

## Declining Populations Workshop – Abstracts of talks

### How many of the world's wader species are declining, and where are the Globally Threatened species?

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The publication by Wetlands International in 2002 of *Waterbird Population Estimates – third edition* (WPE3) involved wide consultation with population experts and provides a useful starting point for the evaluation of numbers and population trends of the world's waterbirds. About one quarter of the species recognised as “waterbirds” by Wetlands International are waders, and information is presented in WPE3 on all 209 of the world's wader species. Estimates are now available for a majority (85%) of the world's wader populations, but population trends have only been estimated for 41% of populations. At the global level, these known trends break down as follows: Increasing, 13%; Stable, 39%; Decreasing, 44%; Extinct, 4%.

A total of 44 species (21% of all wader species) are recognised as Globally Threatened or Near-Threatened under IUCN Criteria. A disproportionate number (72%) of these Globally Threatened species have ranges of distribution in Asia and Oceania. A high proportion (66%) of Globally Threatened species are sedentary, and a majority of these (21 out of 29 species) are specialised island forms. Red Data lists produced by BirdLife International on behalf of IUCN are compiled at the species level; more threatened wader populations would be identified as deserving of conservation action if these lists were compiled at the level of sub-species or biogeographic population.

Most, but not all, Globally Threatened species are known to be in decline, and Globally Threatened species represent just under half of species known to be in decline. Because of special efforts to identify and conserve Globally Threatened species, and because less numerous species are usually easier to monitor, our information about populations and trends is biased in favour of globally threatened species. Many other species and populations whose trend is unknown at present are likely to be declining, and expansion and refinement of monitoring is necessary to identify relatively numerous and widespread species which are nevertheless declining.

### Status of migratory wader populations in Africa and Western Eurasia in the 1990s

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Estimates of the size of wader populations need to be regularly updated for use in flyway and site conservation, and up-

to-date information on population trends is an essential basis for identifying priorities for conservation action. This paper presents the results of a major collation and reanalysis of 1990s migratory wader population data for all countries in Africa and Eurasia.

This review was carried out by the International Wader Study Group between 1996 and 2000. It updates previous estimates dating from the mid-1980s. We present status information on 115 populations of 49 species. Of these we have been able to give size estimates (to varying precision) for 110 populations, 1% population thresholds (or provisional thresholds) for 102 populations, and indications of trends between the mid 1980s and mid 1990s for 70 populations. Comparisons between flyways show that data quality is best for populations using the largely coastal East Atlantic Flyway, than for other flyways in the region: it has been possible to assess precise trends for 78% of East Atlantic Flyway populations, but for only 43% of the Black Sea/Mediterranean populations and just 5% of West Asian/East African populations. It is difficult to draw conclusions on the overall status of waders in Africa/Eurasia, since reliable estimates of population trends can be made for only 44 of the 115 populations using the region. There are, however, 2.5 times as many populations in decline as those that are increasing: there is a decrease or possible decrease in 20 populations and an increase or possible increase in eight, with 36 being stable or possibly stable. Furthermore, some populations are known to be severely threatened and in decline, notably Slender-billed Curlew *Numenius tenuirostris* and Sociable Lapwing *Vanellus gregarius*, and the two Canary Islands races of Stone Curlews *Burhinus oedicnemus*.

A review of progress in improving data and information shows that there has been significant improvement with respect to some populations (especially knowledge of European distribution of breeding waders and their population trends, particularly in the Mediterranean Basin and in Russia). However, very little progress has been made for many other priority areas, such as waders wintering on non-estuarine coasts or inland. Indeed, for 62 populations (57% of those considered) monitoring provision is not adequate to provide even the most basic information on trends in abundance. Only in 16 populations (15%) is there a sound basis for assessing changes in population sizes. For the remaining 30 (28%) populations, monitoring provides some information although this is usually far from adequate in extent or quality. For no biogeographical population is it currently possible to assess trends with any defined degree of statistical precision. This lack of monitoring provision is a serious conservation deficiency given not just the need to assess population change at local and country scales but also to assess the potential major impacts predicted from a changing global climate. The African–Eurasian Waterbird Agreement has highlighted monitoring as a major priority for the international conservation of waterbirds within the region. We hope this review will stimulate concrete urgent actions to this end.



## Status of wader populations on the Central/South Asian flyway

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**Flyway characteristics:** The Central/South Asian flyway covers wader populations breeding in the central Siberian arctic, boreal Russia and the central Asian steppe (long and medium-distance migrants), with short-distance migrants and residents breeding south of Himalayan mountain chain. Under current population delimitations there is considerable overlap of migratory populations with the West Asian/East African flyway and some with the East Asian/Australasian flyway. The staging areas for long and medium distance migrants are poorly known, but are believed to be chiefly inland freshwater and saline wetlands in Central Asian countries. Wintering areas are mostly coastal intertidal wetlands from Pakistan east to Myanmar, and it is possible that some birds continue on to Indian Ocean islands. Major coastal wintering areas include the Indus Delta (Pakistan) and the NW Indian coast, the SW Indian/N Sri Lankan coast, the Bangladesh coast and probably deltas on the coast of Myanmar. This is the shortest of all wader flyways, lying wholly north of the Equator.

**Number of species and populations:** The flyway analyses are derived from *Waterbird Population Estimates 3rd Edition* (2002) (WPE3). There are 59 wader species on the flyway, of which 49 are migrant or partly migrant (“migrant” includes species/populations with partly resident, partly short-distance migrant status), and 10 are wholly resident. There are 71 biogeographic populations of which 54 are migrant and 17 resident. In terms of numbers of species and populations, this is a considerably more diverse flyway in comparison with any of the African–Eurasian flyways. The flyway is dominated by plovers and sandpipers (63% of populations). Many (47%) of the resident populations are plovers. 44% of migrant populations are calidrid and tringid sandpipers and their “allies”, with a further 24% being plovers.

**Population sizes:** WPE3 includes population size estimates for 56 populations (79% of the total). These include estimates for 49 (91%) of migratory populations, but only 7 (41%) of the resident populations. However, precise estimates (i.e. not just a range) are made for only 38% of migrants and just 18% of residents. Furthermore many estimates are old (pre-1990s), and the main source in WPE3 is still Perennou *et al.* (1994) which covers data from 1987–91 (51% of population estimates; 36% of trend estimates). In addition, another 20% of WPE3 population estimates are from as yet unpublished sources. Current population status is very poorly known. Accepting these limitations, most (80%) of migratory populations are in the range 25,000–1,000,000 birds and only 18% are <25,000 birds. Resident populations are mostly smaller, with 57% each <25,000 birds. The total estimated Central Asian flyway wader population is approx. 9.4 million waders for 80% of the populations, suggesting that the total population is around 11 million birds. For migratory populations only, there are 8.6 million waders for 91% of populations, suggesting an estimated total of about 9.4 million birds. This is small in comparison with several other flyways (e.g. East Atlantic 14.4 million; Black Sea/Mediterranean 25.9 million; West Asia/E Africa 22.8 million (Stroud *et al.* 2003)).

**Population trends:** There is very little information on trends in population size for the Central Asian flyway. WPE3 gives trends for only 14 populations (20%), and there is a “definite trend” for only 12 of these (17%). Trend information is available for only 2 (12%) of resident populations, of these, one is decreasing and the other stable. Overall, 50% of populations with known trends are decreasing. Four migratory populations are increasing, but for two of these, the long-distance migrants Black-tailed Godwit *Limosa limosa* and Red-necked Stint *Calidris ruficollis*, only a small part of the relevant population winters on Central Asian flyway. Furthermore, the increasing trend is not certain for the short-distance migrant White-tailed Lapwing *Vanellus leucurus*. Only one population (Pied Avocet *Recurvirostra avosetta*) wholly dependent on the flyway is increasing. It seems that perhaps 3–4 times as many populations on the flyway are decreasing as are increasing.

**Globally threatened species and populations of conservation concern:** There are six Red Listed species on the flyway, from different breeding areas, with different migratory strategies (resident to long-distance migrant), and using different wintering habitats. These are the Critically endangered resident Jerdon’s Courser *Rhinoptilus bitorquatus*; endangered Nordmann’s Greenshank *Tringa guttifer* (medium-distance migrant); the vulnerable Wood Snipe *Gallinago nemoricola* (short-distance migrant), Sociable Lapwing *V. gregarius* (medium-distance migrant) and Spoon-billed Sandpiper *Eurynorhynchus pygmaeus* (long-distance migrant, now believed to be in serious and rapid decline – see the abstract of Tomkovich & Syroechkovski); and the near-threatened Asiatic Dowitcher *Limnodromus semipalmatus* (medium-distance migrant). There are 14 populations of “conservation concern” (i.e. <25,000 birds and/or in decline). These include the populations of the six globally threatened species. In addition, the Long-billed Plover *Charadrius placidus* has a small, (<10,000 birds) declining population that should be considered for Red Listing. Six other populations are small, but of unknown, trend and one (Grey-headed Lapwing *V. cinereus*) has a larger population but is in decline. Overall, at least 20% of flyway populations are of conservation concern and, given the poor state of recent knowledge, this figure may be much higher.

**Conclusions:** The Central/South Asian flyway is a relatively short flyway, with high diversity of wader species and populations but with rather small population sizes. Population status, both sizes and especially trends, is very poorly known and much of the available information is at least 10–15 years old. Resident populations are particularly poorly known. Analyses of WPE3 information for this flyway should be treated with caution, and no time-period assessment of change in population status is possible. However, on available evidence, it appears that the waders dependent on this flyway have a declining status: very few populations are increasing, and others (possibly around 3–4 times as many) are in major decline. Declining populations come from different breeding areas. There is an urgent need to fully update Perennou *et al.* (1994) before WPE4. This can be achieved, at least in part, through a complete analysis of Asian Waterbird Census data in order to yield updated size and trend estimates. There is also a need to understand more about the ecological status (particularly changes and threats) of the Central Asian breeding and staging areas, and the major coastal wintering areas. In particular, is the increasing drought in Central Asia affecting breeding and staging area



suitability? In a region of large coast-dwelling human populations, to what extent are coastal wintering areas under pressure from land-claim, mangrove destruction and other wetland habitat degradation?

### The East Asian–Australasian Flyway

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There are estimated 7 million waders in the East Asian–Australasian Flyway. There are 102 species. Five of these breed in NE Siberia and migrate to South America. One breeds in the same region (Ruff) and migrates to the southwest. Of the remaining 94 species, 41 are residents and 53 migrants. 19 (46%) of the residents are classified by IUCN as Globally Threatened. Four (8%) of the migrant species are classified, two as near threatened, one as vulnerable and one as endangered.

Causes of declines in resident species are habitat loss, predation, small island populations and human disturbance (on beaches). The main threat to migrant species is perceived as human population pressures on the staging areas in Asia, especially around the Yellow Sea. Birds migrate through an area of the world that contains one third of the human population. This creates an enormous demand for use of wetlands for human benefit, to the detriment of waders. For example the Saemangeum reclamation project will remove one of the world's most important staging sites used by 18 species in numbers of international importance, including 31% of the world population of Great Knots *Calidris tenuirostris*.

Monitoring has been carried out on non-breeding areas in Australia and New Zealand with the longest running scheme dating back to 1968. In Australia, there is only good quality long-term monitoring in the southeast and this shows very large declines in some species over the last 10 years. However, these declines may not reflect the situation throughout the non-breeding ranges. Changes in climate may cause a northward shift in the non-breeding range as the remaining parts of the Yellow Sea, which is mostly too cold in winter, becomes more available as a non-breeding site. Monitoring is also carried out at migration sites in Hong Kong, South Korea and Japan.

Annual breeding success is monitored in SE and NW Australia by catching very large numbers of birds. Attempts have not been made to measure breeding success from comparison between non-breeding season counts and the numbers of immature birds remaining in Australia in the northern summer. However, data do exist to explore the possibilities of using counts as a method of measuring breeding success.

Conservation plans are in place for threatened species in Australia and New Zealand. There are also international agreements within the flyway, for example between Japan and Australia (JAMBA) and between China and Australia (CAMBA), and a shorebird site network has been developed under the Asia–Pacific Migratory Waterbird Conservation Strategy. All this has led to an increasing understanding of wetlands and international cooperation within the flyway, but there is still a lack of data from many areas.

### The status of shorebird populations in Oceania

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Oceania, including here New Zealand but excluding Australia, supports a lower diversity of shorebirds but proportionately more taxa of conservation concern than any other region of the globe. Eight of 13 (62%) resident taxa have been assigned an IUCN threat status, including one as Critically Endangered (Black Stilt *Himantopus novaeseelandiae*), four as Endangered (Tuamotu Sandpiper *Prosobonia cancellata*, Chatham Oystercatcher *Haemantopus chathamensis*, New Zealand Dotterel *Charadrius obscurus*, Shore Plover *Thinornis novaeseelandiae*), and three as Vulnerable (Wrybill *Anarhynchus frontalis*, New Zealand Snipe *Coenocorypha aucklandica*, Chatham Snipe *C. pusilla*). The Hawaiian Stilt *Himantopus knudseni* is listed as Endangered by the United States. Population sizes of the nine listed species are mostly under 2,000 individuals, with those of Black Stilt, Chatham Oystercatcher, and Shore Plover numbering 200 or fewer. Encouragingly though, for the Hawaiian Stilt and all New Zealand endemic shorebird species, with the possible exception of the Banded Dotterel, population trends are increasing or stable due to concerted conservation efforts. Numbers of Tuamotu Sandpipers appear to be declining but its status is unclear over large portions of its range. An equally small number of Palearctic- and Nearctic-breeding species has developed various specialized migration strategies in which populations (in whole or in part) spend the non-breeding season in Oceania. Of these, the Bristle-thighed Curlew *Numenius tahitiensis* is the only species whose entire population (<10,000 birds and listed as Vulnerable) occurs exclusively in Oceania during winter. About 90% of the Wandering Tattler *Heteroscelus incanus* population and probably more than 50% of the Pacific Golden-Plover *Pluvialis fulva* population reside in Oceania during the non-breeding season. Other migratory taxa for which habitats in Oceania support varying fractions of their entire or subspecific populations include Ruddy Turnstone *Arenaria i. interpres*, Grey-tailed Tattler *H. brevipes*, and Sanderling *Calidris alba*. Despite there being little trend information for migrant shorebird species inhabiting Oceania, a single paramount issue argues strongly for close vigilance for their welfare among all regions of the planet: human-caused extinctions or extirpations of resident avian populations have been, and continue to be, most prevalent in Oceania.



