there is habitat segregation in that *limosa* tends to use freshwater habitats, such as rice fields, and *islandica* is confined to saline habitats such as mudflats. However, recent data collected from marked individuals has revealed that both subspecies use the same habitats and there is even a small percentage that switches habitats during the non-breeding period. Despite the range overlap being mostly confined to the Iberian Peninsula and Morocco, mid-winter counts from these areas are difficult to analyze, especially when there are large numbers of both subspecies and the aim is to come up with a population estimate for each separately. It is currently believed that the onset of migration from African wintering grounds plays a role in determining the numbers of wintering and migratory godwits on the overlap zone. Therefore this will be used in the analysis of mid-winter counts in an attempt to establish the historical trend of the Icelandic godwit population.

For non-breeding areas outside the overlap zone, we will focus on the shifts in the range of an increasing number of Icelandic godwits.

Distribution and phenology of Black-tailed Godwits in Portugal

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Portugal is an important country for European Black-tailed Godwit migration and wintering stages, with numbers peaking at 45,000 birds. The Tagus and Sado estuaries and the rice cultivations around these estuaries, the salt pans of the

Algarve, and Ria de Aveiro are the key areas for the species in Portugal.

Rice fields are used mainly by the *limosa* subspecies, especially during spring migration when it occurs in tens of thousands from late Jan to late Feb. Rice fields are also used during winter. During autumn migration, salt pans are used.

Limosa l. islandica mainly uses mudflats and salt pans for both migration and wintering, but also occur on rice fields during both periods.

Turnover data are needed, especially for a better assessment of the importance of salt pans during migration.

Patterns of annual distribution and connectivity of *Limosa l. islandica*

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The Icelandic Black-tailed Godwit breeds in Iceland and winters mainly in W Europe. We will use counts and colouring information to quantify current distribution throughout the year and links between breeding, passage and wintering sites. Results of counts are used to compare phenology at a national level and identify important areas year-round. Results show large differences in phenology between sites at a regional level, suggesting a strong effect of local factors on habitat use. Six colour ringing schemes were developed, mainly during the last 10 years, on the breeding grounds and in different parts of the flyway, in England (in the Solent and the Wash), in France (in Morbihan and in Charente-Maritime) and in Portugal, generating thousands of resightings. Outside Iceland, most of the birds were ringed during autumn migration or mid-winter. Following marked individuals year-round allows us to describe the progress of migration and compare behaviour between wintering sites or samples. We also examine sex differences in patterns of annual migration.



Changes in breeding distribution and abundance of the Icelandic Black-tailed Godwit

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Oldest available descriptions of the breeding distribution of *Limosa limosa islandica* in Iceland are from the end of the 19th century. All references agree that the distribution was limited to a restricted part of the southern lowlands. Since then, godwits have spread to occupy almost all lowland areas in Iceland. Most new colonisations seem to have taken place between 1960 and 1990 but godwits are still (summers 2006 and 2007) colonising new areas. The patterns of the spread are correlated with habitat quality at the population scale. The colonisation process took place in two phases; first a colonisation of a few relatively large lowland basins with a high relative abundance of the favoured habitat type and then a second phase with colonisation of many smaller lowland basins close to the already occupied "source" populations.

Large-scale breeding season processes in the Icelandic Black-tailed Godwit

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Variation in habitat quality at the population scale is a prominent driver of Black-tailed Godwit productivity in Iceland. Mosaic habitats of marshes and grassland, that were originally occupied by godwits before the population expansion started, have higher breeding densities and breeding success than more recently occupied, homogenous dwarf-birch habitats. Dwarf-birch habitats have lower food abundance and higher predation rates. At the population scale, demographic parameters are also related to climate and possibly agricultural practices.

The rise and fall of the Black-tailed Godwit in the Netherlands

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We will present a review of the historic development of the Dutch breeding population of Black-tailed Godwits *Limosa limosa limosa*. Three periods of population development in

the second half of the 20th century are distinguishable. The first, 1947–1960, was marked by an increase in numbers. Anecdotal evidence supports the idea that the population expanded into what we now think are suboptimal habitats. This, together with the expansion of agricultural grassland area and legislation against egg-collecting may be the underlying cause of the increase in the godwit population during this period. In the second period, 1960–1980, the number of godwits was stable. However, in the late 1970s and the 1980s, agricultural practices changed dramatically. This is probably the main cause of the steep decline in the third period, from 1980 to the present day. Habitat fragmentation, due to intensified agricultural land use and urbanisation, is probably an additional detrimental factor leading to the population decline.

We will explain the probable mechanisms of these changes in population numbers and breeding habitat with examples and anecdotal evidence.

Key issues influencing non-breeding season processes in Icelandic Black-tailed Godwits *Limosa limosa islandica*

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Icelandic Black-tailed Godwits are typical of temperate migratory shorebirds in using a range of saline and freshwater habitats over the non-breeding season, including mudflats, salinas, grasslands and rice fields. The availability of these different habitats varies across the winter range, resulting in different populations of this highly philopatric species using freshwater and saline habitats to a greater or lesser extent. I will use information on the distribution, movements and behaviour of Icelandic Black-tailed Godwits to address the following questions: (a) How do patterns of use of these habitats vary throughout their range and throughout the winter season? (b) Are there differences in the relative quality of saline and freshwater habitats? (c) What are the relative costs of foraging in different habitats and (d) What are the implications for populations from different parts of the range of using habitats to different extents?

Time to move: patterns of annual distribution and connectivity of Black-tailed Godwits *Limosa l. limosa*

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In the early 1980s, Beintema & Drost made an analysis of ringing data and counts to describe the wintering areas and migration staging sites of Black-tailed Godwits breeding in the Netherlands. Senegal, Mali and Guinea-Bissau were the main wintering grounds, whereas Morocco, Portugal, Western France and Northern Italy were recognized as the most important staging areas during spring migration.

Recently, Kuijper *et al.* performed an assessment of the current situation. Although numbers declined parallel to those in the breeding grounds, the winter distribution is still the same. Mali holds probably only small numbers of the West



European (Dutch) breeding population. In spring, habitat changes have strongly reduced the importance of French and Moroccan staging sites, but Portugal and Spain have become much more important. Italy no longer seems important for Dutch godwits, but mainly a gateway for birds from the central European population.

In 2004, the University of Groningen started a long term population study on Black-tailed Godwits in Friesland, the Netherlands. After four field seasons more than 500 birds have been individually colour-marked inside and outside our study area, resulting in over 5,300 sightings. We will present a first analysis of these newest data, focusing on the timing and extent of migratory movements during southward and northward migration.

What factors affect nest site selection of Black-tailed Godwits *Limosa limosa* in intensively used agricultural grasslands?

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In the Netherlands, most agricultural areas with high densities of Black-tailed Godwits are monotonous and consist of uniform wet grasslands. Despite the apparent lack of clear differences, godwits often breed clustered in specific parts of these areas, the location of which may vary with time. The effectiveness of conservation management could be improved if we knew what factors trigger birds to nest on specific sites. We explore what factors affect nest site selection in three different studies examining (1) the spatial autocorrelation of Black-tailed Godwit territories with a range of environmental variables sampled at the time of territory establishment, (2) the spatial autocorrelation of godwit territories with territories of a number of other grassland breeding birds and (3) the effects of the establishment of shallowly inundated grasslands used by godwits to gather, rest and forage just before breeding. The results of these studies are discussed in terms of their usefulness to help attract meadow birds to sites where conservation measures are being implemented to enhance nest and chick survival.

Stopover processes in Black-tailed Godwits: The Portuguese scenario

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European Black-tailed Godwits *Limosa limosa limosa* perform a long stopover in Iberian rice fields during their pre-nuptial migration, where they essentially forage on rice kernels. One of the main stopover sites are the rice cultivations around the estuaries of the Tejo and Sado rivers, near Lisboa, Portugal. In the last two years peak numbers of godwits have reached 45,000 during February. Such a large number of birds foraging in a small area might lead to substantial resource depletion.

Through bird counts and frequent sampling for rice kernel abundance we tried to investigate the depletion hypothesis. In general, we found rice kernel abundances were so high that

the number of godwits would never be able to totally deplete the rice fields. However, we did find a negative correlation between godwit numbers and rice abundance, and an overall decreasing trend in rice kernel abundance.

Foraging behaviour parameter, namely probes/min and successes/min did not change across the season, despite the observed decrease in food abundance, which suggests two hypotheses: either food depletion is not enough to affect godwit foraging efficiency, or birds are able to compensate by moving to different locations. We found evidence supporting the second hypothesis, as a large proportion of colour-ringed individuals was observed in more than one location, and 62% of these movements were towards areas with higher food abundance, while only 17% were directed to areas with lower food abundance.

Another issue relating to Black-tailed Godwit use of rice fields is the taxonomy of the birds. It has been thought is that these birds belong to the European, *limosa*, subspecies, but important numbers of Icelandic godwits, *islandica*, are known to winter in nearby estuarine areas. At least 70 colour-ringed Icelandic godwits were detected in the rice fields. One subspecific difference that seems to emerge from our observations is that Icelandic godwits seem to move more than European godwits, as only 35% of *islandica* were always seen in the same locations, comparing to 63% of *limosa*.

Key issues influencing non-breeding season processes of Black-tailed Godwit *Limosa l. limosa*: spring-staging ecology of Black-tailed Godwit at East Atlantic Flyway's rice fields

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Within the non-breeding range in Iberia and Africa, rice fields support large numbers (>100,000 birds) of Black-tailed Godwits *Limosa l. limosa*. However, their role as feeding habitats is difficult to establish at the population scale, since ecological data are lacking. Here, we report the main results of a 3-year study on the stopover ecology of Black-tailed Godwits in the rice fields of Extremadura (inland Spain). At some time in the winter, more than 16% and 8% respectively of the total W European and Icelandic populations migrating to the breeding grounds stayed in the rice fields. Radio-tagged birds arriving in late January (7,000–12,000 birds) showed long lengths of stay (38.9±7.6 days). The potential food supply for shorebirds comprises abundant macroinvertebrates and rice seeds, but stable nitrogen isotope analysis ($\delta^{15}\text{N}$) shows that Godwits are almost wholly reliant on rice seeds left on the ground after harvest. Wild and captive Black-tailed Godwits were diurnally active during spring migration, with significant morning and evening peaks of foraging activity. Intake rates also varied with time of day, showing a distinct peak in early morning and around sunset. Lastly, body condition index and plasma levels of triglycerides, glucose, and albumin were significantly higher in the rice fields than in coastal (natural) areas in mid February. These results indicate that the rice fields are a high quality feeding habitat for Black-tailed Godwits in that they provide ample resources to enable them to meet their energy demand.