## Shorebird Populations in North America: Numbers and Trends

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Information on population size is reviewed for 53 species of shorebirds that occur in Canada and the USA, and an outline given of the type of data used to derive the estimates. Population sizes range from a few tens to several millions, with most falling in the low hundreds of thousands. Estimates currently total some 27.5 million shorebirds. Most estimates are considered to be of low accuracy, though detailed information is available for a few species that have been the subject of special investigations. Delivery of comprehensive shorebird monitoring requirements outlined in the Canadian and US Shorebird Conservation Plans has led to the formation of PRISM, the Program for Regional and International Shorebird Monitoring. The main elements of PRISM, which include surveys on breeding, migration and wintering areas, are outlined. Recent analyses of shorebird population trends suggest that many species are declining, especially long-distance, Arctic-breeding shorebirds passing through eastern Canada and the North Atlantic states of the USA. Several case studies are reviewed.

## Are Shorebirds in Decline in the Neotropical Region?

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To answer this question we used data sources from the *Neotropical Waterbird Census – The First 10 years, 1990–1999, Waterbird Population Estimates* (2003, WI), scientific and technical publications, grey literature, queries to specialists, banding programmes and Shorebird Study Groups from the Neotropical Region. Of the 439 shorebird populations in the World belonging to the Charadriidae, Scolopacidae, Haematopodidae, Recurvirostridae, Rostratulidae and Thincoridae, 100 populations (22.9%) representing 60 species (32% of species) are in the Neotropics and for 51% of these, there are no trend estimates available.

Half of the shorebird populations of the Neotropics for which there is trend information are decreasing, including one that is probably extinct while only 2% of them are increasing. However, these data are not reflected in their IUCN threat status. In the Americas, Nearctic populations (65%) are better known than Neotropical ones (33%) because most funding for research, monitoring and conservation come from North America where migrating Nearctic species spend part of the year and their breeding season.

Nearctic species are declining more than Neotropical species (58% of 33 species vs 38% of 16 species respectively)

probably because of their life histories and high dependence on key stopover sites during their long migratory journeys. In some areas, shorebirds have to face conservation threats from pollution, tourism and development, water management, habitat changes from livestock and agriculture. Urgent cooperative research and monitoring are needed to support conservation initiatives throughout the Neotropical Region before it is too late.

## Breeding waders in Europe: a year 2000 assessment of population sizes and trends

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The Wader Study Group project “Breeding Waders in Europe 2000” compiled up-dated population estimates from 52 countries and regions in Europe, including Greenland and northeast Canada. Of 69 European breeding populations there are reasonably good quality breeding data for 35. But due to lack of repeated surveys, it is not possible to assess trends for a number of these. It is thus not possible to assess trends from breeding estimates in most of the large wader populations in the arctic and boreal parts of northern Europe. On the other hand, trends can be assessed for most wader populations breeding further south. In general, wader populations breeding in wetlands are increasing or stable in the western half of Europe while the situation is more variable in the eastern half. In contrast, waders breeding in steppe habitat, in wet grassland and other farmland habitats are declining all over Europe. According to this compilation, 12 European wader populations are of particular conservation concern due to very small populations and/or rapid population reduction. The majority of the most vulnerable breeding populations are confined to steppe habitat (8 populations) or meadows and pastures (3 populations).

## Long-range monitoring of the Arctic: past patterns and future scope, illustrated by trends in migrant wader population sizes in the Western Cape, South Africa

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The longest running regular surveys of a wetland in the southern hemisphere at Langebaan Lagoon in the West Coast National Park, where regular midsummer and midwinter counts of waders started in 1976. The presentation examines trends in population sizes of migrant waders at Langebaan Lagoon and at other sites in the Western Cape. It proposes the establishment of a series of non-breeding sites which could be used to monitor trends in population sizes and considers the qualities such sites would need to have.



### Population trends of waders in Sweden and the monitoring of breeding waders in the north

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I review information about population trends in some of the wader species breeding in (mainly southern) Sweden, or passing through Sweden on migration (arctic breeders). The analysis is based on two main data sources: 1) The Swedish Common Breeding Bird Census (since 1975) and 2) regular trapping and observations at Ottenby Bird Observatory (since 1946). Data quality ranges from good to tentative. Data are presented for 10 out of the 29 wader species breeding in Sweden, and for nine wader species (mainly arctic breeding) occurring regularly on passage. Of particular concern is that monitoring data for several species breeding in the far north is almost completely lacking. A new scheme based on survey routes systematically distributed over the whole of Sweden was launched in 1996, which covers northern Sweden much better than before. There is now the potential to monitor more species at their breeding grounds, for example Eurasian Golden Plover *Pluvialis apricaria*, Whimbrel *Numenius phaeopus*, Wood Sandpiper *Tringa glareola* and Greenshank *T. nebularia*.

### Genetic and ecological consequences of near extinctions (population bottlenecks) of waders

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Many species of waders, especially long-distance migrants that now breed in the high arctic, are genetically impoverished because they experienced severe population bottlenecks in the Pleistocene. In populations with small effective size, genetic drift can be more important than selection in determining the fate of new mutations, and thus these small populations are expected to accumulate deleterious mutations. Genetic theory predicts such fixed alleles will reduce the reproductive success of a species and lead to extinction unless new beneficial mutations are fixed by selection and help restore part of this lost fitness. Critical effective size is thought to be a few hundred individuals, above which a population will persist without extinction due to genetic load. However, this requires approximately a ten-fold higher census population size because of the variance in breeding success and fluctuations in numbers through time. In populations such as those of the Red Knot *Calidris canutus rufa* which is currently undergoing a drastic decline in numbers due to ecologically bad conditions, the risk of extinction is exacerbated. I will review the genetic and ecological evidence that jointly indicate why the population is declining, and argue that other species may be in the same risk category.

### A recent and sharp decline in numbers of Spoon-billed Sandpipers

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The Spoon-billed Sandpiper *Eurynorhynchus pygmeus* has long been considered a vulnerable species because of its restricted range (breeding in coastal Chukotka and Koryak Highlands, northern Far East), specialized breeding habitat, and small population (estimated globally at 2,000–2,500 breeding pairs in the mid-1970s). Initial indications of a sharp decline in the breeding population were obtained in 2000 during a large-scale survey of the Anadyr estuary and adjacent sea coasts, that gave grounds for considering the total population as probably fewer than 1,000 breeding pairs. This effort led to the recommendation that the species be considered as globally endangered (Tomkovich *et al.*, 2002).

Subsequent surveys in 2001–2003 of known and potential breeding areas produced both good and bad news. The surveys revealed several new breeding locations, including what is currently the largest local population (over 75 breeding pairs near Meinypilgino; 62°40'N, 177°05'E). More discouragingly, the 2002 surveys of several sites along the northern coast of the Chukotsky Peninsula failed to find a single site where numbers had increased or were even stable. The most reliable information that suggests a long-term decline in numbers comes from Belyaka Spit (67°04'N, 174°20'W) and nearby Yuzhny Island (67°05'N, 174°40'W). There, up to 95 displaying males were counted in the early 1970s (Kretchmar *et al.*, 1978), but by 1986–1988 the same area supported only 45–51 displaying males (Tomkovich & Soloviev, 2000), and by 2002 only 18 were counted.

Factors contributing to the population decline appear to be low reproduction and decreased survival on staging sites during migrations and/or on non-breeding grounds. Since Spoon-billed Sandpipers are long-lived and highly site faithful to breeding areas, and the observed decline in numbers is widespread, a prolonged declining population trend may be due to a severe factor (or factors) that strongly depresses either reproductive success or (more likely) adult/juvenile survival. Attempts to identify and localize such factors began in 2003 with the initiation of studies on the species' breeding ecology, but the more urgent need is for assessments along the migration corridor and on the non-breeding grounds.



**Population trends and breeding range dynamics in Sociable Plover *Chettusia gregaria*, Black-winged Pratincole *Glareola nordmanni* and Caspian Plover *Charadrius asiaticus* in European Russia**

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An analysis of original and published data for the last 20 years show a catastrophic decrease in the breeding populations and breeding ranges of Sociable Plover *Chettusia gregaria*, Black-winged Pratincole *Glareola nordmanni* and Caspian Plover *Charadrius asiaticus* in southern European Russia.

The current estimate of the European breeding population of the Sociable Plover is only 10–50 pairs. As a breeding species, it has disappeared from a vast area of the Saratov and Rostov Regions and the Republic of Kalmykia. It has also become rare as a migrant.

The current estimate of the European breeding population of the Black-winged Pratincole is 5,000–9,000 pairs. It is reported to have declined significantly in various places in the Cis-Caucasus, particularly in the Kuma-Manych Depression and adjacent steppe areas. During migration, it continues to be rather numerous, but significant numbers are only recorded in a limited number of staging sites.

The current estimate of the European breeding population of the Caspian Plover is 200–500 pairs. However, for the last 20 years, there have been no reports of confirmed breeding for anywhere in southern European Russia suggesting that a major population decline has taken place.

The declines in the populations of these three wader species are probably due to human transformation of steppe ecosystems. However, there are insufficient data to explain what has happened fully.

**Rufa knots: over the edge?**

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Red Knots *Calidris canutus* of the subspecies *rufa* have one of the longest migrations of all waders, moving through 120° of latitude from breeding grounds in the central Canadian Arctic to winter in Tierra del Fuego. Because of concern that the population has been in substantial decline, we, and others, have conducted studies throughout the flyway over the past 10 years.

As far as is known, almost all *rufa* make a final stopover in Delaware Bay, United States, during their northward migration in May before flying directly to their arctic breeding grounds. At around two weeks, this stopover is so short that peak numbers are thought to be close to the flyway total. Based mainly on counts in Delaware Bay it is estimated that the population fell from about 150,000 in the 1980s to 60,000

in the late 1990s. Since then numbers have continued to decline with peak Delaware Bay counts of 50,000 in 1998 dropping to 32,000 in 2002. In 2003, however, the peak count suddenly halved.

At our study site in the breeding grounds on Southampton Island in the NW of Hudson Bay, we found that the number of nests also showed a marked drop from 12 in 2000, eight in 2002 to only two in 2003. The results of our surveys in the main South American wintering areas show a decline in the number of knots from 51,225 birds in 2000 to 29,271 in 2002, but no change in 2003 at 30,475 in contrast to declines in Delaware Bay and the Arctic.

At present, the reason for the sudden drop in numbers in Delaware Bay and on the breeding grounds is unclear. If a major mortality has taken place, this should become clear when the wintering population is counted in January 2004. In the meantime, the following hypotheses appear to be equally plausible:

1. The whole adult population arrived on the E coast of the United States, but numbers were lower than usual in Delaware Bay because of reduced food supplies (horseshoe crabs' eggs). Coupled with insufficient food elsewhere few made it to the Arctic.
2. Some factor, possibly relating to weather or food, occurred during the northward migration and half the adults failed to leave S America.
3. A major mortality occurred during the northward migration (whether through starvation, disease, pollution or weather is unknown).

**Austral migration related to arrival time of Red Knot *Calidris canutus rufa* to Northern Hemisphere**

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Arrival time of Red Knots at their last stopover before reaching the breeding grounds can be critical to adult survival and recruitment. To establish the relationship between the phenology of the austral migration and the arrival time at the last stopover in the Northern Hemisphere, simultaneous censuses were made from 2000 to 2003 in Argentinian Patagonia both at Río Grande, Tierra del Fuego, where Knots spend their non-breeding season and San Antonio Oeste, Río Negro (= SAO), the first main stopover site. In SAO abdominal profiles were sampled visually (Wiersma & Piersma 1995) as an index of body mass at arrival in early birds. Arrival and departure times in SAO was related to arrival in Delaware Bay, USA by resighting 823 birds colour-banded in SAO, with different marks for the first and the second half of March 1998, and 146 banded at the end of March 2003. In both localities scans of colour-banded and non-banded birds were made, and data were fitted to binomial models.

In 2000 and 2001, Red Knots arrived early in SAO by direct flights, and had intermediate abdominal profiles. In 2002, however, Knots left Río Grande 15–20 days earlier but



most arrived in SAO 2 weeks later than previous years, and early birds had significantly lower abdominal profiles. This indicates that they had stopped in intermediate wetlands. In 2003 both early and late patterns were observed. Red Knots arriving early at SAO also arrived significantly earlier in Delaware Bay. These results suggest flexibility in migration strategies of Red Knots (“time selected vs energy minimizing”).

### **Towards an ecological underpinning of changes in abundance of Red Knots in the Dutch Wadden Sea and elsewhere along the East Atlantic Flyway**

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From the early 1970s, about 100,000 Red Knots *Calidris canutus islandica* wintered in the Dutch Wadden Sea. Over the last few winters, however, that number has declined to 20,000 or fewer. Numbers of the other subspecies using our flyway, *Calidris canutus canutus*, which winters in West Africa, approximately halved between 1980 and 1997, but since then that population has apparently stabilized. From our detailed ecological work in the Dutch Wadden Sea, we know that the relationship between the numbers of Red Knots and their food resources is particularly tight, and that the mollusc food of Red Knots has been in decline as a consequence of ongoing industrial (mechanized) cockle and mussel dredging. An intense colour marking scheme for both *islandica* and *canutus* knots has not been in place long enough to establish changes in survival and recruitment as a consequence of food resources. However, we believe that such work needs to have priority if we aim to understand the reasons for the steep declines in wader numbers occurring now in several parts of the world.

#### **Declines in East Atlantic wader populations: Is the Wadden Sea the problem?**

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Stroud *et al.* (2003) identified that some East Atlantic flyway wader populations which breed in the high arctic are in major decline, notably Bar-tailed Godwit *Limosa lapponica*, and two Red Knot populations *Calidris canutus* and *C. islandica*. These breed in different arctic and subarctic regions (Nearctic, Fennoscandia, Siberia) and winter on different parts of the Atlantic coast from W Europe to W Africa. However, other East Atlantic flyway coastal migrant populations are increasing: Grey Plover *Pluvialis squatarola*, Turnstone *Arenaria interpres*, Curlew Sandpiper *C. ferruginea*, Eurasian Oystercatcher *Haematopus ostralegus* and Ringed Plover *Charadrius hiaticula*. Similarly, these increasing populations breed in different arctic and subarctic regions (Iceland, N Europe and Siberia), and also winter on different parts of the Atlan-

tic coast from W Europe to W Africa – in the same wintering areas as the populations in decline. Therefore it seems unlikely that whatever is driving population change is occurring in either the breeding or wintering areas. Moreover, it is also unlikely that the effects of global climate change are currently substantially affecting these populations.

In Stroud *et al.* (2003) we speculate that the different trends may be linked to use of different spring/autumn staging areas, and noted that the Wadden Sea, the major staging area of the East Atlantic flyway, is used extensively for staging by populations in decline. This paper examines whether there is a link between the population status of the guild of East Atlantic migratory wader populations and the extent of their dependency on the Wadden Sea as their autumn and spring staging area.

Spring/autumn staging dependency on the Wadden Sea of the 28 East Atlantic wader populations using coastal habitats for wintering and/or staging were analysed in relation to population trends. Sources were Stroud *et al.* (2003) for trends and Meltofte *et al.* (1994) for the % of each population using the Wadden Sea and the draft Wader Flyway Atlas. The dependency of each population on the Wadden Sea was coded as 0, <33%, 34–66%, 67–99% or 100%. Seven populations were excluded from the analysis because they have an uncertain population trend and/or the extent of their Wadden Sea usage is uncertain. Of the 21 populations analysed, seven breed in the high arctic and 14 are sub-arctic and/or temperate breeders. For each population, the season (spring or autumn) of highest dependency was selected for analysis.

For sub-arctic and temperate breeders there was no relationship between Wadden Sea dependency and population trend. Most of these populations had low Wadden Sea dependency, and a wide range of population trends. Only the Eurasian Oystercatcher had a high dependency (and an increasing trend). However, for the seven high arctic-breeding, long-distance migrant populations there was a very strong link between declining trend and high dependency on the Wadden Sea ( $r^2 = 0.83$ ). For each of the four stable or increasing populations, less than a third of each depends on the Wadden Sea. In contrast, the three populations with high Wadden Sea dependency are in serious decline.

Why is the main problem occurring with high arctic populations? These populations make long distance non-stop flights and need abundant food resources for rapid major refuelling, especially in spring. They are also known to face migratory bottlenecks and to have low disease resistance (Piersma 2003 *WSG Bulletin* 100). Therefore they are likely to be most vulnerable to any change in their key staging area that affects their ability to feed and refuel at the necessary rate, and to depart with the necessary reserves to both migrate and survive severe weather in the arctic (Wilson *et al.* in prep.).

The Wadden Sea has had little recent intertidal habitat loss (land-claim), so has it changed in such a way that although the tidal flats are still available their quality has deteriorated? A major recent and well-documented change has occurred in the Dutch part of Wadden Sea arising from the intensification of shellfisheries. This is known to have decreased feeding opportunities for Red Knots (see e.g. the abstract of Piersma *et al.*). It is not clear whether there are other contributing factors affecting the Wadden Sea, but it may be that the recorded population declines are a reflection of a reduced overall capacity of the Wadden Sea to support wader populations at the critical times in spring and autumn.





Participants in the 2003 International Wader Study Group conference at Cadiz, Spain.

It is known that there are major pressures on key wader staging areas on other flyways, such as deteriorating food supplies in Delaware Bay, USA, and in SE Asia where there has been extensive land-claim of intertidal flats. Is there a similar link between declining population trends and key staging area dependency for arctic breeding waders on other flyways? This should be tested against the following predictions: if key staging areas are deteriorating or disappearing, then populations with high key staging site dependency will have a declining population trend. Also, there will be a stronger link for high arctic breeding populations than for sub-arctic/temperate breeders. Key staging areas on other

flyways to test could include: Black Sea/Mediterranean flyway – Sivash (Ukraine); W Asian/E African flyway – Arabian Gulf; E Asian/Australasian flyway – Yellow Sea; W Atlantic flyway – Bay of Fundy, Delaware Bay. On the Pacific coast of N America, there are many different staging sites, and the implications of habitat deterioration are less clear.

If the loss and deterioration of key stopover habitat continues and if its link with population declines is detected on different flyways, then the future for high arctic waders looks bleak, regardless of any added impacts of global climate change.



## **Covariation between long-term population variability, dynamic complexity and life-history traits in waders: a multi-species analysis**

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Recent analyses of ecological time-series have emphasised the strong pattern of covariation between demography, life-history characteristics and population dynamical patterns among several vertebrate species. Indeed, current evolutionary theory identifies a “slow-fast” continuum in this covariation, where highly variable populations with a recruitment- and stochastic-driven demography lie at one extreme, with largely stable, density-regulated and survival-restricted species at the other.

This study is based on a literature search for time-series of population counts of waders spanning at least 15 years. For each of the 14 time-series that met this criterion, I measured the coefficient of variation of population size through time, the dominant period of fluctuation, the amount of environmental stochasticity impacting on the dynamics, and the Lyapunov exponent of a response-surface model fitted to the data. Additionally, data on the morphology and sexual dimorphism of each species were gathered from the literature. Results suggest a negative relationship between body weight of waders and both the degree of population variability and its dynamic instability (as measured by the Lyapunov exponent). Moreover, the more variable populations were the most affected by environmental stochasticity, while the magnitude of density-dependence affecting the dynamics was larger for the least variable populations.

I found that populations of sexually dimorphic species tended to be more variable from year to year and show no characteristic period of fluctuation relative to monomorphic waders. Interestingly, these results suggest, in contrast to previous findings, that the population dynamical characteristics of waders can be predicted from morphological and behavioural traits alone, even in the absence of demographic information. In this sense, populations of small-sized, sexually dimorphic waders, such as *Calidris alpina*, are very variable inter-annually, show a high degree of deterministic dynamic instability, and are severely affected by environmental stochasticity. In contrast, populations of large monomorphic waders, such as *Numenius arquata*, are more stable, less variable from year to year, and are mainly affected by negative feedbacks in density. In addressing the current world-wide decline of wader populations, these results can be used, for instance, to predict the relative extinction risk of different species and to choose between different management strategies for threatened populations.

## **Is timing that crucial?**

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Arrival on a staging site may have large consequences in demographic terms. In this talk we present data from Delaware Bay on the east coast of the United States describing how turnover of Red Knot *Calidris canutus* occurred during the 2003 spring migration at Mispillion Harbor, one of the major staging areas in the bay. We then look to see if there is any evidence for changes in survival of Red Knot in relation to the predicted departure weight a bird could reach at the end of the spring staging period.

## **Growth rates of wader chicks: a comparison across the latitudes**

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In the altricial–precocial spectrum of chick development wader chicks exhibit the precocial mode of development, meaning that they leave the nest soon after hatching. The chicks of most wader species are self-feeding but some, such as oystercatcher (Haematopodidae) and thick-knee (Burhinidae) chicks, are parentally fed. Energy expenditure of parent birds raising self-feeding young may be less than that of birds that feed their young but the burden of collecting food is shifted to the chick. This results in greater energetic demands on the chick due to greater activity and the requirement for thermoregulation. As a possible result of higher energetic requirements, self-feeding precocial chicks may grow more slowly than parent-fed precocials. The rate of chick growth has been determined for several species in arctic and temperate zones. In the arctic and some temperate areas, waders are time and energetically stressed compared to species breeding in subtropical regions. Subtropical waders have extended breeding seasons and longer reproductive time spans; they exhibit slower growth and longer fledging periods than arctic relatives. In addition, in subtropical regions wader chicks have reduced energetic demands compared to arctic or temperate species due to the warmer ambient temperatures. Peak daily energy requirements are known to scale not only with asymptotic body mass, but are also negatively related to the duration of the fledging period. Growth rates of wader chicks across latitudes in relation to behaviour will be compared.



### Seasonal variation in habitat use and daily energy intake of Kentish Plover *Charadrius alexandrinus*: energy demand or re-distribution hypothesis?

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Traditionally, the breeding season has been considered a period of high-energy demand and as a bottleneck in the life cycle of an individual. However, this general consideration does not always apply. Although there are in the literature studies that reveal the existence of an increase in the daily energy intake during reproduction (energy demand hypothesis), other authors have found that such energy intake during the breeding period is not higher than energy intake during winter (re-distribution hypothesis). Furthermore, it has been proposed that there exists a seasonal variation in energy use associated with gender and each sex should confront these energy requirements in distinct ways behaviourally and/or physiologically. The aims of this study were: (1) to determine whether a seasonal variation between winter and breeding period in the daily energy intake exists in the Kentish Plover, and (2) to establish the foraging pattern of males and females in both seasons.

The study was carried out in an industrial salina (saltpan) and in the adjacent intertidal mudflats, in the Bay of Cádiz, Spain. The percentage of foraging birds in each zone, time allocated to feeding and intake rate were calculated in order to obtain the daily energy intake in winter and the breeding season. Although it was found that there was a different foraging pattern between genders, no differences in daily energy intake were found between seasons. During winter, both males and females behaved in a similar way, regarding foraging activity, and obtained a similar amount of energy. Nonetheless, in the breeding season females fed two hours less than males during daylight, spending less time foraging on the intertidal mud. Despite this different foraging pattern in the breeding season, our results support the "re-distribution hypothesis" for Kentish Plover in the Bay of Cádiz.

### Knowing wader feeding mechanisms better: a field-test analysis of Surface Tension Transport

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Margaret Rubega (*Auk* 110: 169–178) described a novel mechanism of prey transport employed by captive Red-necked Phalaropes *Phalaropus lobatus*: the surface tension of water. She showed that the same mechanism is also used by Wilson's Phalarope *P. tricolor* as well as two small sandpipers (Western Sandpiper *Calidris mauri* and Least Sandpiper *C. minutilla*). To date, however, there are no data on the use of Surface Tension Transport (STT) by birds in the field. In this study we carried out a field test to determine to what extent waders feeding on small prey use this mecha-

nism. We found that STT is commonly used by waders such as Black-winged Stilt *Himantopus himantopus*, Curlew Sandpiper *C. ferruginea*, Sanderling *C. alba* and Little Stint *C. minuta*.

### The role of waders and other waterbirds in the dispersal of aquatic plants and invertebrates

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Although, almost two centuries ago, Darwin suggested that waterbirds are important to the dispersal of aquatic plants and invertebrates and despite the fact that bird-mediated transport is crucial to our understanding of the structure and composition of aquatic communities, little attention has been paid to this topic by waterbird researchers. This is especially true in the case of waders.

We review current evidence that waders and other waterbirds are responsible for transporting aquatic organisms attached externally to their bodies or inside their guts. Intact seeds are commonly reported in the pellets and droppings of waders. Eggs and seeds were found attached to the feathers and legs of a high proportion of waterbirds trapped in the Doñana area of Spain (35% to 100% depending of locality). These data therefore indicate that bird-mediated transport is frequent, at least at a local scale, such as within a wetland.

A comparison of the genetic structure of four species of North American invertebrates with waterfowl movements estimated from ring-recovery data gives further support to the crucial role of waterfowl in explaining the invertebrates' population structure at a continental scale. However, more information is needed on the impact of bird-mediated transport on the population structure of aquatic organisms and on the spread of alien species.

### The importance of the Netherlands as a staging area for Icelandic Black-tailed Godwits *Limosa limosa islandica* during spring-migration in 2001 and 2002

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Until the early 1990s, the Icelandic Black-tailed Godwit was a scarce and not very well known subspecies in the Netherlands. An investigation during 1984–1992 showed an increase in numbers during spring with a maximum of 630 birds in 1992 (Scheepen & Oreel 1995). Of these, most (460) were using the mudflats of the Wadden Sea near Wieringen, Noord-Holland. Because we both noticed a strong increase of the numbers of Icelandic Black-tailed Godwit in our study areas (Wieringen and the river IJssel), in 2001 we organised five spring counts at the best-known Dutch spring staging sites (29). However, foot and mouth disease made it impossible to count some important areas in that year. Therefore a more complete census was organised in spring 2002, when



seven counts were carried out at 44 locations. In spring 2001, Icelandic Black-tailed Godwits were found at 72% of the sites during one or more counts. The maximum number of birds (3,015–3,556) was counted on 31 March/1 April. Regular counts at one of the key sites (Wadden Sea coast of Wieringen) showed that almost 50% of the birds had arrived by mid March. In March and April 2002, birds were seen at 98% of the counted spring migration sites, and again the maximum (6,758–9,811) occurred over 31 March/1 April. These totals show that at the peak of spring migration in 2002, 19–28% of the subspecies population used the Netherlands. This was a surprise that had not documented before. These figures show that in the last ten years the Netherlands has become a major staging area during spring migration. Most birds use coastal areas but large numbers also use flooded grasslands. Resightings of individually colour-marked birds allows estimation of residence time and site faithfulness. Along the river IJssel in spring, Icelandic Black-tailed Godwits stayed on average for 12 days with a maximum of 37 days. Inter-annual resightings of the same individuals were recorded both on Wieringen (up to seven subsequent years) and along the river IJssel (up to three years).