The quest for *Limosa*

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The presentation will cover a brief light-hearted overview of the migration of both races of the Black-tailed Godwit. It will also follow the diehard members of the Farlington Ringing Group and Operation Godwit, known to some as the “god squad”, on their annual cycle of life tracking godwits across the flyway. The lecture will also attempt to focus on just some of the amazing results and achievements of an outstanding project made possible by both a dedicated field team and the many committed observers across Europe. The presentation will include a brief analysis of godwits colour-ringed on Icelandic study sites in the far north-west and north and on The Solent in southern England. We will also highlight some obvious gaps in our knowledge as far as the *islandica* race is concerned and suggest some possible future areas of research. A short 8-min BBC film will follow the presentation popularising the godwit project.

Seasonal survival in *L. l. limosa* and *L. l. islandica*

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Data from two Dutch studies (five sites) on adult survival in *L. l. limosa* show that adult survival is high and has not decreased over the past 50 years. At two sites survival estimates (0.93, n = 54 and 0.97, n = 148) are similar to those of *L. l. islandica* and higher than estimates from literature, while

at the other three sites survival estimates are somewhat lower (0.81, n = 78), possibly due to lower breeding site fidelity, but still similar to older estimates. Seasonal effects (summer vs winter) were only tested in one of the studies and were not significant. Though the data from literature have been collected in a period that populations were already declining, the fact that, at two sites, survival was similar to that of *islandica*, suggests that population declines of *L. l. limosa* cannot be explained by a decreased adult survival. Detailed data on juvenile survival are missing. In adult *islandica* survival is lowest during spring migration (0.96) and highest in the second half of winter (0.99, n = 2578). In juveniles (n = 503), most deaths occur in the first period from hatching until arrival at the wintering sites (survival 0.3), probably mainly before fledging. Again, survival is highest in the second half of winter (0.99), when it is similar to that of adults.

Key issues influencing breeding season processes in *Limosa l. limosa*

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Currently the Netherlands form the major stronghold of the European population of the nominate subspecies of Black-tailed Godwit. A strong increase in numbers occurred between 1920 and 1960, followed by a 50–75% decline, with the most rapid declines occurring in the 1970s and again since the mid-1990s. Outside the Netherlands, numbers have similarly declined, though not until more recently in Eastern Europe. In this talk I will focus especially on the declining phase of population development. The breeding season is divided into key phases (arrival, settlement, incubation and chick-rearing), and factors that affect the birds in each phase are discussed, and changes therein identified if data are available. Data on the performance of Black-tailed Godwits in each phase are reviewed to try to identify factors that are most limiting to population development, now and in the past.

The initial increase of the Dutch population was probably triggered by increasing fertilizer use on agricultural grasslands that increased the availability of soil fauna as food for adults. The negative side-effects of increasingly intense agricultural use started to outweigh these benefits after 1960, especially clutch losses due to mowing and trampling and chick losses due to direct mowing mortality and deteriorating foraging conditions (fields either mown early or vegetation too dense). Since the late 1970s, several predator species have also (re)colonised the ‘meadowbird landscape’ and this increase in predation, enhanced by interactions with intensive agriculture, may help to explain the recent acceleration of the population decline notwithstanding large-scale conservation efforts.

Data indicate that over recent decades there has been a strong reduction in chick survival and this is currently the main driver of the population decline. However, there is a lack of understanding of factors operating in the arrival and settlement phases. Godwits have laid progressively earlier through much of the 20th century, but this has ceased since the 1980s. It is as yet unknown what factor prevents the birds from laying yet earlier, thus adapting better to current early mowing schedules.



Seasonal survival in Black-tailed Godwits
Limosa l. limosa

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Long-distance migratory waders experience two very different habitats over the course of a year. In the nominate race of the Black-tailed Godwit, these habitats are rice fields and mudflats during winter and spring migration and the wet green meadows of the Dutch lowlands during the breeding season. Birds might experience different mortality risks in different habitats. Here, we present a survival analysis that tests for differential survival in winter and summer, with sex as a covariate. In Friesland, the Netherlands, we colour-ringed 148 breeding individuals from 2004 until 2006. We have a high probability of resighting these individuals on the breeding grounds ($p = 0.94$), and our efforts during spring stop-over on the Iberian peninsula are increasing steadily (up to $p = 0.47$). We find a relatively high adult survival ($\phi > 0.97$) and no effect of season or sex. However, this might be due to a bias in our sample of birds, as all colour-ringed individuals that we used in this study were caught on high quality breeding areas.

Historical changes in the non-breeding distribution of *L. l. limosa*

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The winter distribution of the nominate race of the Black-tailed Godwit is situated in West Africa, in the Sahel and along the coastal zone from Senegal to Guinea. Haverschmidt (1963) was one of the first to analyse Dutch ring recoveries and publish information about the migration and wintering areas. Subsequently, some French ornithologists – amongst others F. Roux, X. Moreau and G. Morel – did fundamental and pioneering work in W Africa making available the first valuable information on the number of godwits in the Sahelian floodplains. On the basis of this work and extensive surveys in the 1980s by Altenburg & van der Kamp (1985) as well as a recent survey by Kuiper *et al.* (2006) we will sketch the changes that have taken place in the winter distribution and numbers of the Black-tailed Godwit in Sub-Saharan Africa, and discuss the questions that remain unanswered.



Black-tailed Godwit. Photo by Tómas Gunnarsson.



Abstracts of talks

Potential conflicts between expanded shrimp aquaculture in Brazil and conservation of wader habitats

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Over the last two decades, production of farm-raised shrimp in Brazil has increased from 500 to >5,000 kg/ha/yr. The Brazilian Shrimp Farmers Association (ABCC) expects to increase production to annually export 1.5 million metric tons of shrimp, which has a value of \$US 7.5 billion. Concern about the spread of disease in production ponds has led farmers to stock shrimp at lower densities in recent years. As a result, the only way to increase production is to increase the amount of land used for shrimp aquaculture. The ABCC estimates that 600,000 ha of salt flats and converted salt ponds will be needed for expansion to meet export targets. Although some shrimp farm development is occurring along freshwater rivers, most facilities are sited along the NE coast of Brazil. Herein lies the potential for conflict with waders.

The N coast of South America supports millions of Nearctic-breeding shorebirds during the northern winter; some, presumably second-year, individuals remain along the coast during the northern summer. Projected expansion could bring shrimp farming to coastal areas that are critical wintering and stopover sites for waders. Besides the loss of habitat posed by expanded shrimp farming, production practices degrade water quality, which, in turn, could negatively affect wader prey. Conflicts have also developed between commercial shrimp farming and local fishing communities. Greater regulation of shrimp farm operations in Brazil and consumer awareness of environmental and societal costs of eating cheap shrimp are needed to secure wader habitats. This is germane to the International Wader Study Group because 86% of Brazilian shrimp exports are sent to EU countries.

Immune function in Red Knots faced with limited food availability

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Waders, especially long distance migrants, balance demands on competing physiological systems by allocating resources to maximize fitness under different environmental conditions and during different seasons. The immune system is one such physiological system and is important for survival. In the wild however, a myriad of factors affect immune function (i.e. temperature, season and resources). Thus a logical first step in the study of immune function in waders is to examine the effects of these different factors in a controlled environment. To look at the effect of food restriction on immune function we manipulated food availability by giving a treatment group access to food 6 hours a day and a control group access to

food 22 hours a day (essentially *ad libitum*). We measured constitutive (non-induced immunity) by quantifying microbial killing abilities, circulating cellular immunity, complement and natural antibodies. We also induced a sickness response using lipopolysaccharide (LPS) and measured the intensity of the response by examining mass loss, temperature, haptoglobin (an acute phase protein) and behaviour. We found that birds under food restricted conditions have reduced body mass, lower hemocrit and changes in certain aspects of immune function. Furthermore, although all birds reacted to LPS injection with higher haptoglobin, lower hemocrit and a tendency for higher microbial killing, food restricted birds also showed a greater fever response. We conclude that resource availability affects both body condition and certain aspects of immune function in red knots.

Effects of changes in sewage disposal on the survival and numbers of waders wintering in north-east England

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Over the last 16 years, there have been major improvements to the treatment and discharge of sewage throughout the EC as a result of the 1991 Urban Waste Water Treatment Directive. The impact of these changes has raised concern as sewage discharges may provide considerable food supplies to birds, either as directly edible matter or by enhancing concentrations of invertebrate food. Our study investigated how changes to sewage disposal in the Northumbria Coast Special Protection Area (SPA), NE England, affected waders wintering in this area. Stable isotope analyses indicated that following the changes, there were significant declines in the % of particulate organic matter (POM) attributable to sewage and thus likely the total POM available.

Numbers of both Ruddy Turnstone and Purple Sandpiper – the two species for which the SPA is designated – declined following the changes to sewage disposal, declines being most apparent at a local scale. The survival rate of colour-marked adult Ruddy Turnstones also fell in the first full year after changes, suggesting a mechanism for the decline. By combining evidence from detailed count data and a marked population of a key species, this study has provided the best evidence to date that improvements to sewage discharges can impact invertebrate-feeding waterbird species.

International importance of French nature reserves for wintering and migrating shorebirds along European coastlines (distribution and temporal variations): A shorebird monitoring scheme developed by Réserves Naturelles de France

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The various bays and estuaries of the French coast are significant stopover areas for waders during spring and autumn migration along the East Atlantic Flyway. Some of these areas, especially those with extensive sand- and mud-flats, are also among the important wintering sites for waders on the European coast. The key location of these areas midway between north and south Europe and the large number of waders they support fully justify a monitoring scheme in order to measure the exact importance of the French coastline for waders in a European context.

Sixteen important wetlands on the north and west coasts of France are included in the Shorebird Monitoring Program that was initiated in 2000 and managed by Réserves Naturelles de France. This scheme is a long term program developed to complement the traditional International Waterbird Census organised by Wetlands International in mid-January. The monitoring comprises monthly counts throughout the year and attempts to cover as much as possible of each of the sixteen sites, even beyond the official limits of the protected areas of the reserves. Already the scheme has demonstrated the key importance of French sites for species like Black-tailed Godwit *Limosa limosa* and Red Knot *Calidris canutus* which are particularly abundant.

The results of the four first years of monitoring (2000–2004) have been analysed and this has allowed us to test and to improve coordination between monthly counts in each site. The aim of this talk is mainly to present the initial results in order to highlight the national importance of the scheme, its capacity to evaluate protected areas, its compatibility with other international or national bird censuses and its ability to encourage the inclusion of further sites that support wintering and/or migrating shorebirds of national or international importance.