### Non-breeding surveys of terrestrial waders – why and how?

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Autumn migration patterns and the winter distribution of open-habitat inland waders were identified as gaps in knowledge 16 years ago. I will discuss how these gaps remain for Eurasian Golden Plover and Northern Lapwing in north-west Europe. Particularly as, against a background of changing climate and modified farmland landscapes, shifts in distribution and habitat use may be evident in Britain and northern Europe. I suggest that there is a need for internationally-coordinated surveys and ecological studies of these species in autumn and winter to estimate abundance, identify key sites and migration routes and understand the timing of migration.

### A stable isotopic search for the Slender-billed Curlew

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The Slender-billed Curlew *Numenius tenuirostris* is among the most endangered bird species on earth. The International and European Action Plans for the species agree that the primary requirement for its conservation is to locate the breeding grounds. The breeding range has never been mapped, and only one nest location has ever been described. The potential range – as suggested by experts – covers a vast area, and several biomes, from steppe to tundra. Ground-searches have hitherto failed to locate any Slender-billed Curlews, despite substantial cost. In a novel approach to the problem, we aim to narrow the search for the breeding and

moulting areas, and shed light on other aspects of the species' ecology, by using stable isotope analysis of museum skins. We describe the project's rationale and methods, and report some preliminary results from stable isotopic analyses of Slender-billed Curlew museum-skin feathers.

### Where should Kentish Plover parents raise their young?

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Most waders are precocial, and thus they are expected to rear their young in a habitat that is safe from predators and/or provides resources for the developing offspring. If the costs and benefits of rearing the brood in a habitat change over time, then the parents are expected to move with their young between habitats. We investigated these propositions in the Kentish Plovers *Charadrius alexandrinus* that reared their broods in two habitats at our field site in southern Turkey: in saltmarsh and on a lakeshore. We present data on changes in the time spent in the two habitats as the season progressed and relate this to habitat-specific changes in food abundance and bird density with season. Our results are consistent with the notion that changes in the ecology of the brood-rearing habitat resulted in the movement of families between habitats, which in turn influenced the parental behaviour of the plovers.

### The influence of rainfall on the behaviour of wintering Northern Lapwings and Eurasian Golden Plovers in southern Portugal

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Northern Lapwings *Vanellus vanellus* and Eurasian Golden Plovers *Pluvialis apricaria* are widely distributed in southern Portugal in the winter due to high availability of suitable habitat. In this study, we investigated patterns of habitat use, as well as the diet and the behaviour of these birds in varied farming systems and under different rainy conditions.

The percentage of land units used by the birds was greater in dry winters than in wet winters. Lapwings used more land units than Golden Plovers. Lapwings fed in a greater range of the available habitats than Golden Plovers, which preferred to feed in pastures. Lapwings seem better suited than Golden Plovers to spend the winter in southern Portugal due to their ability to use a wider range of habitats.

The Lapwings' diet is mainly earthworms, which are widespread and abundant and are consumed whenever they were available. In contrast, earthworms are less important in the diet of Golden Plovers, being replaced by arthropods and gastropods. Generally the ingestion of prey associated with damp habitats, like earthworms and dipteran larvae, is lower during dry winters. In both species, those prey are replaced by adult arthropods and gastropods. In wet winters, both species occur in similar numbers at coastal and inland sites. In these circumstances intra- and inter-specific compe-



tion is lower and the birds occur in larger flocks. On the other hand, in dry winters the birds tend to concentrate in the most favourable coastal areas. Prey shortage leads to more agonistic behaviour and flocks are smaller. In relation to feeding behaviour, we find two different scenarios: wet winters, with less time spent feeding, and dry winters, with more time spent feeding.

Large-scale intensification of agriculture and climate change are together having a major negative effect on Portuguese farmland as wildlife habitat. These changes could be responsible for a long-term decline in the capacity of the land to support Lapwing and Golden Plover populations. The wintering strategies of Golden Plovers are less dependent on wet soils than those of Lapwings, but much more dependent of a single habitat, pastures. In drier winters, Lapwings face food scarcity and greater competition. In these winters, smaller flocks, more time spent feeding and a greater incidence of night feeding suggest that Lapwings need to increase the intake rates. This may mean that in dry winters Lapwings have difficulty obtaining enough food to assure winter survival, to migrate and breed.

### Algal mats and foraging wading birds: is foraging in a green environment profitable?

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In Western Europe, green macroalgal mats may develop in sheltered bays and estuaries during spring and reach high levels of cover and biomass during the summer before breaking down in autumn or early winter. A consequence of organic enrichment (eutrophication), algal mats are known to have profound effects on the underlying sediment chemistry with subsequent negative effects on benthic invertebrates. This paper presents the results of a three-year study at Clonakilty Bay, West Cork, Ireland (2000–2002).

The study aimed to examine the effects of algal mats upon wintering waders at two levels. The questions addressed were firstly, when present, did algal mats appear to exert any influence on the distribution of foraging waders? Secondly, following the algal mat breakdown, how successful or profitable could foraging be, within such previously impacted areas? Detailed foraging studies were carried out at six sites between August and February of the winters 2000/01 and 2001/02. Results are presented for Black-tailed Godwit *Limosa limosa* and Redshank *Tringa totanus*.

When a patchy algal mat coverage was present, foraging Black-tailed Godwits and Redshanks showed a distinct preference for clear patches of sediment. Black-tailed godwits took significantly more foraging actions within clear patches, although there was no significant difference in the number of steps, swallows or foraging success between patches with and without algal mat. In contrast, Redshanks swallowed more prey and achieved a greater foraging success within clear patches in comparison with algal-covered patches. Measured foraging parameters of Black-tailed Godwits and Redshanks exhibited both spatial and temporal variation but analysis revealed no significant negative relationships with either algal cover or algal biomass.

A major difference between Black-tailed Godwits and Redshanks was the difference in their foraging success and estimated prey biomass intake rates. Black-tailed Godwits achieved a prey intake rate comparable with other studies, whereas Redshanks foraging within algal mat areas were unlikely to meet daily energy demands. Biomass intake (mg ash-free dry weight) of both Black-tailed Godwits and Redshanks were positively correlated with the densities of *Hydrobia ulvae*. Increases in the densities of this mud snail and the amphipod *Corophium volutator* in the months following algal mat breakdown appeared important in partially offsetting the negative effects of algal mats.

### Different breeding origin of migrating and wintering Dunlin *Calidris alpina* at Portuguese estuaries – evidence from morphology, ringing recoveries and mtDNA

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Migratory connectivity plays a major role in conservation of long-distance migrants. Here, we studied links between breeding and wintering areas of Dunlin *Calidris alpina* populations that use Portuguese estuaries during migration and winter. We combined three methods (ringing recoveries, morphometrics of genetically sexed birds, and mitochondrial DNA markers) for assessing breeding origins and migration routes, revealing different aspects of the migration pattern.

Recoveries show clear differences in migration routes of Portuguese Dunlin between seasons. In August and September, recoveries originate mainly from stopover sites in Great Britain, showing links to breeding areas in Iceland and Greenland. In October, and the winter months, a clear shift to more eastern migration routes occurs, with recoveries from stopover sites in the Baltic Sea and in the migratory direction of breeding populations from N Scandinavian and N Russia.

Consistent with the ringing recoveries, morphological data show significant differences between wintering populations and migrants. In autumn, shorter morphological measurements indicate birds of more western breeding origin, whereas larger birds during winter resemble eastern breeding populations in N Russia.

In addition, we used mitochondrial DNA haplotype frequencies to estimate the breeding origin of the populations. In breeding populations on the East Atlantic flyway, two mtDNA haplotypes occur (European and Siberian), and the frequency of the European haplotype decreases gradually with the longitude of the breeding zone. In Portugal, all spring and autumn migrants had European haplotype, corresponding to the subspecies *C. a. schinzii* and *C. a. arctica*, while the wintering population had 21% of Siberian haplotype, which is similar to N Russian populations of the nominate subspecies.



**The effect of weather and tide on the intake rate of Eurasian Oystercatchers *Haematopus ostralegus***

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For the Eurasian Oystercatcher *Haematopus ostralegus*, a single low water period of normal duration is not sufficient to meet daily energy requirements (Zwarts *et al.* 1996). From experiments it is known that captive Oystercatchers are able to increase their intake rate when exposure times are reduced (Swennen *et al.* 1989). In this field study, we investigated the prediction that free-living Oystercatchers will increase their intake rate after a period of reduced feeding opportunities.

Behaviour observations were made of a population of colour-banded Oystercatchers, foraging in a bay on the Wadden Sea island of Texel during the winter. Variation in intake rate was analysed within individuals and exposure time was used as a measure for potential foraging time.

There was no significant effect of any of the temperature parameters on the intake rate, neither was there any detectable effect of the potential foraging time at the moment the observation was made. However, there was a significant positive relationship between the intake rate and the average length of the potential foraging time during the two days preceding the observation.

This leads to the conclusion that, after a period of reduced foraging time, Oystercatchers have a lower intake rate than after a period of good feeding opportunities. This is opposite to the expectation, and we present several possible explanations for this effect.

**Waders in the new edition of the Red Data Book of Belarus: current numbers, trends and distribution.**

Edward Mongin

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The Red Data Book is the legislative document for wildlife preservation in Belarus. New criteria for including different taxa of animals in the protection list were developed in the Institute of Zoology NAS in the course of preparing the new Red Data Book. Waders are among the more vulnerable groups of birds because their habitats are threatened as a result of human activities. In Belarus, 24 species of waders breed and half of them need protection. The new edition of the Red Data Book will include 15 wader species that are afforded different categories of protection. Great Snipe *Gallinago media*, Ruff *Philomachus pugnax* and Black-tailed Godwit *Limosa limosa* are new species included in the list of protected animals for the first time. Work carried out during preparation of the new Red Data Book included summarising and collating recent data on numbers, trends and distribution of waders in Belarus. Among the protected species, the populations of Whimbrel *Numenius phaeopus*, Curlew *Numenius arquata* and Greenshank *Tringa nebularia* have been stable over the last ten years. Eurasian Oystercatcher *Haematopus ostralegus*, Ringed Plover *Charadrius hiaticula*,

Eurasian Golden Plover *Pluvialis apricaria*, Marsh Sandpiper *Tringa stagnatilis* and Terek Sandpiper *Xenus cinereus* have increasing numbers. However, the populations of Stone Curlew *Burhinus oedichnemus*, Great Snipe, Black-tailed Godwit and Ruff have declined considerably during the past 50–70 years. Jack Snipe *Lymnocyptes minimus* is a secretive species that probably breeds in Belarus only sporadically. There are single instances of breeding by Dunlin *Calidris alpina* and Black-winged Pratincole *Glareola nordmanni*.

**The relation between body condition and intake rate in free-living Eurasian Oystercatchers *Haematopus ostralegus***

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Optimal foraging theory presumes that organisms are perfectly adapted to their environment and will forage in a way that maximizes their fitness. As fitness is hard to measure directly, a measurable currency that relates to fitness is used. Instantaneous intake rate is an important factor in maximizing foraging efficiency (Charnov 1976) and is used as such a currency. However, it is also difficult to relate intake rate directly to fitness. A possible solution for this problem is to relate intake rate to another indirect measure of fitness, body condition. Here we present the results of a field study on the relationship between instantaneous intake rate and body condition in Eurasian Oystercatchers *Haematopus ostralegus*.

During the winter of 2002/2003, free-living oystercatchers were captured at various sites in the Dutch Wadden Sea. The biometrics and blood composition (white and red blood cells) of the birds were measured in order to determine their body condition. After release, their foraging behaviour was studied in their natural environment. The relationship of body condition and intake rate was analysed for between sites and within sites.

A positive association was found between body condition and intake rates between sites (i.e. body condition was better on sites where intake rates were higher), but on an individual, within-site level this relationship was negative (i.e. body condition was better in birds with lower intake rates). This contradiction between the site and individual levels gives rise to an interesting insight in the spatial distribution of Oystercatchers on the mudflats in relation to condition, intake and survival.

**Records of the Slender-billed Curlew *Numenius tenuirostris* in Bulgaria during the last ten years (1993–2002)**

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Almost every year, the World-threatened Slender-billed Curlew visits Bulgaria, which offers favourable places for



resting and feeding during its migration between the unknown breeding grounds in Western Siberia and the distant wintering grounds in Morocco. During the last ten years the species has been recorded in Bulgaria 63 times with an aggregate total of 178 birds (though almost certainly not that number of individuals). Numbers appear to follow a 3–4 year cycle, as the birds were most numerous (33–72 birds) in 1993, 1996 and 1999. Most observations have been of single birds, but in the peak years mentioned there were flocks of 10, 9 and 15 individuals respectively. Lakes Atanasovsko and Pomoriisko are the most important sites having provided 74.2% and 14.6% of Slender-billed Curlew records for the country. The species is more regular and numerous (82.6% of birds recorded) during spring (March to May) than in autumn. It is more numerous and remains longer in Bulgaria during cool, rainy springs. The autumn migration is on a much smaller scale. Single birds have remained on some Bulgarian reservoirs in summer, as well as in autumn. Recent studies in Bulgaria, as well as in other countries, confirm our previous conclusions (Nankinov 1998) that, although there are fluctuations from year to year, the number of the Slender-billed Curlews is increasing slowly and hopefully its population will become stable.