The Coastal Non-Estuarine Waterbird Survey

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The second coastal Non-Estuarine Waterbird Survey (NEWS II) took place in the Republic of Ireland between 1 Dec 2006

and 31 Jan 2007, and was organised by the I-WeBS Office of BirdWatch Ireland in conjunction with the National Parks and Wildlife Service. It follows on from the baseline survey carried out in 1997/98. In the Republic of Ireland, NEWS II was carried out as an additional and complementary survey to the Irish Wetland Bird Survey (I-WeBS) which routinely monitors the waterbirds of Ireland's bays, estuaries, lakes and rivers. Non-estuarine coast, however, is not typically well represented by I-WeBS counts alone. Few tracts of open coastline are surveyed during core counts and so several waterbird species, particularly those that use sandy, shingle and rocky shores are poorly censused. The target for NEWS II was to cover 50% of the non-estuarine coastline of each county. This sample of sectors within each county was randomly selected for coverage. Over 90 people took part in the survey. These were mainly experienced volunteer observers and also some professional staff. Overall, 1400 km (50%) of Ireland's coastline was surveyed. Over 80,000 birds and 62 species were recorded, of which almost 50% (19 species) comprised waders. Eurasian Oystercatcher and Eurasian Curlew were the most numerous wader species recorded. Curlew was also the most widespread wader species occurring in more than 300 sections.

An atlas of wader populations in Africa and Western Eurasia: establishing the flyway boundaries and identifying key sites for 91 Old World shorebird species

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Wetlands International and the International Wader Study Group have recently completed a Consultation Draft of a milestone publication titled *An Atlas of Wader Populations in Africa and West Eurasia*. The principle aims of this publication are to present mapped population boundaries (flyway boundaries) for populations of 91 shorebird species in Africa, Europe, West and Central Asia, and to identify the key sites for each species. The data used to prepare the Atlas comprised waterbird count data collected within the framework of the International Waterbird Census (IWC) coordinated by Wetlands International, together with published results of bird ringing. Analysis showed that 933 sites within the region have held 1% or more of a population of one or more species of wader. The importance of many sites, particularly in Africa, was revealed for the first time. The site holding the highest number of species at this level was The Sivash in Ukraine, with 16 species exceeding 1% thresholds.

Waterbird conservation takes place increasingly at the level of flyways of individual biogeographic populations. The information presented in this Atlas will be used by parties to international treaties such as the Ramsar Convention on Wetlands and the African Eurasian Migratory Waterbird Agreement under the Bonn Convention as a basis for the conservation of waders.



Consequences of a major habitat change on survival and distribution of wintering Eurasian Oystercatchers

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Habitat loss is one of the major threats to bird populations. Eurasian Oystercatchers are long-lived shorebirds, faithful to their wintering area, and are particularly sensitive to changes in tidal regime that can reduce their access to low-tide feeding grounds. The Netherlands host about 30% of the European wintering population, with a significant proportion in the Delta area. However the Dutch population has declined by 40% since 1980. We investigate the effect of a major habitat change (loss of a third of the tidal area after the closure of one main branch of the Delta in 1986) on the survival and distribution of birds wintering in the area. Before the closure, an unprecedented number of oystercatchers was caught and marked, which allowed us to use a new parameterization for multistate capture–recapture models to estimate simultaneously survival and movement rates (mixing live recaptures and dead recoveries). We looked both at a local scale (Delta) and at the continental European scale and we tested the additional effect of winter severity and food abundance, as well as the origin and the age of the birds. We hypothesized that birds affected by the habitat loss would show an increased propensity to move and reduced survival in the years immediately following the habitat loss. We tested how long the impact on the birds persisted.

Landscape features and patterns of nest predation and chick survival on wet grasslands

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Re-establishing wet features into grassland landscapes is a common and successful method of encouraging breeding wader populations. However, the structure of these wet features could influence patterns of predator movements through these landscapes and consequent levels of nest and chick predation. Here we explore patterns of fox movement and lapwing nest predation and chick survival in relation to the structure and complexity of wet features in the landscape.

Sexual differences in movements of wintering Eurasian Curlew

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Despite a long history of radio-tracking analyses, basic home-range and movement information are still lacking for most wader species, especially during winter. We investigated how home-ranges and daily foraging movements were influenced by extrinsic (year, temperature, date, tidal cycle) and intrinsic (sex, age, body-size and condition) factors. We captured radio-tagged and monitored 45 Eurasian Curlew *Numenius*

arquata in the Réserve Naturelle des Marais de Moëze Oléron and its surrounding mudflats over two consecutive winters. We found no year, age, body-size or body-condition effects on home range size or distance travelled. While home-range size and foraging distance did not differ between the sexes, we found important interactions between sex and extrinsic factors that explained distance travelled. We found differences in the distance travelled inside or outside the Natural Reserve for males and a continuum for females. Males had similar foraging distances throughout the winter while females increased distances over time. Finally, the tidal cycle influenced the foraging distances in males but not in females. This study revealed different wintering strategies between the sexes: males appeared more constrained by their foraging habitat around the Reserve than females which increased their foraging trip distances over time. The strong sexual dimorphism in this species may explain why females are less constrained by their environment since they have access to more or different prey (because of their longer bill) than males.

Quality vs profitability: Bimodal selection of mussel sizes by Red Knots *Calidris canutus rufa* when soft preys were available during the 2006 northward migration at San Antonio Oeste, Río Negro, Argentina

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From Feb to Apr, San Antonio Oeste is an important stopover site for Red Knots after leaving their wintering grounds in Tierra del Fuego. In the 1990s, flocks of thousands of knots fed on a “restinga”, a broad intertidal rocky flat, ingesting the small mussel *Brachidontes rodriguezi* taken from patches attached to the substrate. However, from 2004 Red Knots also fed on an extensive intertidal sandflat. Benthos sampling and dropping analysis from Feb to Apr 2006 showed:

- On the restinga, mussels eaten had bimodal distributions of shell length (5–7 and 10 mm) in seven samples, but a single mode (5–7 mm) in two samples taken on 22 April just before departure. These selections could not be explained by benthos distribution of mussel sizes. In the 1990s, the 10 mm size-class was positively selected by the knots that fed only on the restinga (González *et al.* 1996), while small sizes (<7 mm) were not.
- On the sandflat, the main prey was the slow but mobile polychaetes, *Travisia olens*, a better quality prey in terms of flesh content than hard-shelled mussels.

Censuses and resightings of colour-banded knots showed that more birds fed on the sandflat in 2006 (median N = 1,500, max N = 7,000) than on the restinga (median N = 140, max N = 4,300, $p < 0.016$). Knots did not feed on the restinga early or late in the passage, and earlier short-staying knots never feed on the restinga. It is expected that just after arrival and before departure the birds have small gizzard mass because migration is less costly if the digestive apparatus is small. Therefore at such times the birds are not able to feed on hard-shelled mussels so they avoid the restinga.

The bimodal size-distribution of ingested mussels on the restinga probably reflects two different strategies: knots having a larger (time minimizing) gizzard mass that can fuel faster on lower quality food, and knots with a smaller (energy maximizing) gizzard mass that fuel faster on higher quality



preys as polychaetes and small mussels. Small mussel sizes are better quality food because they have lower shell mass relative to biomass (0.29 AFDM/ash mass) compared with the 10 mm size (0.23 AFDM/ash mass), though the latter is more profitable in terms of total biomass.

Population trends, breeding biology and sustainability of Pied Oystercatchers *Haematopus longirostris* using beach and estuary habitat in northern NSW, Australia

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Shorebirds globally and nationally are threatened by habitat loss, human disturbance and predation. The Pied Oystercatcher, which is patchily dispersed along the NSW coast, is regarded as a “vulnerable species”. To better manage such species, information is needed on numbers, population trends, breeding biology and on impacts of threats to breeding success and survival. An estimated 129 Pied Oystercatchers were present in 2003 along the 186 km coastline surveyed; almost 70% were breeding birds. Declines occurred in breeding pairs (17%), non-breeding territory holders (5%) and non-breeding floaters (33%) over the following two years. A rapid downturn in numbers since the late 1990s is evident, with a decline still underway. Breeding occurred from July to January. Up to three replacement clutches were laid. Hatching success was 46%, with 51% of chicks then fledging. Breeding pairs produced an average of 0.60 fledglings per pair per year, with estuaries more productive than beaches. Red Foxes *Vulpes vulpes* were the most frequently identified cause of egg loss. Torresian Crows *Corvus orru* and Lace Monitors *Varanus varius* also took eggs. The finite rate of increase calculated for the population suggests it is probably unsustainable. Based on projections, population stability should be achieved if productivity is increased to 0.70 female young produced per pair each year. Alternatively, juvenile survival to breeding age must increase to a minimum of 35%. Continuation of fox control is necessary, and human disturbance should also be controlled at nesting sites to avoid unnecessary deaths of young and parents, and avoid time costs to parenting birds.

Research on the migration and habitat selection of migratory shorebirds in northern Bohai Bay, China

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Our study sites are located in the central northern part of Bohai Bay in N China (39°02'N, 118°21'E). The habitat includes intertidal mudflats and salt works. From Jan to Dec 2004, we counted shorebirds on the mudflats and adjacent salt pans regularly from a 6-km long seawall. We also surveyed the mudflats and an inland salt pan during the low tide period in spring 2006.

Thirty-nine species, most of them migrants, were observed in the study sites, including 9 species which were present in numbers exceeding 1% of the estimated East Asia–Australasian Flyway (EAAF) population: Curlew Sandpiper, Red Knot, Red-necked Stint, Marsh Sandpiper, Eurasian Curlew, Grey Plover, Pied Avocet, Black-winged Stilt and

Broad-billed Sandpiper. In 2004, shorebird numbers peaked in spring; there was a secondary peak in September, and a third in winter. The species-richness of shorebirds varied seasonally from 27 species in spring to 3 in winter. During the peak of the 2006 northward migration, 11 shorebird species in the study area were present in numbers exceeding 0.25% of their estimated EAAF population. Of these, four preferred foraging on the inland salt pan and seven preferred the mudflats. Banded shorebirds from Australia, New Zealand, and Chongming Island, China occurred at our study sites. Among them were Red Knots from NW Australia, SE Australia and New Zealand.

Around our study region, the Caoheidian industrial project is being developed, which is by now the largest in China, additionally, the big Nan Pu oil field has been recently discovered. As a result, many inland and coastal wetlands are disappearing. Therefore keeping a balance between using wetlands and protecting biodiversity is a serious problem.