**Breeding of African Black Oystercatchers  
*Haematopus moquini* at Koeberg Nuclear Power  
Station and Dyer Island: a comparison between a  
mainland site and an island with no alien predators**

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During the 2002–03 nesting season, the breeding productivity of African Black Oystercatchers *Haematopus moquini* was monitored at two study sites. One of these, at the Koeberg Nuclear Power Station, 30 km north of Cape Town, had 37 breeding pairs of oystercatchers, which produced 10 fledglings (0.3 fledglings/pair). This site consists of a sandy shore and an artificial rocky shore inside a sheltered harbour which acts as the “settling pond” to the cooling water intake of the power station. Common predators here include Yellow Mongooses *Cynictis penicillata*, Pied Crows *Corvus albus*, Sacred Ibises *Threskiornis aethiopicus* and Kelp Gulls *Larus dominicanus*. At the other site, Dyer Island (55 km west of Cape Agulhas, area 20 ha, shoreline 2.5 km), 21 pairs of oystercatchers bred and produced 18 fledglings (0.9 fledglings/pair). The island’s shoreline consists of exposed rocky shore; there are no introduced mammalian predators on this island and Kelp Gulls are the only avian predator. Various aspects of breeding productivity are compared between these two sites.

**Spatial and temporal fluctuations in use by  
shorebirds and in availability of chironomid prey  
in the Odiel salt pans, southwest Spain**

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The Odiel Estuary in southwest Spain is protected as a Natural Park, Biosphere Reserve and Ramsar site and is one of the major sites on the East Atlantic flyway for shorebirds and other waterbirds. Tidal marshes (6,000 ha) and salinas (= salt-pans) (1,100 ha) are the major habitats used by shorebirds in the estuary. The importance of the salinas as feeding habitat increases during the spring and autumn migrations, when we have recorded up to 10,000 shorebirds using them at any one time. We present details of the variation in availability of chironomid larvae prey in the salinas according to season, situation and salinity during 2001. We show how this variation relates to differences in the importance of the salinas as feeding habitat for different shorebird species in the spring and autumn migration periods.

**Eggs in the fridge: nest site choice and nest  
scrape design in tundra shorebirds**

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Living in the arctic entails high thermostatic costs and these extend to maintaining egg temperature during incubation. Energy expenditure of arctic-breeding shorebirds during incubation is about 50% higher than that of temperate-breeding birds, and approaches physiological limits to energy expenditure in small species (*Funct. Ecol.* 17: 356–362). Hence, arctic shorebirds, and especially small ones, may be expected to show behavioural adaptations that reduce the cooling rate of eggs. Recently, Reid *et al.* (*Funct. Ecol.* 16: 305–312) quantified the significance of several heat-conserving features of Pectoral Sandpiper *Calidris melanotos* nest scrapes.

We collected data on nest distribution, scrape dimensions and composition of nest lining material in six wader species breeding in NW Taimyr, Siberia (ordered by size these were: Little Stint *C. minuta*, Red Phalarope *Phalaropus fulicarius*, Dunlin *C. alpina*, Curlew Sandpiper *C. ferruginea*, Ruddy Turnstone *Arenaria interpres* and Pacific Golden Plover *Pluvialis fulva*). Nests were often located on south-facing slopes which have a favourable microclimate. There was a tendency for small shorebirds to make deeper scrapes than



the larger species and to apply them with a thicker layer of lining material. Little Stints deposit 1,000–2,000 willow leaves in their nest scrapes, by throwing them in one by one. At similar distances from the permafrost (no difference between species), thicker nest floor lining reduces clutch heat loss to the ground. Small species also tended to have a higher nest cup depth to diameter ratio, which results in a reduced sensitivity to the cooling effect of wind. Little Stints further used nest-lining material with better insulative properties than lining used by Turnstones and Golden Plovers, with medium-sized species selecting intermediate-quality materials. A quantitative integration of these differences indicates that heat loss from objects in nests increases with species body size in this shorebird assemblage, and thus supports the prediction that small shorebirds invest more than large species in their thermal incubation environment. Potential constraints and interactions due to species differences in habitat preference and parental care are discussed.

### **Wader nesting success and rodent abundance in the Arctic: testing prey-switching hypothesis at a super-regional scale**

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In a number of studies, prey-switching by predators has been shown to be an important factor determining the nesting success of tundra birds, including waders. However, this relationship has never been analysed at a scale wider than a single region due to a lack of the data needed for formal quantitative processing. We used data for the 11 years, 1992–2002, accumulated in the framework of the Arctic Birds Breeding Conditions Survey (IWSG project) to study the temporal and spatial variability of the relationship between wader nesting success and rodent abundance as well as to interpolate nesting success information across the ranges of selected wader species. Missing data on rodent abundance were reconstructed for a proportion of samples based on the assumption that population peaks are very likely to be followed by population depression.

A general linear model linking rodent abundance and wader nesting success was established that took into account the variation in data quality. This showed a significant linear relationship between these parameters. This relationship was then used to predict wader nesting success for localities for which information was missing. Wader nesting success was interpolated for the whole circumpolar arctic region for each year from 1992 to 2002 based on the original and estimated data values. Comparison of nesting success across the ranges of some wader species and flyway populations with the proportions of juveniles on wintering grounds revealed significant correlations. This supports the validity of the methods chosen for modelling wader nesting success at a super-regional scale. However, these methods did not account for a substantial part of the environmental variation related to climatic conditions. Poor data coverage in some regions did not allow the making of any reliable interpolation. This shows the importance of expanding the information network further in order to raise the analysis to a global level.

### **Breeding systems of waders**

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Waders exhibit some of the most diverse breeding systems among all birds. Immense variation exists both within and across species. I will overview recent phylogenetic comparative studies, and ask how ecology, life-history and developmental mode of the young have influenced their mating system and parental care. I will also investigate the determinants of sexual size dimorphism and plumage patterns. Finally, I will discuss some of the main unresolved questions where progress should be made. Taken together, waders are excellent model organisms for elucidating the evolution of avian breeding systems, and much remains to be learnt about their behaviour.

### **Interspecific variation in mercury contamination between Black-winged Stilt *Himantopus himantopus*, Kentish Plover *Charadrius alexandrinus* and Avocet *Recurvirostra avosetta* chicks in southwest Europe**

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The main objective of this study was to investigate variation in mercury contamination in three wader species feeding on macroinvertebrate communities in salt pans. Chick feathers were collected from Black-winged Stilts *Himantopus himantopus*, Kentish Plovers *Charadrius alexandrinus* and Avocets *Recurvirostra avosetta* at Ria Formosa, the Guadiana estuary and Cadiz Bay. Samples were taken during the breeding seasons of 2000–2003. Mercury concentrations were determined by cold vapour atomic absorption spectroscopy.

Significant differences in total mercury concentration were observed between Kentish Plover and the other species. Moreover Kentish Plover showed the highest mean mercury concentration (e.g. Esperanza in Cadiz Bay: 3.64 ppm; Marim in the Guadiana estuary: 4.67 ppm; Tavira in Ria Formosa: 1.94 ppm). Interspecific variation in mean mercury levels was explained on the basis of differences in habitat use. Avocet and Black-winged Stilt chicks feed mainly on macroinvertebrates available in salt pan ponds. However, Kentish Plover chicks feed on both terrestrial and aquatic invertebrates from a large range of sites in and around the salt pans, including roads and pond walls. Therefore they can be contaminated by mercury from several different sources. Avocet chicks use only a small range of feeding habitats in the salt pans and this probably accounts for the fact they were found to have the lowest variation in mercury levels. Although Black-winged Stilt chicks feed mostly in water, they also take terrestrial food from the edges of the salt pans, particularly insects from among plants and wet soils. This probably explains the higher variation in mercury levels in Stilts compared with Avocets. Significant inter-site variation was



observed in mercury levels in all three species but no significant correlation was observed between species. This can also be explained on the basis of the species' different habitat usage.

### **Pipping at peak time: how well synchronised is hatching with food abundance in arctic chicks?**

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The prime food resource for the chicks of arctic-breeding shorebirds is surface-active arthropods. The arctic summer is short and breeding must be well-timed to enable the young to grow fast enough and fledge before winter sets in. Thus, a close match between the growth period of the chicks and the seasonal pattern of abundance of the food supply is paramount for successful reproduction. This is particularly the case under arctic circumstances, much more so than at lower latitudes where food peaks are more spread. We evaluate the hypothesis that breeding is timed to allow the chicks to grow up during the peak period of the food supply. Our studies are based on data relating to the phenology of both surface-active arthropods and breeding shorebirds.

Concurrent with breeding bird studies, arthropod abundance was measured during three expeditions to the Taimyr peninsula in the Russian Arctic. Variation in seasonal patterns of abundance was large and can be attributed to weather and season-related variables. In two of the three years, the timing of the shorebird breeding season appeared to be late compared with the food peak: chicks hatched on the decreasing slope of the food abundance curve. However an earlier start of breeding in these years was impossible, because egg-laying took place almost immediately after snow had disappeared. On the basis of the close relationship between weather and season and arthropod abundance, we utilised our field data to model food abundance using a 30 year weather dataset for the same area. Over the 30-year period, peak abundance dates ranged from 10 July to 1 August, but in most years, occurred around 17 July. In our three-year study, all median hatching dates were before 23 July and, in most species, all nests hatched within a two-week period. This therefore contradicts the conclusion of our three-year study that chicks hatch too late. It appears that hatching is well synchronised with food availability when looking at the long-term average. However, the 30-year data does show a trend towards more variation in the timing of food abundance and a longer season. Possibly this has been induced by climatic change. Therefore the number of years in which hatching and food abundance are ill synchronised is likely to increase.

### **The p-value culture, and other statistical problems**

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The way in which statisticians “do” statistics is moving away from a primary concern about formal statistical significance, a way of operating which is now known, disparagingly, as the “p-value culture”. In its place is coming a paradigm which states that a result must not only be demonstrated to be statistically discernable, but must also be demonstrated to be biologically consequential. The talk will also consider other practical statistical issues, such as the importance of measuring variability, and will be illustrated by examples using waders and data collected on waders.

### **Choice of meadows for feeding in Ruffs, spring staging in The Netherlands: a pilot study**

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From late February until early May ca. 50,000 Ruffs *Philomachus pugnax* stopover in the Province of Fryslân, in the north of the Netherlands, making it a major staging site in Western Europe. During their stopover, Ruffs refuel on a (presumed) diet of earthworms, leatherjackets and insects found in grassland meadows. At the same time, they moult into their wonderful breeding plumage. The much smaller females arrive later than the males and are relatively scarce compared with staging sites in Central and Eastern Europe. We studied choice of feeding sites (meadows) by Ruffs and Reeves and tried to relate meadow characteristics to use. We chose 125 meadows that varied in grassland type, agricultural use and landscape characteristics. In these meadows, Ruffs and Reeves were counted weekly between 1 April and 2 May 2003. The foraging behaviour of the birds, which fed either on buried prey or surface insects, was described by counting peck, probe, pace and intake rates. Whenever possible, a male and female feeding close to one another were observed sequentially and these observations were considered as paired.

Ruffs used about 50% of the meadows we studied. Sward height and distance to the nearest roost were the most important characteristics explaining variation in usage. Also important were vegetation type, fertilising intensity, and, to a lesser extent, openness of the landscape, drainage level and soil type. Water coverage, relief, presence of grazers and the fertilisation method were of no importance. In general, Ruffs



preferred to feed in meadows close to a roost, with low vegetation comprising grass mixed with herbs, either on a sandy or clayey soil, with an intermediate drainage level and in a more or less open landscape. Recently fertilised fields were highly attractive but scarce. The number of Ruffs feeding in meadows varied only with date (numbers decreased, as did overall numbers staging) and time of the day, as birds take siestas on roosts in Lake IJsselmeer. In the course of April, the proportion of birds feeding on insects increased. Females had lower prey intake rates than males, but higher pacing rates and equal pecking and probing rates. We suggest that aspects of feeding behaviour and feeding site choice can account for the rather different migration routes taken by each sex.

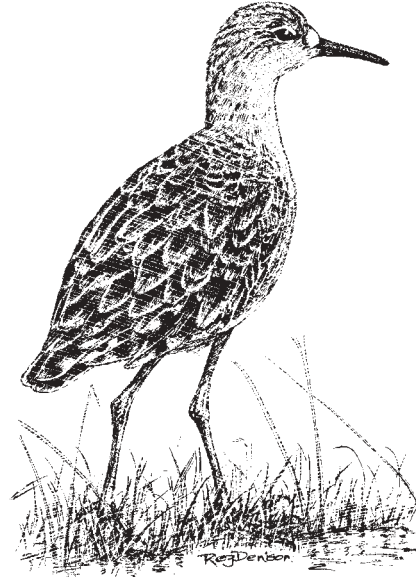
### Breeding biology of the Stone-curlew in intensive agriculture habitat: a seven year study

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The Stone-curlew *Burhinus oedicnemus* uses three habitats in France: steppe areas, vineyards/fruit plantations, and agricultural habitat. Very few data are available from this latter habitat, although most of the French population occurs in cultivated landscapes. Here we present results from a seven-year study (still ongoing) on a very large study site (340 km<sup>2</sup>)

in central western France. This study site still holds a high density of Stone-curlews (total population: about 300–400 pairs). We present data on habitat selection, spatial distribution of pairs, breeding biology, breeding success and population trends. We discuss these results with regard to trends currently affecting agricultural habitat in cereal plains in France (and Europe), and discuss some management and conservation issues for this species.