Shorebirds adjust body mass components in response to increasing predation danger

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To cope with predation risk, organisms do not only show behavioural but also phenotypic adjustments. It is well established that birds adjust pectoral muscle to body mass changes, e.g. during fattening. Shorebirds that risk being depredated may adjust the relationship between pectoral muscle and body mass beyond this ratio in order to increase escape abilities. We tested this in indoor aviaries at Royal NIOZ, the Netherlands, by exposing birds to a raptor model at unpredictable times. This revealed that shorebirds respond to elevated risk by either increasing pectoral muscle size or decreasing body mass. We thus demonstrated that pectoral muscle was not a constant fraction of body mass, but may effectively be uncoupled from it by either an increase of pectoral muscle size (as in an experiment with Ruddy Turnstones) or a decrease of body mass (as in an experiment with Red Knots). Wanting to integrate potential compensations for these phenotypic changes, we also recorded a set of behavioural elements.

In Red Knot, we tested whether such adjustments to predation danger would also occur in the field (Banc d'Arguin, Mauritania). For that reason we compared the ratio of pectoral muscle to body mass of juveniles that foraged risk-prone to those of adults foraging in safer places, and correspondingly recorded anti-predator behaviours.

Habitat selection of the Sociable Lapwing *Vanellus gregarius* in central Kazakhstan

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Due to an assumed sharp decline during the last century and the remaining world population being very small, the Sociable Lapwing was classified as “Critically Endangered” on the IUCN World Red List in 2005. As part of a long-term research



and conservation project, we analyzed habitat selection of the species in Central Kazakhstan in 2006.

We used a presence/absence modelling approach combined with information theoretic modelling algorithms in order to find the most influential parameters on two hierarchical levels: habitat selection on landscape scale and nest site selection on colony scale.

The results of multivariate logistic regression showed, that on landscape scale, the occurrence probability of Sociable Lapwing is mainly influenced by vegetation height, the density of large grazing animals, and the availability of freshwater. Furthermore, suitable habitat is selected more often close to rivers, which suggests migration following the course of steppe-rivers. Topographical and soil parameters were found to be of no influence.

Nest site selection is strongly influenced by the presence of further Sociable Lapwing pairs, as to be expected for a colonial species. Apart from that, we identified a maximised occurrence probability at certain stages of animal dung density and bare ground cover, with 68% of all clutches placed into dung piles. Selection preferences for different plant types were not pronounced.

Model fit and discriminative power (evaluated using Nagelkerke's R^2 , AUC and Cohen's Kappa) were good to excellent. Internal model validation (bootstrapping procedure) did not reduce predictive success significantly. Temporal transferability of the results was tested with 2004 to 2007 nest site locations and found to reach 95% correct classification rate, i.e. 95% of all nest sites were found in areas labelled as "suitable" on a habitat suitability map. First results from spatial external validation with data collected in NE Kazakhstan in 2007 point to a good spatial transferability of our results as well.

Based on our findings, we discuss population development as a function of habitat availability, which fluctuated during the last 100 years due to changing land use practices, population development of wild and domestic ungulates and steppe fire dynamics.

Sex-specific foraging strategy of the African Black Oystercatcher *Haematopus moquini* in the Eastern Cape, South Africa

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During Jan–Feb 2007, we investigated the foraging ecology of the African Black Oystercatcher in the Eastern Cape Province of South Africa. A total of 23 breeding adults were trapped on their nest during incubation, of which 14 were females and 9 males. Birds were trapped in 3 main areas: East London, Kenton-on-Sea, and Port Elizabeth. Blood was collected from every bird to analyse the stable carbon and nitrogen isotope signatures; bill length and body mass were also measured. Samples of the birds' main available prey were collected from the foraging territories of each pair for comparative isotope analysis. The carbon isotope segregated mussels and limpets, and the oystercatchers showed an intermediate value. An enrichment of 3.4‰ in nitrogen occurred between the main prey and the oystercatchers indicating that the birds foraged both on mussels and limpets. Bill length significantly segregated males and females, female bills being longer though there was no significant difference in

body mass between the sexes. The carbon isotope signatures were more depleted in females than males while the nitrogen isotope signatures did not demonstrate significant sex-related differences. These results indicate a difference in diet between the sexes, with females foraging preferentially on mussels and males favouring limpets. Such a situation suggests that sex-specific foraging strategies occur in the oystercatchers that feed on rocky shores. We interpret this as a means to reduce within-pair food competition and to optimize the exploitation of their foraging habitats. The shape and length of the bill demonstrated morphological adaptation to specific prey, as previously shown in other oystercatcher species.

Stopover dynamics in a south European estuary of Dunlin *Calidris alpina* migrating along the East Atlantic Flyway

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Long distance migration usually necessitates stopping at least once (stopover sites) along a migratory flyway. The migration strategy of a species, population, group or individual is dependent on the choice of stopover sites, including the stopover length and the rate of energy gain at each. We used a small estuary in the east coast of Iberia to model stopover dynamics during migration periods. We show that significant variation occurs throughout the migration periods in body and residual mass as well as in the rate of mass gain. The same approach was used to analyse variation in structural size. We also estimated real stopover length by monitoring birds that were individually marked with colour rings. The individual resighting histories, gathered from daily surveys of supratidal habitats, were then used to estimate stopover length. This approach also allowed us to incorporate individual covariates (e.g. mass and structural size) in order to test for differences in stopover length.

Movements of New Zealand Bar-tailed Godwits and Red Knots

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Bar-tailed Godwits ($n = 803$) and Red Knots ($n = 345$) were individually colour-banded at non-breeding sites throughout New Zealand between 2004 and 2007, resulting in ~7000 and ~1500 resighting records respectively. Movements between sites were age-related in both godwits and knots, with young age-classes moving more widely than adults; overall knots were much more mobile than godwits. Movement rates were similar for juvenile knots and godwits (57% versus 60%) but were higher in immature knots (45% versus 35%) and much higher in adult knots (50% versus 28%; note that many of the latter were fairly short-distance godwit movements). It is speculated that the difference between the species may be related to less predictable food supplies for knots. Some adult godwits returning to New Zealand use staging sites within the country before settling at their traditional non-breeding site,



but, contrary to the received wisdom, there was no evidence of movement through the country prior to northward migration. Colour-banded godwits have also resulted in increased understanding of migration routes, including the previously unrecorded staging of New Zealand birds in eastern Australia on southward migration – possibly associated with bad weather conditions over the Pacific. The future focus of the project will be monitoring survival rates.

Disturbance by harvesters working by hand at low tide: How mud-digging affects the Eurasian Curlew's *Numenius arquata* foraging ecology during migration

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One of the main conservation priorities in many geographical regions for intertidal estuaries is to protect and maintain internationally important numbers of migratory shorebirds (Charadrii). Traditional practices used to harvest benthic resources at low tide cause alterations to the surface of the intertidal habitat by trampling and digging the substrate. These may have negative effects on shorebirds. In this study, we conducted a BACI experiment to monitor changes in the foraging ecology of Eurasian Curlews before and after an experimental disturbance of the intertidal mud at a key stopover area for migratory shorebirds. Mean density of curlews, foraging activity, feeding rate, percentage of crabs in the diet, size of crabs, and foraging speed did not differ between treatment and control plots, nor before and after mud disturbance. The feeding technique was similar between treatment and control plots, but differed significantly between periods. These findings suggest that mud disturbance by harvesters working by hand does not affect curlew fitness by altering the fat and protein deposition necessary for long-distance migration. Although conclusions must be extrapolated with caution to other sites and/or species, Santoña Marshes Natural Park may provide a potentially good example of compatibility between shorebird conservation and traditional low-tide harvesting practices.

Using biometric data for sex discrimination is unreliable when sexual dimorphisms are environment-dependent:

Eurasian Oystercatchers as an example

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Reliable molecular techniques to sex birds have been available for over a decade now. Nonetheless, for various practical reasons many studies still use biometric data for sex-discrimination. For many species, statistical models have been developed that use several biometric measurements to estimate the probability that a given individual is either a male or female. Usually, these models are parameterized and verified using data from a limited number of sites and years,

but are subsequently widely used for other populations or time-periods. A crucial, but typically untested assumption of this approach is that sexual dimorphisms in biometry are not environment-dependent (i.e. do not vary in time and space). Here we illustrate the consequences of the violation of this assumption using a study on Eurasian Oystercatchers in which sexual dimorphism varies over time. Based on biometric data from a large number of known-sex birds, we show that sexual dimorphism in Eurasian Oystercatchers (i) varies substantially between years, (ii) shifts over time, and (iii) even becomes smaller as a result of environmental change over a period of two decades. We show that the consequences of this temporal variation in sex-discrimination in Eurasian Oystercatchers are quite subtle and easily overlooked, but can result in inaccurate and strongly biased sex-estimates. We recommend that using biometric measurements for sex-discrimination should be avoided in Eurasian Oystercatchers, and also in other species where these biometric traits are likely to depend on environmental conditions.

Estimating turnover and volume in staging wader populations

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Estimating the total number of birds passing through a staging site during a migration season (volume) is important as the conservation status of sites has traditionally been based on maximum or mean counts. The numbers of birds using sites with any appreciable turnover will therefore be underestimated. Recent advances in mark–recapture methodology (Pradel survival and recruitment models) have allowed the estimation of the mean length of stay and resulted in the computer package SODA (StopOver Duration Analysis, Schaub *et al.* 2001) that estimates turnover.

Estimating volume is closely related to estimating turnover or stopover duration, but also includes estimating how many birds are present at any one time (Frederiksen *et al.* 2001). Here we describe an approach to estimating volume that will be incorporated in a new version of the freely available SODA program. We also describe how much data are necessary to calculate turnover and our project that aims to start calculating turnover from an SPA in Britain during the 2007–08 winter.