## Annual Conference – Abstracts of posters

During the conference, Petra de Goeij organised the usual poster competition and participants voted for the one they preferred. The results were:

- ❑ **1st prize: Neap-tide roost selection by waders: maximizing feeding opportunities or reducing risks of predation?** by Susana M. Rosa, Ana Encarnação, José P. Granadeiro & Jorge Palmeirim
- ❑ **2nd prize: Assessing the use of mudflats by waders: bias due to the response of birds to the tidal cycle** by Maria P. Dias, Ricardo J. Martins, José P. Granadeiro & Jorge M. Palmeirim
- ❑ **3rd prize: Predation of horseshoe crab eggs by migratory shorebirds in Delaware Bay, USA** by S. Gillings, P. Atkinson, R. Robinson, R. Stillman, R. Weber & S. Love

### Coping with heat-stress during incubation: the influence of water proximity on nest desertion by Kentish Plovers *Charadrius alexandrinus*

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Kentish Plovers *Charadrius alexandrinus* are small shorebirds that readily nest on exposed sites in hot environments, where air temperatures at ground level may be >45°C dur-

ing the hottest parts of the day. In these environments, leaving a nest unattended even for a short period may compromise nesting success. We examined whether the probability of nest desertion was affected by proximity to water. We found that this was the case. Nests located close to water were deserted less frequently (39.0% of 346) than nests located far from water (57.6% of 118). This was so in spite of the nests located close to water being more frequently placed in exposed sites (62.4% of 346) than were the nests in sites far from water (51.7% of 118). It seems likely that susceptibility to thermal stress changed in relation to proximity to water because in sites close to water it was possible to belly-soak, which would allow a more continuous nest attendance.



## Evaluation of human impact on the use of the Cádiz Bay marshes by waders: application of Geographical Information System

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Management of the bird populations of the Natural Park of the Bay of Cadiz as a natural resource is a complicated process in which a whole range of factors have to be considered. In this work we have tried to reconstruct the evolution of the habitats of the wetland birds over the last 50 years.

During 2001/2002, the wintering population of all wetland birds combined was 72,886 individuals of 70 species and the breeding population, 3,140 pairs. The largest proportion of these birds used the salinas (saltpans) where average densities reached 27.0 indiv/m<sup>2</sup> in 1996 and 31.0 indiv/m<sup>2</sup> in 2002. Although the traditional salinas are falling into disuse or being converted for other purposes, they are areas of great importance for both wintering and breeding wetland birds.

The other main land-use in the Bay of Cadiz is extensive aquaculture and these areas are used by 44% of the breeding bird populations and 52 % of the wintering populations and are important feeding areas for birds. However, the development of intensive aquaculture (1125 ha) and the abandonment of salinas (1502 ha) have negatively affected many bird populations.

The results of this study represent a considerable asset for the conservation of the whole of the Cadiz Bay Natural Park because we now have accurate, spatially-referenced and up-to-date information offering a synoptic view of each part of the bay that allows us to identify the most sensitive and vulnerable areas.

## Rescuing the Sociable Plover is an international problem

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In the 19th century the Sociable Plover *Vanellus gregarius* died out in the Ukraine. In the 20th century it practically disappeared from Russia. Now it is under threat of disappearance in its last stronghold, Kazakhstan (Intern. Act. Plan 2002). My analysis of the reasons for its disappearance has revealed the following main factors (Belik, in press): (1) Ploughing of virgin steppes during the 19th and 20th centuries; (2) Increased numbers of Corvids resulting from artificial afforestation and their intensive predation on plovers during the second half of the 20th century; (3) Recent humidifying of the steppe climate and spread of tall grasses across the steppes; and (4) The economic crisis in Russia and Kazakhstan since the early 1990s, which has led to a reduction of number of cattle and therefore reduced grazing and

taller grass in the steppe pastures. Taking into account the very low numbers of Sociable Plovers and current trends, the species could become extinct within the next few decades. The usual methods of bird protection, such as legislative protection, creation of reserves etc., cannot help the Sociable Plover in Russia and Kazakhstan, as they do nothing to restore its habitat. Therefore possibly the only way to rescue the species is through its artificial resettlement in regions where suitable conditions for breeding still exist. One of such country could be Spain with its dry summer climate, extensive pastures, very low number of Corvids, and where ecologically similar steppe species live in safety.

## Habitat choice and breeding success of Northern Lapwing *Vanellus vanellus* in the Marais de Brouage, western France

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Aspects of the breeding biology of the Northern Lapwing were studied from 1990 to 2001 in western France in a 12,000 ha wetland area. Trends in Lapwing numbers showed an increase between 1990 and 1995, followed by a period of stability. Habitat selection studies revealed a recent and strong tendency for breeding on arable land (c.15 % of the area) versus pastures (c.85 %), with 60% of nests or colonies in Maize fields. Vegetation height in Lapwing colonies at the time of settlement in the breeding areas was on average 4.5 (±6.1) cm (n = 145 colonies), and varied significantly between years and habitat type (pasture versus arable). Lapwings strongly selected fields that had lower vegetation height than random control fields. They also significantly avoided grazed pastures, with 8 % of colonies in grazed pastures at settlement compared to 62 % in grazed pastures over the whole breeding season. Between 1998 and 2001, vegetation height on control pastures increased, and this was apparently related to a decrease in grazing pressure, resulting from a decreasing percentage of grazed fields, and a lower stocking density for those fields that were grazed. First settling date was on average 28 March, but this varied significantly with year. Hatching success depended significantly on habitat, being higher in pastures (75 %, n = 40 nests) than arable land (56%, n = 124 nests). The main cause of failure was agricultural work in arable land and to a lesser extent, predation at the egg stage. The average number of fledglings per successful pair varied between 1.27 and 2.0 over the years, a variation less than overall productivity, which ranged from 0.32 to 0.86. This suggested that breeding failure occurred mostly during incubation and/or during the early chick-rearing period. Lapwing population productivity in this study site, is less than the expected value for a sustainable population (0.8 to 1).



### Melanin-based plumage colouration and flight displays in plovers and allies

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Plovers and allies exhibit an impressive diversity of melanin-based plumage patterns ranging from non-melanised to completely melanised species. We used phylogenetic comparative methods to test whether melanisation has evolved in relation to sexual selection for attracting mates, or in relation to selection for signalling territory defence, or in relation to natural selection for camouflage.

According to sexual selection theory, melanised plumage may have evolved to amplify the courtship displays of males. As predicted by this hypothesis, we found that males with aerial displays had more melanised plumage than males of ground-displaying species. In addition, sexual dimorphism in melanisation was greater in species with display flights than in species with ground displays.

Alternatively, melanisation may have evolved through social interactions to signal competitive ability in territory defence. We did not find evidence for this hypothesis, since breeding density was unrelated to the melanisation of either sex.

Finally, melanised plumage may camouflage the incubating parent. The latter hypothesis was not supported, since melanisation was unrelated either to the darkness of the nest substrate, or the extent of vegetation cover.

Taken together, our results are most consistent with the sexual selection hypothesis, and suggest that melanised plumage has evolved to enhance the aerial displays of male plovers.

### Chick energetics of African Black Oystercatchers *Haematopus moquini*

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Many studies have focused on the energetic requirements of birds during incubation and chick rearing in a range of positions on the altricial–precocial spectrum. In altricial species the chick-rearing period is often the most energetically expensive period for adult birds because food needs to be collected and transported to the nestlings. In most species of the sub-order Charadrii, the chicks are precocial and the burden of collecting food is shifted to the chicks resulting in greater energy requirements for activity and for thermoregulation and, thus, greater energetic demands. The oystercatchers Haematopodidae are exceptions, in that the chicks hatch as

developed as other charadriid chicks, but are parent-fed, because the prey capture and handling process is too complex for the chicks. The burden of collecting food is shifted back to the adults. These “semi-precocial” chicks may, therefore, be able to grow at a faster rate than self-feeding precocial chicks. This study explores the ecological consequences of this developmental mode for African Black Oystercatchers *Haematopus moquini*. Fieldwork, on Robben Island, South Africa, included the determination of chick energetics using doubly labelled water methods, time budgets and growth rates.

### Diet of Kentish Plover chicks in two salinas in Cádiz Bay Natural Park: do they show selection?

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Knowledge of a species' diet is the first step to understanding many aspects of its feeding ecology, such as habitat and prey selection or niche width. In the Cádiz Bay Natural Park, salinas (salt pans) are important breeding habitats for Kentish Plovers *Charadrius alexandrinus*, supporting a great number of pairs and their broods. Kentish Plover chicks are precocial so begin to feed by themselves soon after hatching. However, the role of the salina as feeding habitat for the chicks is poorly known. The aim of this study was therefore to make a first assessment of salinas as a feeding habitat for the chicks.

We investigated the diet of Kentish Plover chicks in two salinas in the Cádiz Bay Natural Park. The work was carried out in an actively worked salina and in another that had been recently restored. From the two salinas, 16 and 9 faeces respectively were collected from ringed chicks and the non-digested parts were analysed. In order to compare prey ingested with prey available, we sampled the density of macroinvertebrates in each salina. In the actively worked salina, the most abundant invertebrate was *Artemia salina* (10,939 m<sup>-2</sup>) followed by coleoptera larvae (10,970 m<sup>-2</sup>), and *Quironomus* sp (2,840 m<sup>2</sup>). In the restored salina, the density of all invertebrates was lower and the most abundant were the gastropods *Hydrobia ulvae* and *Hydrobia minoricensis* (343 and 127 m<sup>-2</sup> respectively) followed by *Quironomus* sp larvae (145 m<sup>-2</sup>) and *Scrobicularia plana* (93 m<sup>-2</sup>). The coleoptera *Octhebius* sp did not occur at high density in either habitat, with 2,700 m<sup>-2</sup> in the actively worked salina and 0.7 m<sup>-2</sup> in the restored one. Despite this, however, the only prey appearing all faeces from both salinas was the coleoptera *Octhebius* sp., suggesting strong positive selection for this prey in Kentish Plover chicks. We discuss to what extent this result may be related to the detectability of this particular prey in the faeces, as opposed to other potential prey. We also discuss the value of *Octhebius* sp. in relation to the nutrient requirements of the chicks and the fact that targeting this prey may avoid the ingestion of salty water.



## Migration of waders across the Strait of Gibraltar: Preliminary results

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“Los Lances” Beach, in the Strait of Gibraltar, is the most southerly stopover site of Europe for waders migrating along the East Atlantic Flyway. The MIGRES SEABIRD program monitors waders passing the Strait of Gibraltar. More than 13,000 waders of 28 species were counted at Los Lances between January and December 2002. Peaks of migration were observed in April and November. Many waders stayed in the area during the winter. Scolopacidae species dominated the wader community; mainly Sanderling *Calidris alba* (48.9%) and Dunlin *Calidris alpina* (17.4%). In addition, important numbers of Charadriidae were also recorded throughout the year, especially Ringed Plover *Charadrius hiaticula* (6.5%) and Kentish Plover *Charadrius alexandrinus* (18.9%). We describe the phenology of the main wader species at Los Lances Beach, pointing out age-related differences in the autumn migration of Dunlin, in which adults arrive earlier than juveniles.

## A new approach to measuring the impact of human disturbance

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Waders include a large number of migrant species that depend on intertidal areas to obtain their trophic resources to survive. During recent decades, not only have many of their coastal habitats disappeared as a result of human activities, but there has also been a large increase in the amount of human-related disturbance. This paper proposes a simple mathematical model based on the birds behaviour during the low-tide period, which can evaluate each species' response to disturbance and allow us to predict the consequences of increased disturbance.

Our study area of about 3 ha at low tide is on the intertidal mudflats of Cadiz Bay Natural Park, NW of Cadiz, Spain. The study took place from November 1997 to March 1998. We carried out 117 censuses during 12 complete low-tide periods. We recorded the number of birds and the number of shell-fishermen. We used a chi-square test to compare the number of birds in places where shell-fishermen were present with the number of birds in the same places when shell-fishermen were absent. In order to develop the model, we needed to know not only the numerical response to disturbance, but also the turnover in order to obtain a balance between the entry and exit flow of birds in the study area.

Four abundant species of different size and feeding technique were selected for detailed study: *Calidris alpina* (tactile-small), *Charadrius alexandrinus* (visual-small), *Limosa lap-*

*ponica* (tactile-big) and *Pluvialis squatarola* (visual-big). We found a significant difference between censuses with and without shell-fishermen for each of the four species. However, they also showed different responses to disturbance. We found that *Pluvialis squatarola* is the most affected by disturbance and *Charadrius alexandrinus*, the least. We also found that bird exit is greater than bird entry during disturbance and that the opposite occurs before and after disturbance. In general, the model we have developed is easy to use and gives results on the response of the birds to disturbance throughout the tidal cycle that are intuitively correct. Moreover, the observed responses allow us compare, in an absolute way, not only responses between different species, but also the responses of one species in different seasons and places.

## Changes in the use of Fracasso beach, Peninsula Valdes, Patagonia, Argentina, as a stopover site by shorebirds

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From 1994 to 2002, we studied the way in which Red Knots *Calidris canutus rufa*, White-rumped Sandpipers *C. fuscicollis* and Two-banded Plovers *Charadrius falklandicus* use Fracasso beach, Patagonia, Argentina and investigated their diets. Simultaneously we monitored the availability of the benthic invertebrate food stocks. We discovered many changes in the course of the years. In March 1998 an extraordinary rainfall had strong erosive effects and changed the substrate from medium-sized to fine muddy sediments. This habitat change appeared to have great consequences. Up to 1997, Red Knots fed and roosted on Fracasso Beach and their abundance was correlated with the abundance of their prey, the clam *Darina solenoides*. From 1999, they stopped using Fracasso Beach as a roosting site and they only fed there during ebb tides before commuting to another beach 20 km away. In 2002 and 2003, no Red Knots were observed. White-rumped Sandpipers and Two-banded Plovers continued to use the beach, but their abundance was no longer correlated with the densities of the clam *Darina* but became correlated with the densities of the polychaete worm *Travisia olens*.