Pattern of primary moult of adult Wood Sandpipers at southern African non-breeding grounds

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The course of primary moult in Wood Sandpipers *Tringa glareola* at their sub-Saharan non-breeding quarters has been poorly described due to limited availability of data. In this



study, we analysed primary moult protocols of 1,497 adult Wood Sandpipers (aged 2+) from museum specimens ($n = 116$) collected during 1900–1975 or ringed ($n = 1,381$) during 1966–2007 at their non-breeding grounds in southern Africa, applying the Underhill–Zucchini (1988) model and related software. Adult Wood Sandpipers arrive in southern Africa from the beginning of July and depart from mid-March. Among 747 birds in primary moult, 7% showed suspended moult. The remaining birds showed continuous primary moult from P1 ascendantly, which on average started on 21 Aug. Moult lasted an average of 131 days ($SD = 29$) and 95% of birds commenced moult between 26 June and 16 Oct. This is consistent with the fact that the arrivals of adults in southern Africa is observed until ca 10 Oct. Development of the smaller inner primaries, P1–P5, lasted an average of 47 days, with up to 4 growing simultaneously; their mean inter-shedding interval was 7 days. The large primaries P6–P10 were developed over an average of 92 days; at most only 2 primaries grew at the same time, and the mean intershedding interval was 15 days. The overall rate of production of feather material was relatively constant throughout the whole season. Primary moult in adult Wood Sandpipers combines two strategies observed in other waders: quick and simultaneous growth of primaries observed in populations moulting in the N Hemisphere, and slow replacement of primaries typical for waders moulting in the S Hemisphere. Despite the relatively long moult, thanks to its early completion and the delayed fattening and departure, Wood Sandpipers earn about 2.5 months of “slack” time between completion of primary moult and migration.

**A new key staging area for the declining
W European population of the Black-tailed Godwit
*Limosa l. limosa***

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The W European breeding population of the Black-tailed Godwit has shown an extremely rapid population decline, exceeding 50% since the mid 1980s. Most Black-tailed Godwits en route from and to the W European breeding grounds cross the Iberian Peninsula. Iberian staging locations are therefore likely to be critical to this population as foraging areas, but fundamental aspects of the migration ecology of Black-tailed Godwits in Iberia are unknown. In Extremadura, inland Iberia, 30,000 ha of new rice fields have emerged since the 1960s. In this study, we investigated the Extremadura rice fields as a key staging site for Black-tailed Godwits on spring migration. In 2004–2007, weekly counts showed that large numbers used the Extremadura rice fields during northward migration, with an average of $22,029 \pm 5,173$ birds in mid Feb. From sightings of individually colour ringed godwits, we determined that most individuals were *L. l. limosa*, but 10.5 ± 2.3 % were *L. l. islandica*. At some time in the winter, $>16\%$ and $>8\%$ respectively of the total W European and Icelandic populations stayed in the rice fields. Radio-tagged birds that arrived in mid-late Jan (when 7,000–12,000 godwits were present) showed long lengths of stay (38.9 ± 7.6 days). Extremadura is the final take-off site for a large proportion of Black-tailed Godwits making for breeding grounds in W Europe. The Extremadura rice fields play a critical role for the

declining population of Black-tailed Godwits, and we discuss their importance in the context of Iberia.

**Abundance and phenology of some wader species
on the Sabaki River mouth, Malindi, Kenya**

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The Sabaki River Mouth is an Important Bird Area on the northern coast of Kenya, known as a stopover and wintering site for many wader species but has never been studied before on a long term basis. Monthly counts were carried out on the mud flats from Apr 2004 to Feb 2005 to try to understand how different wader species use the study area; particular attention was paid so that count conditions were always the same, in order that numbers would be comparable. Simple charts that show population fluctuations for each species gave us information on their abundance and phenology. Some species such as *Charadrius hiaticula*, *C. mongolus*, *Pluvialis squatarola*, *Calidris alba*, *Numenius phaeopus* and *Actitis hypoleucos* appear to use the estuary as a wintering site, though with different timing according to diverse migratory strategies. Other species such as *Charadrius leschenaultii*, *Calidris minuta*, *C. ferruginea*, *Tringa stagnatilis*, *Limicola falcinellus* (particularly rare in Africa) and *Xenus cinereus* seem to use the area as a stopover going to and coming from wintering sites further south. Various species appeared to use the area on their spring migration more than their autumn migration suggesting different routes. Other *Tringa* sp. numbers were low and did not show a clear trend. *Glareola pratincola* already known as locally resident was discovered nesting in the study area; while the globally vulnerable *Glareola ocularis* appeared to use the estuary as a congregation point even though it probably uses a much larger area to feed and it winters elsewhere. Simple counts, carried out by a few skilled counters, in a very standardized way, gave us much information that has proved useful for reaching a better understanding of the timing of migration in the East African Flyway. They also form a good basis to justify future conservation action on the site.

**Sexual differences in dispersal in Ruffs:
a molecular approach**

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The Ruff has a Eurasian breeding distribution ranging from Scandinavia to eastern Siberia. The species shows an apparent variation in the timing of migration and breeding. However, no morphologically or behaviourally recognized subspecies or populations have been described in Ruffs. Our research focuses on whether we can distinguish genetically different populations. Using 13 microsatellite markers and sequence data from the control region in the mitochondrial genome, we searched for genetic differences between the Scandinavian and Siberian breeding birds. We will assess the following hypotheses: (1) genetic variability in Ruffs is high due to a large effective population size and no major recent population bottlenecks; (2) being a non-bottlenecked population they have had ample evolutionary time for lineage sorting, and thus Ruff populations are structured genetically; (3) gene flow is mainly due to sex-biased dispersal of males.



Abstracts of posters

During the conference, the new Conference Coordinator, Jutta Leyrer, organised the usual poster competition and participants voted for the one they preferred. The results were:

✿ **Joint first prize: Reproduction of Common Redshanks *Tringa totanus* in the Wadden Sea: small-scale variation in hatching success** by Nadine Oberdiek, Anja Cervencel, Klaus-Michael Exo, Martin Maier & Arndt Wellbrock

✿ **Joint first prize: Spatial variation in the incubation behaviour of Redshanks *Tringa totanus*: adaptation to predation pressure?** by Anja Cervencel, Nadine Oberdiek, Klaus-Michael Exo & Stefan Thyen

✿ **Third prize: Timing and breeding success: is it really good to be the first one home?** by Anneke Rippen, P.M. Lourenço, R. Kentie, J. Schroeder, J. Hooijmeijer & T. Piersma



The quality of rice fields as feeding habitats for the declining W European population of Black-tailed Godwit *Limosa l. limosa*

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Rice fields support important numbers of migratory waterbirds around the world, but data about their role as stopover refuelling areas versus natural habitats are lacking. The use of metabolite profiling under field conditions has been validated to assess stopover refuelling rates of birds during migration. Here, we compare plasma metabolite concentrations and body condition in migrating Black-tailed Godwits at rice fields (Extremadura, inland Spain) and in natural habitats (coastal marshes, S Spain) to assess the quality of rice fields as stopover refuelling sites in the East Atlantic Flyway. Plasma levels of triglycerides, glucose, and body condition index were significantly higher in rice fields than in coastal areas, suggesting that rice fields are a high quality feeding habitats for godwits during spring migration. These findings contribute to explaining why large numbers of Black-tailed Godwits from W Europe use rice fields during the non-breeding season.

Eurasian Oystercatcher trends in the UK

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Long-term Eurasian Oystercatcher trends in the United Kingdom will be presented to help inform the Oystercatcher workshop.

Waterbird population trends in the international Wadden Sea 1987–2004: an update

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The Wadden Sea is one of the world's most important wet-

lands and supports 44 populations of 34 migratory waterbird species that use the East Atlantic Flyway. Trend results are presented for 10- and 17-year periods, both ending in 2003/2004. Of the 34 species, 12 show a decrease in respect of both periods, but in part this applies to different species in each period. Six and eight species show significant positive trends during the 10-year and 17-year periods respectively.

Decreases dominate in Schleswig-Holstein, while increases occur more frequently in the Netherlands and Denmark. Several shellfish specialists (e.g. Common Eider *Somateria mollissima*, Eurasian Oystercatcher *Haematopus ostralegus*, Red Knot *Calidris canutus* and Herring Gull *Larus argentatus*) show negative trends across the entire Wadden Sea, and there is evidence that for these species food availability has deteriorated in recent decades. This is probably due to a combination of factors, but especially over-harvesting of shellfish and climate change (lack of cold winters). For other species, however, the causes for the population trends and their regional differences are not known in detail, and cannot be assessed by monitoring alone. Importantly, some of the declining species are long-distance migrants, of which >50% of the total flyway population utilize the Wadden Sea as a strategically important and thus indispensable food source.

It is desirable to conduct more detailed analyses on regional trends, particularly identifying links with habitat quality and availability as well as the various management regimes in the different countries.

Immuno-redistribution over the annual cycle in Red Knots *Calidris canutus*

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The immune system is important for survival and has been increasingly measured as a proxy for self-maintenance when addressing ecological and evolutionary questions about life history. Yet very little is known about how immune function changes throughout the annual cycle. In this study we examined immune function in the context of the entire annual cycle using data taken on a monthly basis for several measures of standing (non-specific, non-induced) immune function (microbial killing, white blood cell concentrations and hemolysis-hemagglutination titers) in captive Red Knots. We further examined the effect of increased cost of living



on immune function by manipulating ambient temperature to vary thermoregulation costs. To examine relationships among immune measures we performed principal component analysis. We found that annual cycle stage and acclimation to captivity affected immune function much more than our temperature manipulations. Furthermore, different measures of immune function show different patterns over the annual cycle. Within individuals, lymphocytes, monocytes and thrombocytes formed a component that we interpret as “low cost”, whereas phagocytosis-based microbial killing, heterophils and hemolysis formed a component which we interpret as “high cost”. Over the annual cycle these components indicate that during mass gain there is a shift towards higher “high cost” scores, during mass loss scores are high on both axes, and during peak moult there is a shift towards more “low cost” and less “high cost” immunity. We propose that these findings support the possibility of different immune strategies during different periods in the annual cycle via changes in investment within the standing immune system.

Spatial variation in the incubation behaviour of Redshanks *Tringa totanus*: adaptation to predation pressure?

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Previous studies of breeding Redshanks in the Wadden Sea showed spatial variation in hatching and breeding success in that both were considerably higher on an island than on the mainland coast. These findings were not completely explained by differences in the occurrence or activity of predators. Rather, indications were found that varying individual incubation and antipredator behaviour may play a significant role in explaining spatially varying reproduction. In 2006, Redshank incubation and antipredator behaviour was studied on Wangerooge Island and on the mainland coast (Jadebusen, Germany) by direct observation of parents and by thermologgers applied in the nests. As revealed by data loggers, adults on the mainland spent less time incubating (62.6% of whole daytime, $n = 16$ nests) than birds on Wangerooge (87.0%, $n = 10$ nests). No differences in the number of incubation recesses (times the adults left the nest for ≥ 30 min) were found, but the mean length of recesses was longer on the mainland (167 min) than on the island (76 min). On the mainland, two different behavioural strategies were identified. Some nests were left unattended at night for a considerable period (nest attendance: 3.8%) whereas others were incubated most of the night (nest attendance: 88.7%). The latter strategy was very similar to that of the island birds. Possible explanations for these findings as well as consequences for reproduction are discussed.

Illustrated key for colour-ringed Black-tailed Godwits

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More than twenty colour ring schemes are in use to mark Black-tailed Godwits, individually or as groups. In order to simplify the identification of each scheme by birdwatchers, a set of drawings was made, each presenting all possible combi-

nations of rings for one specific scheme. They are organized as a key in order to facilitate scheme identification.

Habitat selection by Eurasian Golden Plovers *Pluvialis apricaria* wintering in pseudosteppe areas in the south-west of the Iberian Peninsula

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Extensive agrosystem (pseudosteppe) areas in the southwest of the Iberian Peninsula are considered to be of high value for threatened steppe birds by reason of the important populations they support during both breeding and non-breeding seasons. For example, 20 large areas of Extremadura, SW Spain, have been designated as Important Birds Areas for steppe avifauna. In most cases, the breeding habitats selected by each species are well known as a result of numerous intensive studies; in contrast, there are very little data on habitat selection during non-breeding season.

In an effort to address this knowledge gap, we monitored the winter habitat selection of Eurasian Golden Plovers along >400 line-transects of 500 m in pseudosteppe areas of Extremadura. For each transect, landuse cover (cereal crops, pastures, fallow, ploughed, stubble, vine and olive, etc.), a related landuse diversity index, livestock stocking rates (ovine and bovine), and other landscape variables (topography, accessibility, farmhouses, etc.) were recorded and related to golden plover abundance. Two different farmland systems were identified having distinct landuse distribution and livestock species: pasture (livestock farming) and arable. However, these showed no differences in their landscape variables.

Eurasian Golden Plovers showed significantly higher abundance in pasture areas devoted to livestock farming than in arable ones. The factors affecting golden plover abundance are analyzed and their conservation implications discussed both at a local and regional scale.

A winter paradise for Icelandic Black-tailed Godwits *Limosa limosa islandica*: but why don't they take advantage of it?

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Over the last ten years, the number of the Icelandic Black-tailed Godwits has greatly increased on mudflats of the “Pertuis Charentais” on the central Atlantic coast of France. They now comprise approximately 30% of the whole of the population of the subspecies. The Yves bay located just south of La Rochelle is one the four main wintering sites of the region. An atypical trend has been observed in this bay: after a massive arrival of several thousand godwits each year in early August, there has been an early, sudden and irregular departure every autumn compare with other nearby sites. The object of this study was to describe the use of feeding and roosting areas in order to determine the factors acting



on the movements of the birds at a local scale. We collected data on: (1) the use of both Yves Bay and the North Charente estuary mudflat feeding areas in space and time, (2) the available trophic resources, and (3) the godwits' diet by analysing faeces. The results showed that in terms of biomass the godwits' diet comprised 99.8% *Macoma balthica*, the most abundant bivalve in the study area. We found that the birds' movements are linked not only to the availability of their food resources (which remain abundant and accessible after they disappear), but also to a complex association of various factors, such as the availability and accessibility of roosting sites, and human-disturbance.

Shorebirds of the Río Negro saltmarshes in northeast Patagonia: a progress report

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The coast of Patagonia, Argentina, is one of the most undeveloped shores in the world. However, the importance of the saltmarshes in NE Patagonia as feeding and resting places for shorebirds has received little attention. Recently, we started a research project to evaluate the biodiversity of shorebirds, habitat value and potential threats to the saltmarshes in the estuary of the Río Negro River. Between the austral spring of 2006 and the winter of 2007, we recorded 12 shorebird species of five families, of which seven are Nearctic breeders (Black-bellied Plover *Pluvialis squatarola*, American Golden Plover *Pluvialis dominica*, Hudsonian Godwit *Limosa haemastica*, Greater Yellowlegs *Tringa melanoleuca*, Lesser Yellowlegs *Tringa flavipes*, White-rumped Sandpiper *Calidris fuscicollis* and Baird's Sandpiper *Calidris bairdi*) and five Neotropical species (American Oystercatcher *Haematopus palliatus*, White-backed Stilt *Himantopus melanurus* and Southern Lapwing *Vanellus chilensis* which are local residents and Rufous-chested Dotterel *Charadrius modestus* and Two-banded Plover *Charadrius falklandicus* which are Neotropical migrants). In addition we recorded the Plumbeous Rail *Pardirallus sanguinolentus*.

We found two periods of maximum species-richness, one in the late austral summer and another in the early austral spring. The highest abundance of shorebirds was recorded in February. These data show that Río Negro saltmarshes are an important shorebird habitat. Among potential threats to the shorebirds in this area, we identified cattle farming, the absence of proper planning for tourism and urban development and the absence of control programs for invasive exotic wildlife.

Timing, duration and pattern of wing moult in the Eurasian Thick-Knee *Burhinus oedicnemus*

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Generally wader moult has been investigated in depth, but that of the Eurasian Thick-Knee remains poorly known.

Available accounts are based on small samples and were made before the latest statistical methodologies designed for the analysis of moult data were developed. Furthermore, no coherent information regarding the pattern of secondary moult is currently available nor do earlier studies report data that enable the moult to be placed within the context of the species' annual cycle. In this study we investigated the timing, duration and pattern of the moult of remiges in a sample of more than 140 birds trapped between 1998–2007 in the Taro River Regional Park (Parma, Italy; 44.74°N, 10.17°E). Birds were caught while incubating or during the post-breeding season. The timing of primary moult was estimated according to the method of Underhill & Zucchini (1988). The analysis was restricted to birds that had not yet moulted or were in moult, assuming that thick-knees that moult in our study area arrive with old primaries, but migrate out of it soon after they have completed moult. According to the data we collected, the primary moult of this population is very slow and embraces most of the breeding season, beginning in early May and ending in October. The moult of the secondaries is much more irregular and is not completed within a single moult cycle. This study provides the first detailed analysis of wing moult in the Eurasian Thick-Knee and suggests some useful ageing criteria based on the pattern of secondary moult.

Secrets in the eyes: sexing Black Oystercatchers in the field

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Sexing oystercatchers in the field is difficult; the sexes have identical plumage and are similar in size. Although Black Oystercatchers *Haematopus bachmani* are sexually dimorphic, using morphology to determine sex requires capturing both pair members for comparison, or using discriminant analyses to assign sex probabilistically based on morphometric traits. All adult Black Oystercatchers have bright yellow eyes, but some of them have dark specks or "eyeflecks" in their irides. We hypothesized that this easily observable trait was sex-linked and could be used as a novel diagnostic tool for identifying sex. To test this, we compared data from genetic molecular markers (CHD-W/CHD-Z and HINT-W/HINT-Z), morphometric analyses, and the presence or absence of eye flecks. When compared to molecular markers, we found that discriminant analyses yielded variable results, which were further confounded by geographical differences in morphology. However, we found that eyeflecks are indeed sex linked: all females had eyeflecks in the anterior part of the iris that varied in size and shape, while in most males they were absent. Discriminant analysis correctly assigned sex in 88% of birds ($n = 119$), while eyeflecks correctly attributed sex in 94% of oystercatchers. We propose the eyefleck technique for sex determination is preferable for certain research applications because it does not require capture, is quicker, simpler, and at least as accurate as discriminant analysis of morphology, and can be used when access to molecular methods is limited or delayed.



Migrant plovers on steppe wetlands in European Russia: coexistence or “competitive exclusion”?

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More than 40 steppe wetlands containing potentially suitable habitat for migrant waders in southeast European Russia (Republic of Kalmykia, Volgograd region, Stavropol Territory) were inspected during 1997–2006. Many migrant flocks included a mix of species of the genus *Charadrius*: Kentish Plover *Charadrius alexandrinus*, Ringed Plover *Ch. hiaticula*, Little Ringed Plover *Ch. dubius* and Caspian Plover *Ch. asiaticus*. In order to evaluate similarity of resource-use between these species, the following parameters were analysed: 1) number of species in migrant flocks; 2) geographical distribution; 3) microhabitat distribution.

The most common species was Kentish Plover (max. 400) and Ringed Plover (max. 306). In all seasons, the number of Little Ringed Plovers was much lower (max. 53). Caspian Plovers were rarely found and were therefore excluded from the analysis.

The similarity of geographical (Izgeo) and microhabitat (Izmic) distribution was as follows: Ringed Plover – Little Ringed Plover (Izgeo = 0.27; Izmic = 0.93), Ringed Plover – Kentish Plover (Izgeo = 0.59; Izmic = 0.78), Little Ringed Plover – Kentish Plover (Izgeo = 0.52; Izmic = 0.89).

On the basis of the data obtained it is concluded that the greatest competitive pressure is felt by Little Ringed Plovers, which in terms of ecological demands appears to be between Ringed Plover and Kentish Plover. Therefore it seems that this can explain the lower numbers of Little Ringed Plovers on steppe wetlands in comparison with the two other species.

Trends in breeding birds in the Wadden Sea

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The Wadden Sea is of outstanding importance for several breeding birds and supports a major share of the European populations of e.g. Eurasian Spoonbill *Platalea leucorodia*, Pied Avocet *Recurvirostra avosetta*, Gull-billed Tern *Sterna nilotica* and Sandwich Tern *S. sandvicensis*. Since 1991, annual censuses of breeding birds have been carried out by the Joint Monitoring Group of Breeding Birds, focussing on 31 species.

Growing numbers of Great Cormorant *Phalacrocorax carbo*, Eurasian Spoonbill, Lesser Black-backed Gull *Larus fuscus* and Common Gull *L. canus* mainly reflect increases in their European breeding range. In contrast, other species, especially coastal waders, have suffered major declines. Common Snipe *Gallinago gallinago* and Ruff *Philomachus pugnax* have almost disappeared, while Dunlin *Calidris alpina* of the subspecies *schinzii*, for which the Wadden Sea represents a major breeding site, is on the verge of extinction. Beach-breeders like Kentish Plover *Charadrius alexandrinus* and Great Ringed Plover *Ch. hiaticula* have decreased, partly

because crowded beaches and lack of coastal dynamics affect their breeding sites.

Different trends in the same species exist within the International Wadden Sea. In the Netherlands, for example, more species show declines than elsewhere. These include two shellfish-eating species, Common Eider *Somateria mollissima* and Eurasian Oystercatcher *Haematopus ostralegus*. Both species are known to have been affected by over-harvesting of shellfish in the Dutch Wadden Sea, which is more intensive than in Germany and Denmark.