## Coastal Waders wintering in France – Trends over 20 years: 1983–2002

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Nearly one million waders are counted every year in France during the mid-winter count. Twenty five coastal sites are of international importance for at least one wader species. Trend analyses have been carried out using the TRIM 3 software for the 1983–2002 period. Nine species are increasing: Eurasian Oystercatcher *Haematopus ostralegus*, Ringed Plover *Charadrius hiaticula*, Grey Plover *Pluvialis squatarola*,



Sanderling *Calidris alba*, Purple Sandpiper *C. maritima*, Redshank *Tringa totanus*, Turnstone *Arenaria interpres*, Black-tailed Godwit *Limosa limosa* and Dunlin *C. alpina*. Although these species have increased over the whole 20 years, 1983–2002, some of them declined in the early part of this period: Redshank (1983–87), Black-tailed Godwit (1983–90) and Purple Sandpiper (1983–89). Numbers of four species have been stable or have fluctuated: Pied Avocet *Recurvirostra avosetta*, Red Knot *C. canutus*, Bar-tailed Godwit *L. lapponica* and Eurasian Curlew *Numenius arquata*. Red Knots increased until 1994, since when numbers have fluctuated. Bar-tailed Godwits declined until 1993 and then increased until 1997. Eurasian Curlew showed strong increases during the cold winters of 1987 and 1997. Ruff *Philo-machus pugnax* is the only species to have decreased significantly over the 20 year period.

In France, the numbers of most wintering waders are increasing at coastal sites. This is largely the result of site protection. Many major estuaries and mudflats have been designated (at least partially) as nature reserves and hunting reserves, where shooting is prohibited. Designation has resulted in strong increases in wader numbers during the ensuing years. This suggests that in general, wetlands are not at carrying capacity in France and trends observed at the national level may not be related to international trends, and thus, do not reflect the status of the species. Despite positive trends, all wader species are vulnerable because of their concentration in few sites.

#### **Assessing the use of mudflats by waders: bias due to the response of birds to the tidal cycle**

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The importance of particular intertidal mudflats for feeding waders is often inferred from their distribution during a restricted part of the tidal cycle (in most cases, around low water). However, over the whole period of tidal exposure, most waders move about within an estuary using different parts of it for feeding. This means that the distribution of birds during any particular part of the period of tidal exposure may not reflect their use of the estuary throughout the entire cycle. We compared data on distribution and abundance for the six most common wader species of the Tagus Estuary, Portugal, provided by low-tide counts with equivalent estimates based on half-cycle counts. The data were collected during the winter on a superficially homogenous mudflat divided into 12 plots of increasing distance from the saltmarsh (i.e. subject to different periods of tidal exposure). For most plots, low-tide counts resulted in serious underestimates of use (up to 9 times lower than full cycle counts). The magnitude of this bias was influenced by both the behaviour of birds in relation to the tide edge, and the exposure period of the feeding areas. We suggest that the best way of evaluating wader usage of intertidal areas is to combine

counts carried out at different stages of the tidal cycle, thereby reducing this bias.

#### **Waders of the wetlands of the south Bulgarian Black Sea Coast, 1996–2002**

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During 1996–2002, regular monitoring of the waterbirds of the wetlands of the southern Black Sea coast of Bulgaria has been undertaken on a monthly basis by a team from the Bulgarian–Swiss Biodiversity Conservation Program “Bourgas Wetlands Project”. This presentation includes population dynamics charts for the wader species of the four Bourgas Lakes – Lake Pomoriysko, Lake Atanasovsko, Lake Vaya and Lake Mandra. The results (given in the charts by season) show the importance of Lakes Atanasovsko and Pomoryisko for migrant and breeding wader species along the Western Black Sea Coast. Comparison with older data is also given.

#### **Behavioural effects of disturbance by shell-fishermen on waders at a sandy beach in southwest Spain: preliminary results**

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We studied the effects of disturbance by shell-fishermen on the behaviour of waders at a sandy beach in Cádiz Bay, southwest Spain. Eurasian Oystercatcher *Haematopus ostralegus*, Bar-tailed Godwit *Limosa lapponica* and Sanderling *Calidris alba* were the most abundant waders. We defined two foraging sites with different exposure time (near to the beach and a sandy island). We measured disturbance duration and the displacement distance of the birds when shell-fishermen approached. We also counted and mapped the distribution and numbers of waders and men during complete tidal cycles. Finally, we recorded the aggregation factor or percentage of the surface area occupied by each bird species in each foraging site.

Preliminary results show that the minimum distance at which birds are disturbed and the distance they are displaced increase with bird body size. However, disturbance duration was lower in Oystercatcher and similar in Bar-tailed Godwit and Sanderling. At low water, the aggregation factor decreased at the foraging site nearest to the beach, but increased at the island site. We discuss these results in terms of differential site-selection by waders during the tidal cycle and the distribution of the shell-fishermen. We make some suggestions on ways in which the conservation of waders can be reconciled with this traditional human activity.



### Relationship between tides and activities in two shorebirds species in The Marshes of La Algaída, Cádiz

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Following habitat restoration work, the Marshes of La Algaída (Parque Natural de Doñana) are the subject of a scientific project with the title: "Monitoring the Ecological Restoration of The marshes of La Algaída". This project began in 2000 and the principal object is to monitor the recovery of the ecological processes, functions and interactions that allow the maintenance of a self-sufficient marshland ecosystem. Colonization by typical shorebirds species of tidal and non-tidal wetlands was immediate and, right from the start, they used the study area for both feeding and roosting. The purpose of our study was to investigate resource partitioning in two shorebirds species, *Calidris alpina* and *Charadrius alexandrinus*. Our hypothesis is that the two species partition the allocation of their resources between them because of the need to avoid competition. We therefore compared the use of space, the behaviour and the time budgets of both species. First, we established whether there were any differences between the behaviour of each species that related to the area in which it was found (i.e. whether it behaved differently in a preferred habitat and whether there was any difference in this respect between the two species). Second, we compared those records with the tidal regime to establish whether the behaviour of each species is related to the movement of the tide. The results show that *Calidris alpina* does not use this area to feed, only to rest, so they do not compete for the use of habitat. In *Charadrius alexandrinus*, we found that there is a direct relationship between activity and site. We also found a relationship between the state of the tide and the sites they used and the activity in which they were engaged.

### Predation of horseshoe crab eggs by migratory shorebirds in Delaware Bay, USA

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The eggs of horseshoe crabs *Limulus polyphemus* form the main diet of migratory shorebirds refuelling in Delaware Bay, eastern USA during their spring migration. Concern over population trends and horseshoe crab fisheries has prompted research into the factors governing the refuelling rates of shorebirds, especially the declining Red Knot *Calidris canutus rufa* population.

In May 2002, we began a study of foraging behaviour in a suite of shorebird species as a means of understanding

functional relationships between prey abundance, availability and intake rates as part of an individual-based model aimed ultimately at predicting the rate of body mass gain. We employed a feeding tray experimental design, using known starting densities of eggs and videoing foragers for a set interval followed by quantifying the remaining eggs. Experiments in 2002 involving surface eggs revealed constant peck rates across prey densities (ranging from 0–25000 eggs/m<sup>2</sup>) but eggs consumed per peck, and hence intake rate, increased to a plateau with increasing density. Results will also be presented from experiments in 2003 involving buried eggs and will show the rate and depth of depletion by different species.

### Breeding waders of the Shatskiy National Park, Ukraine

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The Shatskiy National Park is situated in the Western Ukraine and borders with Poland and Belorussia. Because of its unique natural landscapes, it is characterized by a high diversity of wader species and has received the international status of a natural swamp area reserve and is also an International Bird Area (N001 UA). In the 1950s, a series of regular and occasional ornithological surveys were initiated in the Shatskiy lakes area, focused mainly on waders. These surveys have shown that several waders that were numerous in the past have shown major declines, especially over the last 20 years. In particular, *Philomachus pugnax*, *Tringa glareola* have disappeared from the region altogether. On the other hand, *Charadrius hiaticula* has been recorded as breeding for the first time in Ukraine. Today, 12 wader species are observed in the Park regularly. Of these, the populations of *Limosa limosa*, *Numenius arquata*, *Vanellus vanellus* have decreased considerably.

In order to assess the current breeding status of waders, special surveys have been conducted to map their breeding territories. For four species of high conservation priority – *Gallinago media*, *Tringa totanus*, *Limosa limosa*, *Numenius arquata* – the reasons for dramatic population decreases have been studied. Only for *Gallinago media* has a small population increase been detected. However, it is characteristic of this species that its population size shows strong fluctuations. After a sharp decline as a result of swamp drainage from the end of the 1960s, this species increased from the mid-1990s, and especially after the rainy summer of 1997. The revival of the almost extinct breeding population of *Gallinago media* can be explained by the restoration of water-meadows and swamps carried out in the National Park under the ECONET Action Fund Project in collaboration with the Ukrainian Ministry for the Preservation of Natural Resources. At the present time, the only wader included in the National Red Data Book is *Numenius arquata*, the population of which has declined strongly. However, we are now recommending that *Gallinago media* and *Tringa ochropus* shall be added. Both of these species are observed only rarely in the Shatskiy Park or the Ukraine as a whole.



### Defining habitats for waders at a broad scale: an example from the Tagus estuary, Portugal

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The occurrence of shorebirds in estuarine areas is often modelled using the physical characteristics of their feeding sites. However, at a broad scale, the interactions among these factors can pose difficulties in clearly defining the characteristics of wader habitats. In this study we applied a novel analytical approach, in order to characterize the habitats of different wader species using the Tagus estuary, Portugal. The mudflats were surveyed at 228 sampling sites, covering the majority of the intertidal area of the estuary (ca. 60 km<sup>2</sup>). At these sites we recorded several physical variables, as well as the numbers of all wader species.

The first step of the analysis consisted in summarising the (combinations of) physical conditions found in the mudflats, by means of a principal component analysis (PCA) over the variables set. The result enables a visual interpretation of the available habitats, the relative importance of different factors in defining them, and also the degree of association among them. The second step involved the association of the scores for the sampling points in the first two principal components (which define the "habitats space"), with presence/absence information available for each wader species. These binary data were then modelled from the PCA scores, using generalised additive models. The predictions of this model generated a smooth surface of probability of occurrence, over the range of available habitats. The occurrence of most species could be explained in terms of habitats representing combinations of grain size, amount of surface water, presence of oyster beds and inundation periods. Other variables such as penetrability, shallow water pools or sediment roughness did not define new habitat conditions, and their contributions were usually made along the already existing gradients. This method provides a valuable tool for defining habitats for estuarine organisms, by synthesizing the physical gradients found in large intertidal areas.

### Crop mosaics provide enhanced breeding opportunities for Lapwings *Vanellus vanellus* on arable farmland

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As a breeding species, the Lapwing *Vanellus vanellus* has declined by almost 50% in lowland Britain over the last 20 years, largely as a result of the increasing dominance of winter-sown crops and the loss of unimproved grassland. Although, non-cropped habitats, such as fallows may help population recovery, strong contributions to population regeneration will certainly be required from land allocated to commercially viable crops (i.e., at low cost to the farmer or tax payer). Here we show evidence of high densities of birds breeding in peas and sugar beet within cereal dominated landscapes. We discuss the conditions associated with successful pairs in the context of crop heterogeneity and crop management.

### Analysis of the migratory dates of waders in the Aviles estuary

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In recent years, there have been an ever-increasing number of studies on the effects of climate change on the phenology of migratory birds. Among waders, already there is evidence that the breeding latitudes of Ruff *Philomachus pugnax* have moved north. In order to look for possible changes in the migration phenology of waders, we have analysed the dates of first arrivals and the peak migration in spring and autumn of waders in the Aviles estuary, north Spain, over a 15-year period. We selected for study the ten most common species on the estuary: *Charadrius hiaticula*, *Pluvialis squatarola*, *Calidris alpina*, *Calidris canutus*, *Calidris ferruginea*, *Calidris alba*, *Calidris minuta*, *Limosa lapponica*, *Numenius phaeopus* and *Tringa totanus*.

In autumn, we found that three species had significantly changed trends: *Calidris canutus* (advanced arrival), *C. alba* (retarded arrival) and *Pluvialis squatarola* (retarded peak). No other species showed a significant change. Although we found that the peak passage of arctic species was synchronized in spring (except for *Limosa lapponica*), we did not find the same in autumn, neither did we find that first arrivals were synchronised in either season. These results appear to indicate that there is no clear tendency for a change of migration phenology affecting all wader species passing through the north coast of Iberia.

### Individually marked Eurasian Oystercatcher population at the White Sea: results of a four-year study

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Individual colour-ringing of the White Sea Eurasian Oystercatchers *Haematopus ostralegus* was started in the Kandalaksha Nature Reserve in 1991 by Rob Lambeck of the Netherlands (altogether he ringed 53 of which 13 were in the author's study area). A few of these birds were still recorded in the summer of 2003.

Since 2000, individual colour-ringing and monitoring the breeding performance of colour-ringed birds has been carried out by the author on the islands of the Northern Archipelago, Kandalaksha Bay. In four years, 62 breeding adults and 62 grown up chicks were colour-ringed. Colour-ringing has been carried out on a group of 13 islands all situated within a radius of 4–5 km. Specific attention has been paid to monitoring the Oystercatcher population of Devichya Luda Island which is 2 km long and 0.5 km wide. There the population has ranged from 29 to 45 breeding pairs in different years and over 50% of the breeding adults as well as most of their chicks are individually colour-ringed. Over 80% of nesting adults have been recorded at the same breeding localities in subsequent years. Some of the islands are



more and some less favourable for breeding Oystercatchers and the reasons are described.