Our data show that to date not all targets addressed in the agreed trilateral *Wadden Sea Plan* have been met, especially with regard to beach-breeding and shellfish-eating species. In many other species, target evaluation has proved difficult since breeding success has not been monitored. Inclusion of breeding success in the monitoring scheme is therefore strongly recommended.

Decline over time in foraging opportunity and spatial predictability in a digestively-constrained forager, the Red Knot *Calidris canutus*, at landscape scale

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In contrast to what traditional prey-selection models assume, intake rates of most predators is not limited by handling time, but rather by digestion rate, if the long term average intake rate is to be maximized. The digestive rate model (DRM) exploits prey selection based on digestive quality (energy content over ballast mass), whilst respecting a digestive-constraint. Foragers that ingest large prey whole are very likely to face a digestive constraint during feeding. Depending on the strength of this flexible constraint, different prey-types are included in the diet to maximize average long-term energy gain. Using data from a large-scale, detailed benthic research programme in the Dutch Wadden Sea, we predict intake rates (mg AFDM s⁻¹) for every sampled position in 1996–2005 with the DRM. This model is parameterized for our focal shorebird, the Red Knot *Calidris canutus*. Also, for every single year the spatial distributions of intake rate are analyzed with Moran's I. Spatial predictability, as well as feeding opportunity, are reviewed here for both subspecies that visit the Wadden Sea during their non-breeding season or southward migration, i.e. *C. c. islandica* and *C. c. canutus*. Local survival of *islandica* knots in the Wadden Sea is described on the basis of a long-term colour-banding programme. Over the years, both subspecies encountered a sequentially more limited foraging area, especially when a threshold value to meet energetic demands is considered. The predictability decreases as well, as indicated by the decrease of spatial structuring. Knots wintering (*islandica*), or fattening up during migration (*canutus*) are forced to spend more time searching for suitable feeding sites and commuting between foraging areas and/or their high tide roosts. This decrease in feeding opportunity and predictability coincides with a strong decrease in the survival of knots in the Wadden Sea, a Marine Protected Area of international significance.



Could the Black-tailed Godwit

Limosa limosa islandica be a “microphage wader”?

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In recent years, an increasing number of Black-tailed Godwits have been found wintering along the Atlantic coast of France. In the Gulf of Morbihan, flocks of several hundred godwits regularly exploit the Sarzeau bay, which has a wide mudflat of 115 ha with beds of *Zostera noltii*. Generally they fed the whole time that the mud was exposed by the tide during daylight, i.e. 5.5 to 6.0 h. They were also suspected to feed at night. According to fecal analyses, their diet appeared to consist exclusively of the bivalve, *Abra ovata*. We did not find any trace in the faeces collected from the godwit feeding areas of other bivalves, annelid jaws or seta, gastropods (*Hydrobia* sp.) or vegetal remains (eelgrass seeds or rhizomes). However, several inconsistencies emerge if it is assumed that *A. ovata* is the only prey that is consumed:

- The mean density of *A. ovata* available in the Sarzeau bay (177 ± 22 ind/m²) is below the lower exploitable bivalve threshold estimated by depletion models. Furthermore, individual prey mass of *A. ovata* is much lower than that of bivalves species usually consumed by godwits in Portugal, Britain or in other French estuaries.
- The spatiotemporal feeding utilization of the Sarzeau bay was not correlated with prey (*A. ovata*) abundances.
- The mean ingestion rate was very high (17.3 ± 2.8 prey items/min) and not compatible with available densities of the bivalve, or the probable ability of the birds to digest items like bivalves. It is also several times higher than most ingestion rates recorded in the literature, for areas where the main preys are bivalves.

Our conclusion, which is confirmed by feeding behaviour analysis, is that the godwits do consume *A. ovata*, but mainly exploit another as yet unidentified very small prey during their long feeding sessions with high prey intake rates.

Breeding Redshanks *Tringa totanus* on mainland salt marshes: effects of changing land use and predation

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Since the 1980s, the management of the mainland saltmarshes of the German Wadden Sea has changed due to the establishment of national parks. Nowadays large parts of the formerly grazed and mown saltmarshes are fallow land. These changes in land use have strong effects on the structure and zonation of the saltmarsh vegetation, and hence habitat parameters for breeding birds. In order to assess the consequences of the changing land use on breeding birds, we study the effects of different management schemes and differences of predation pressure on breeding Redshanks.

For this purpose we chose four study areas with different land use schemes on mainland saltmarshes along the Lower-Saxony coast of the German Wadden Sea. The data on nest locations, nest and egg parameters and hatching success of Redshanks in relation to vegetation characteristics and predation

rate along elevation and vegetation gradients of the study sites were analysed. The poster will present first results of the 2007 breeding season and discuss the role of different site management schemes for breeding meadow birds.

Does a differential immune function explain the latitudinal segregation of the sexes of Black-tailed Godwits *Limosa limosa* on their wintering grounds?

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Latitudinal sexual segregation during the non-breeding season is known to occur in many bird species. In long-distance migratory arctic shorebirds (Charadrii), some species shows complete or partial latitudinal segregation between the sexes along the overwintering grounds. To date, shorebird studies concerning spatial segregation between the sexes proposed several hypotheses, but none from the perspective of the immune function. Black-tailed Godwits exhibit a strong sexual dimorphism in size, with females being larger than males and having substantially longer bills and tarsus. In an important staging area (Extremadura, inland Spain) for godwits using the East Atlantic Flyway, we collected feather tips for analyses of stable isotopes, which indicated a strong latitudinal and habitat segregation between sexes in early winter. Additionally, we carried out an experiment with captive birds to compare T-cell mediated immune response of male and female godwits during the non-breeding season. Cell mediated immunity of males was significantly greater than that of females. We suggest that latitudinal sexual segregation during the non breeding season in arctic shorebirds could be partially explained by a differential immune response between the sexes. This hypothesis is not mutually exclusive with others, such as the ‘dominance’, ‘body size’, ‘arrival time’ or ‘predation risk’ hypotheses.

Variation in several innate immune components in Ruffs migrating through Friesland

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The investment in the immune system is likely to be one of the many trade-offs that migratory shorebirds have to make during their annual cycle. Specially, in energetically demanding periods such as migration, it is likely that the immune function would be down regulated, and that energy would be preferentially channelled to other physiological functions more related with migration. If this could be shown, it follows that migratory birds are more susceptible to infections during this period. Theoretically, the risk of infections would be higher in species that use habitats where the density of parasites and pathogens is high, such as freshwater wetlands. The Ruff *Philomachus pugnax* is a migratory shorebird that winters in the inland areas of sub-Saharan Africa and breeds across a wide range of latitudes throughout Eurasia. The birds that stop to refuel in the grasslands of SW Friesland, in the north of the Netherlands during spring migration, come from wintering areas mainly in the west of sub-Saharan Africa, probably Senegal and Guinea-Bissau. In this project, we looked at seasonal variation in several components of the



innate immune system (complement proteins, natural antibodies, total white blood cells and ratio leucocytes/lymphocytes) in Ruffs that migrate through Friesland from March to May 2007, with the goal of determining the periods when migratory Ruffs are more susceptible to infection.

**Reproduction of Common Redshanks
Tringa totanus in the Wadden Sea:
small-scale variation in hatching success**

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The Wadden Sea saltmarshes are of high importance as breeding habitat for Common Redshanks. At the beginning of the 21st century, about 11% (15,000 pairs) of the NW European population bred in the entire Wadden Sea. While most inland populations have shown a dramatic decrease during recent decades, the numbers breeding in coastal areas have been stable. High densities were observed especially in mainland salt marshes in sheltered bays. One of the most important breeding sites within the German Wadden Sea, the Jadebusen (Lower Saxony), supports about 2,000 breeding pairs, or 15% of the Wadden Sea population.

Previous studies on large-scale variation in redshank reproduction revealed a high hatching success on Wadden Sea islands in contrast to an extremely low hatching success on mainland saltmarshes. Reproductive success in the western Jadebusen is insufficient to maintain a stable breeding population. In 2007, we investigated three adjacent study sites (each about 60 ha) on the mainland coast (Jadebusen) in relation to breeding densities and hatching success of redshanks. Breeding densities were comparatively high with 1.4–2.0 breeding pairs per ha. Hatching success differed significantly between the three study sites. In Beckmannsfeld and in Idagroden, hatching success was just under 50% (respectively: 47.0% of all clutches, n = 10, and 48.3 % of all clutches, n = 23). In Petersgroden, which is close to Idagroden (~2.5 km), only 8.7% of all clutches (n = 26) hatched. Possible explanations for the observed small-scale variation in hatching success and especially the impact of predation are discussed.

**Phenotypic flexibility in red knots
faced with food limitation**

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Red Knots *Calidris canutus islandica* are migrant shorebirds that breed in the High Arctic (Greenland and Canada) and winter in the intertidal zones of Western Europe. Because they eat mainly molluscs that they find in the intertidal mud, food availability in the wild is very variable and depends on location, time of year and weather.

In this experiment we studied how Red Knots adjust their physiology and behaviour to maintain an equilibrated ener-

getic balance when facing food limitation. We kept birds in aviaries at the Royal Netherlands Institute for Sea Research, where they were fed trout food pellets. During 21 days, one group had access to food during 22 hours a day whereas the other group had only six hours of available food per day. We measured changes in their body mass, food intake, basal metabolic rate (BMR) and behaviours. We expected that, when birds had less time to eat, their food intake would be lower and that they would be less active to economize their energy output. Thus, their body mass and BMR would also be decreased.

We found that, although at the beginning of the six hours food availability treatment birds had decreased food intake, by the end of the 21 days they were back to their original food intake because they increased feeding behaviours when food was accessible. During the same period, they dropped their body mass but then quickly stabilized it. However, we did not observe any difference in BMR according to food treatment.

Results suggest that Red Knots maintain an equilibrated energy balance when faced with limited access to food through minimizing their energy output by decreasing their metabolic tissues (mass loss) and maximizing their energy input by increasing their feeding behaviours when food is available.

Diet selection of Red Knots *Calidris canutus islandica* wintering on the French Channel coast

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The occurrence of Red Knots *Calidris canutus canutus* in very limited areas during winter make them vulnerable to the loss of their key resources and to the degradation of their habitat. In the context of the decrease in the European wintering knot population since a peak in 1992, it is important to understand the factors influencing their distribution on European tidal flats as this is imperative for the guidance of habitat management and conservation. Despite a large body of research on the distribution and feeding ecology of Red Knots, their winter distribution and activities on French coasts are poorly described. We focused our research on the relative quality of French wintering sites. The prey resources and diet of knots were studied during Jan/Feb 2006, the season when maximum numbers are present, at three wintering areas along the French Channel coast that support about a third of the entire French wintering population (the Bays of Mont Saint-Michel, Saint-Brieuc and Veys). In parallel, the knot numbers were recorded by the managers of local nature reserves that run wader monitoring on tidal flats by monthly counts. Results showed two types of responses, numerical and functional, with significant differences in the occurrence of knots and prey-selection at sites in relation to stocks of available and accessible bivalves. This study highlights the high potential winter carrying capacities for Red Knots of the Saint-Brieuc and Mont Saint-Michel Bays compared to other areas in Europe.



Timing and breeding success: is it really good to be the first one home?

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Several studies have argued for the advantages of early arrival on breeding grounds for migratory birds. Birds that arrival earlier and lay their clutches earlier tend to be more successful.

The present study shows results from a breeding population of Black-tailed Godwits in the province of Friesland, the Netherlands. Individuals have been individually colour-marked and arrival dates, laying dates and several nesting parameters have been monitored since 2004.

As expected, successful nests were on average laid earlier in all years, despite a general trend for later laying across the four study years. Early laid nests had larger eggs and tended to yield bigger chicks.

Despite this, we found no evidence for a correlation between early arrival and breeding success. In fact, arrival dates showed no relation with laying dates and, ultimately, no relation with hatching success.

When comparing the length of the pre-laying period we found that early arrivals tended to be the birds that waited the longest until starting to lay eggs, whereas early layers were generally the birds with the shortest pre-laying periods, suggesting that the full picture might be much more complex. Therefore birds that arrive too early and others that arrive at just the right time to start breeding may be influenced by events that occurred earlier during spring migration and possibly also to temporal variation in food availability on the feeding grounds.

Diet variation of Black-tailed Godwits

Limosa limosa islandica on the central Atlantic coast of France over a complete winter period

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The Black-tailed Godwit *Limosa limosa islandica* is one of the most common shorebird species wintering on the mudflats of the central Atlantic coast of France. During recent years, up to 35% of the total *islandica* population have used this area, which is divided between four favourable feeding and roosting sub-sites, from early Aug to late Feb. These sub-sites are close together and benefit from being protected as nature reserves. In an attempt to understand the distribution of the

birds and their movements between sub-sites, we studied the prey-resource available to the birds. First, we surveyed the food resource in three nature reserves: the bays of Aiguillon and Yves on continental coast (which are bare mudflats) and the Fier D'ars Bay on Ré Island (which has a cover of the seagrass *Zostera noltii*). Each month we sampled five sediment cores from four points along a transect covering the intertidal zone of each mudflat from Sep 2004 to Feb 2005. We estimated the temporal and spatial variation of the density, biomass (AFDM) and depth of the main potential prey of Black-tailed Godwits. These results were compared to changes in the diet of the Black-tailed Godwits as shown by faecal analysis.

Five species of molluscs were dominant in mudflats (*Macoma balthica*, *Hydrobia ulvae*, *Cerastoderma edule*, *Abra tenuis* and *Scrobicularia plana*) but with large differences in densities and proportion between sites. On sites without seagrass cover, the birds' diets consisted almost entirely of *Macoma balthica* although others mollusc and worm species were locally abundant. On the other hand, on Ré Island the diets were completely different and faeces contained very few remains of molluscs or worms, but large amounts of seagrass fragments. We conclude that Black-tailed Godwits are highly selective predators during winter and can adopt very clear-cut diets even when a variety of different prey is available. In the light of the movement of the birds between sub-sites, it would seem likely that the godwits' digestive systems have a capacity to switch rapidly between hard-shelled prey and seagrass to maintain the energetic gain they need in winter.

Diet patterns of foraging activity and feeding rate of migrating Black-tailed Godwits *Limosa limosa* in rice fields

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Information on factors influencing habitat use in non-tidal areas may be key in providing explanations for differences between shorebird species or populations in patterns of habitat use and in estimating the optimal diet. Diel patterns of foraging activity and feeding rate of Black-tailed Godwits *Limosa limosa* were studied in Extremadura's rice fields (inland Spain), a key non-tidal stopover area for large numbers of migrating godwits. Data from radio-tagged and colour ringed individuals showed that Black-tailed Godwits were day-active in spring migration, with significant morning and evening peaks of foraging activity. Black-tailed Godwits kept in large outdoor aviaries and feeding *ad libitum* also were day-active, showing a similar pattern of foraging activity than wild birds. Feeding rate (mean: 12.7±7.7 items · minute⁻¹) also varied on a diel basis, with a distinct day-time peak in early morning and evening. Although several authors have speculated on the possible connection between diel feeding rhythmicity of migrating shorebirds and activity patterns of their food prey items, our results suggested an endogenous control of feeding activity in non-tidal areas where food harvestable by shorebirds is abundant.



Shorebird conservation: success or failure in education and public outreach depend on communication language and the role of scientists

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San Antonio Bay, Río Negro province, Argentina, is a Western Hemisphere Shorebird Reserve Network site where beach tourism in summer is the main economic activity that impacts shorebird habitats. In 1999, we began conservation initiatives to promote educational and public outreach projects to increase visitor and community awareness.

The objective was to design a model programme about shorebirds and habitat conservation, with a common communication message from various perspectives (rational, emotional, regional and universal). It was important that participants should have stimulating experiences if we were to succeed in helping them link current scientific knowledge with their personal wishes and values.

With scientific advice, the study was targeted at two groups that were unlikely to have any previous interest in birds: tourists and school children (both primary and secondary). About 150 tourist groups of 8–10 people were conducted on excursions to shorebird beaches led by a tourism guide. Similarly 32 student groups of 20–30 people received tuition from a teacher and visited shorebird areas; four of them also participated in shorebird banding activities. Experimental groups were subjected to different communication language levels ranging from major information (less easily understood) to less information (more easily understood). Some met with Argentine or international shorebird researchers. A group was considered successful if >60% paid attention, or requested more information, or asked what they could do to help conservation or expressed satisfaction.

The success of communication language was group-dependent: whereas some responded best to less, more easily understood, information, others were stimulated by a higher degree of information. Thus a standard information package would be inadequate to cater for the needs of all groups. Contact with scientists and participation in research activities always generated keen interest when researchers showed themselves to be human beings with a genuine commitment to conservation; otherwise group perception was negative.

Temporal variation in energy intake of waders on an artificial mudflat

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In the course of intensified coastal protection measures in the face of rising sea levels, clayey tidal mud deposits were often removed for dyking, even from protected Wadden Sea saltmarshes. The remaining clay pits surrounded by natural saltmarsh were regarded as potential feeding sites for migratory birds. But, it is not well documented whether, when and how long migratory birds can benefit energetically from using these new artificial feeding habitats during the natural infilling and succession processes to which they are subject.

Here we present the results of a seven year research project investigating a 9 ha clay pit excavated in the saltmarshes of the western Jadebusen (Lower Saxony, Germany) in 1998/99. Since 2000, the density, foraging success and energy intake of migratory birds has been observed in the clay pit and also in an adjacent 16 ha tidal flat annually during spring and autumn migration. Although most of the migratory birds obviously preferred the mudflat control area as feeding habitat, foraging success and energy intake were significantly higher in the clay pit in some years. However, the time when energy intake was beneficial varied between species and migration period of the respective species. Mostly, there has only been one year of higher energy uptake in the clay pit compared to the mudflat during the past seven years, considering each species' migration period separately. Keeping these short-term energy benefits in mind, the ecological relevance of the clay pit as a lasting feeding habitat for roosting migratory birds will be discussed.

Wintering grounds of Common Snipes *Gallinago gallinago* ringed in Poland

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Common Snipes are among the waders that migrate in large numbers through central Europe to wintering grounds in the western part of the continent. We have analysed ringing recoveries obtained from birds marked at seven ringing stations in Poland during autumn migration. Four of them were situated in Gulf of Gdansk area in N Poland; the other three at inland water bodies in the centre of the country. In the analysis, only winter (Dec–Feb) recoveries were used. Birds that migrate through Poland are recovered during winter mainly in France (71% of all recoveries, $n = 321$). Mean distance travelled was 1,300 km. Data from direct recoveries show that Common Snipes migrating through northern part of Poland fly to more northerly situated areas than birds using inland water bodies (mean angle of migration 242.2° vs. 248.9° ; Watson & Williams test $F = 9.66$; $df = 1$, $p < 0.001$, $n = 188$). Also the mean gravity points of their wintering grounds are different (Wilks test $F = 8.20$; $df = 2$; $p < 0.001$). Their wintering grounds differ in latitude (ANOVA $F = 15.95$; $df = 1$; $p < 0.001$) but not longitude (ANOVA $F = 0.45$; $df = 1$; $p = 0.502$). When we look at recoveries obtained from birds ringed in different periods of their autumn migration, it appears that birds ringed before the median date of the migration period (13 Aug) fly to more northerly located areas than birds ringed after that period (mean angle of migration, 245.2° vs. 238.5° ; $n = 101$, Watson & Williams test: $F = 4.63$, $df = 1$, $p < 0.05$).



Time budget of Northern Lapwing chicksLucyna Woloszyk, Włodzimierz Meissner &
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The study was carried out in Turov, south Belarus (52.04°N, 27.44°E), between the end of April and the end of June in both 2006 and 2007. The study site consists of seasonally flooded lowland valley in the middle part of the Pripyat River.

We investigated the time budget of Northern Lapwing chicks by direct observations from a hide, three times daily for three hours, using focal sample methods. On average, each chick was observed for 5 minutes. To minimize possible disturbance to chicks, the distance between the hide and the family group was kept to a minimum of 10 m. All types of behaviour of chicks were recorded and analyzed. We calculated mean percentage time of each behaviour category within the total observation time. Additionally we documented presence

and behaviour of the nearest adult.

The first days of life appeared to be the most important period for chicks due to the slow development of thermoregulation. During the first five days, chicks were brooded, mainly by female, for about 49% of their total time budget. In this period foraging comprised about 40% of their budget. As the chicks grew older, the length of brooding bouts decreased. One week old chicks were brooded for 20% of the time whereas two weeks old chicks for only 3%. Over the same period foraging bouts increased from 59 to 71% of the chicks' time. Three weeks old chicks and the older ones were not brooded at all, despite the presence of the parents. At this age about 60–75% of the chicks' time was spent foraging, 7–12% preening, 3–17% watching. The chicks spent about 1–7% of the time in movement – mainly looking for suitable foraging habitat. The proportion of time spent brooding and foraging depended on the age of chicks and ambient temperature. In adverse weather conditions small chicks may need so much brooding that there is insufficient time for feeding.