Overall, the social structure of the breeding population on Devichya Luda Island has been stable from year to year (as shown by annual territory maps). The oldest known bird that was still breeding on the island in 2003 (and individually colour-ringed in 2002) was hatched on the same island in 1979, 34 years ago. Records of individually marked White Sea Oystercatchers in Europe during the non-breeding season are surprisingly few. Most are from the Netherlands, but there are also some from Denmark and France.

### Effect of stress caused by different predators on the sexual behaviour of the Pied Avocet *Recurvirostra avoetia*

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Birds are considered as being more exposed to predators during the breeding season. Predators may represent a direct threat to adults, which are more vulnerable when engaged in various reproductive activities such as copulation, laying and brooding eggs, care of chicks, etc. The reproductive process involves an increase in activities that render birds more detectable to predators. It also decreases the time and attention they can give to vigilance. Moreover some predators also try to take advantage of the opportunity represented by eggs and chicks.

The establishment of breeding colonies in birds (as in the Avocet) facilitates a decrease in predator-associated mortality by improving vigilance and/or through risk dilution. This is achieved by collective anti-predator defence behaviours such as alarm calls, flying or flocking on the ground in dense groups, or even by attacking the predator.

We have found that the reaction intensity of Avocets depends mainly on the predator species involved. Our observations, made over several years in the Natural Reserve of Séné (Réserve Naturelle des Marais de Séné, Morbihan, France), indicate that there can be some unusual reactions by Avocets that have been stressed by a raptor. In addition to the classic reactions already mentioned, it appeared to us that the proportion of Avocets engaged in copulation was particularly high after a raptor had flown over the colony. These unpublished observations, but confirmed by other naturalists in the reserve, are worth further investigation in order to confirm and quantify the phenomenon. This is the aim of this poster, which shows the different reactions of Avocets to different predators on their sexual activity. The possible adaptive advantages of this behaviour are discussed.

### Shorebird distribution on the mudflats of Aiguillon Bay, France: analysis using a GIS method

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The national nature reserve of Aiguillon Bay is the third most important French site for wintering waders and the second for Shelduck *Tadorna tadorna*. Although the number of waders and Shelducks has been relatively stable for 25 years, its importance has decreased relative to the rest of the French coast. One aim of the reserve managers is to estimate the carrying capacity of the bay by establishing the quantity of the food resources (benthic molluscs, annelids) and understanding their population dynamics. In parallel, the use of the mudflats by shorebirds is being analysed with different methods.

This poster presents the method used to analyse the distribution of shorebirds at low tide, when the whole of the mudflats are accessible. We present the first results of monthly shorebird counts conducted between October 2002 and February 2003. For each count, the number of individuals and the location of groups are reported on a 1:25,000 map. We then used a GIS to register each group as a field with the parameters "species" and "number of individuals". To analyse cumulative data for the whole winter season, we created a regular hexagonal grid and calculated the number of birds of each species present in each hexagon as the sum of the field for each month weighted by the proportion of the field intersected by the hexagon. For all species together, we observed a relatively homogeneous distribution across the whole site. However, this obscured two different types of distribution: gregarious species that favour particular zones on the mudflats (Avocet *Recurvirostra recurvirostra*, Black tailed Godwit *Limosa limosa* and Knot *Calidris canutus*) versus other species that are more dispersed across the bay (Dunlin *Calidris alpina* and Shelduck). Our results show the relevance of this method in describing the distribution of shorebirds at low tide. However, the number of monthly counts needs to be increased in order to define more precisely the use shorebirds make of each zone of the bay.



### Waterbird conservation in the salinas of the Sado Estuary, Portugal

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For several decades, the salinas (or saltworks) of the Sado Estuary, near Setúbal, Portugal, have been subject to an intense process of abandonment and destruction. Many have been completely transformed into rice fields or fish farms and others are in an advanced state of degradation or lost (e.g. flooded with sea water, filled with solid waste or turned into reservoirs). Currently, only a small number of salinas are functioning for salt production and offer habitat for waterbirds.

In 2001, a LIFE-Nature project was approved, in order to promote conservation of the salinas in this protected area. The objects are to encourage the reactivation of traditional salt exploitation, the management of water levels and the conservation of the salinas as a habitat for their bird communities. Among the actions planned as part of the LIFE project are two studies that are being carried out during the current year. One focuses on the *Himantopus himantopus* breeding population (present situation and threats) and the other on the availability of food in the salinas for waders. Data have been collected on the breeding success and productivity of *Himantopus himantopus* in specific salinas in order to establish favourable management prescriptions and all the main colonies have been counted. The evaluation of food availability is being conducted in salinas under different environmental conditions (in active salt production, abandoned, subject to flooding with sea water and under water management plans), in order to obtain data on invertebrate prey diversity and abundance. Data are also being gathered for the habitat management plan now being prepared.

### Use of the Aiguamolls de L'Empordà Natural Reserve, NE Spain, by migrant shorebirds: stability and fluctuation of the available habitat

Teresa Montràs

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The distribution of the shorebirds in the Aiguamolls de l'Empordà Natural Reserve is determined by the availability of suitable habitat in the different ponds, lagoons, marshes and beaches. The coastal lagoons, such as La Rogera, are the principal habitat for certain East Atlantic Flyway migrants (*Haematopus ostralegus*, *Calidris alba*, *C. canutus*, *Limosa lapponica*) while others use the beaches and brackish marshes (*Pluvialis squatarola*, *Charadrius alexandrinus* or *Numenius phaeopus* and *N. arquata*). The beaches and marshes are also an excellent alternative habitat for *Recurvirostra avosetta*, *Tringa totanus*, *T. nebularia*, and to a lesser extent, *Ch. hiaticula* and *C. alpina*. In contrast, *Himantopus himantopus*, *C. minuta*, *C. ferruginea*, *Philomachus pugnax*, *Gallinago gallinago*, *L. limosa* and *T. glareola* only occur in small numbers and are mainly restricted to the less salty and freshwater environments.

La Rogera lagoon is a self-contained ecosystem that is

unaffected by variations in water levels elsewhere in the reserve. This means that it always provides good wetland habitat for shorebirds. Bearing in mind the unpredictability of the Mediterranean environment, the stability of the available habitat appears to be a major reason why the reserve is so attractive to shorebirds. Moreover, artificial ponds with controllable water levels have been constructed that enrich and complement the habitat on offer. These ponds are managed so that they have boggy and muddy extensions, which increase both the habitat types available and shorebird feeding opportunities. These new areas are a major attraction for migrant shorebirds, particularly Charadriidae and those Scolopacidae that feed in water less than 5 cm deep (*C. minuta*, *C. alpina* and *Actitis hypoleucos*). Such areas can support shorebird densities of up to 53.6 ha<sup>-1</sup>, but if they dry up, they are unproductive and useless. When they are re-flooded, they do not become productive again until a period has elapsed that is about three times the period that they have been dry.

Together, the stable environments, the artificial controllable systems and the coastal areas create a wide array of opportunities for the migrant shorebirds that stop at the Aiguamolls de l'Empordà Natural Reserve – Mediterranean marshes where man has left his mark.

### The migration of shorebirds through the Aiguamolls de L'Empordà Natural Reserve, NE Spain: evidence of the effect of the north wind (Tramuntana) on migration phenology

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The stability of the available habitat appears to be one the main factors explaining the attractiveness to shorebirds of the Aiguamolls de l'Empordà Natural Reserve, NE Spain. However, located in the Mediterranean, it suffers from long, hot, dry summers that damage this stability. These conditions have a major effect on the habitats and the resources they have to offer and so, indirectly, affect the composition of the shorebird community. During autumn migration, when juveniles dominate, the numbers of most shorebird species are more than double numbers in spring. This particularly applies to the following: *Recurvirostra avosetta*, *Charadrius hiaticula*, *Calidris alba*, *C. ferruginea*, *Philomachus pugnax*, *Limosa limosa*, *Tringa erythropus*, *T. totanus*, *T. nebularia* and *T. glareola*. In contrast, *Ch. dubius*, *C. minuta*, *C. alpina*, *Numenius arquata*, *T. ochropus* and *Actitis hypoleucos* are more abundant in spring than in autumn. During summer, the main breeding species are *Himantopus himantopus* and *Ch. alexandrinus*, and in winter there are significant numbers of *Vanellus vanellus* and *Gallinago gallinago*.

Both spring and autumn migrations are characterised by the dominance of different species for short periods. No species dominates throughout a whole season. During autumn migration the dominant species are *G. gallinago*, *L. limosa* and *Ph. pugnax* and *Ph. pugnax* is the most abundant of the Scolopacidae. During spring migration, dominance is shared between *G. gallinago*, *Ch. dubius*, *H. himantopus*, *V. vanellus*, *C. minuta*, *C. ferruginea* and *T. glareola*. *Ph. pugnax* is very scarce. *C. minuta* and *T. glareola* are the most abundant of the Scolopacidae, together with *G. gallinago* (for which it is difficult to distinguish between wintering birds



and spring migrants). Other East Atlantic Flyway species (*Haematopus ostralegus*, *C. alba*, *C. canutus*, *L. lapponica*) and those that mainly use beaches and brackish marshes (*Pluvialis squatarola*, *Ch. alexandrinus* or *N. phaeopus* and *N. arquata*) only represent between 5–10% of the total number of shorebirds. In both periods the dominant family is Scolopacidae.

At any one time, the community of migrant shorebirds in these Mediterranean marshes is determined as much by local weather as by the phenology of the species. The north wind (tramuntana) appears to be an important factor that remodels the phenological profiles. It is actually a NNW wind that is cold, dry and sometimes violent and extremely important in the region. It blows often, but especially in spring, and with gusts of sometimes more than 100km/h. Peaks numbers of *Ch. hiaticula*, *T. glareola* and *A. hypoleucos* during 9–16 May 1995, those of *C. alpina*, *T. totanus* and *A. hypoleucos* during 17–23 April 2000 and those of *Ch. dubius*, *Ph. pugnax*, *T. erythropus*, *T. totanus*, *T. nebularia*, *T. ochropus* and *T. glareola* in April 2001 all coincided with periods of strong northerly winds. A similar example is the arrival of 40 *L. lapponica* on 1 September 2001, another day characterised by strong northerly winds. The rule is proved: the combined action of abundant migration and strong northerly winds, gives rise to sudden peaks in the migration phenology of shorebirds.

#### Effects of traditional shellfishing on foraging activity, feeding rate and habitat use of migrating Eurasian Curlews *Numenius arquata*

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In coastal areas, shorebirds are often subject to human disturbance associated with harvesting practices such as shellfishing and baitworm digging. We studied the foraging activity, feeding rate and intertidal habitat use of Eurasian Curlews *Numenius arquata* in the presence and absence of shellfishermen working by hand. We found that foraging activity was significantly lower when shellfishermen were present than when they were absent. However, the feeding rate and distribution pattern of Curlews were similar in both situations. This study provides a base of information for site-managers of coastal areas.

#### Habitat use and feeding activity of waders and Shelduck in Aiguillon Bay, France

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The aim of this study was to investigate shorebird use of an intertidal mudflat in space and time. It was carried out in Aiguillon Bay, the third most important French site for wintering waders and the second for Shelduck *Tadorna tadorna*. The study forms part of a scientific program designed to establish the carrying capacity of the bay for waders and other estuarine birds and to optimise the management of the site as a nature reserve. Here, we present results from a weekly record of the feeding activity of the six principal study species (Avocet *Recurvirostra avosetta*, Black-tailed Godwit *Limosa limosa*, Bar-tailed Godwit *L. lapponica*, Red Knot *Calidris canutus*, Dunlin *C. alpina* and Shelduck) for the period January to May 2003.

In three areas of the bay, containing different composition and abundance of invertebrate prey, we scanned the number of birds and activity of each species hourly during the period of tidal exposure. We compared feeding density (= number of individuals that were feeding, per unit area) between species, areas and seasons (where winter is before 15 March and spring is after that date).

The mean feeding density for the six species was 9.5 individuals / ha in winter compared with 5.2 in spring. For these two seasons, the feeding density was greatest for Dunlin. Feeding density was not significantly different between the three study areas for all species combined for each season separately. However, the feeding density of godwits in winter was greater in the St-Clement zone than in the two others. The opposite was the case for Red Knots. There was also a significant difference in feeding density between areas for Shelduck in winter.

At this stage, it is difficult to link the feeding density of the birds with the density of the benthic food resource because of incomplete data for the latter. However, the great spatio-temporal variability of abundance in the major species of bivalves (*Scrobicularia plana* and *Macoma balthica*) and gastropods (*Hydrobia ulvae*) observed over a period of 18 months could explain the variability of space use by shorebirds. However, it is clear that before the distribution of the



birds of the Aiguillon Bay can be fully understood, a study of their diets will be essential.

### Management of coastal salinas as a means of improving breeding habitats for waders

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The number of salinas (saltpans) available as habitat for waders in Cadiz Bay has suffered a dramatic decrease since the early 20th century, from more than 150 to only four active, traditionally managed coastal salinas today (3% of the surface area of the Bay). Despite this, the active or restored salinas support 59% and 36% of the Cádiz Bay breeding Avocets *Recurvirostra avosetta* and Kentish Plovers *Charadrius alexandrinus*, respectively.

We describe several management actions carried out in one abandoned salina and a restored one in Cadiz Bay Natural Park. These were: restoration of walls and crystallisation ponds, management of water levels and supplementation of the substrate. Although the sites chosen for this work were not, or only marginally, occupied by breeders in previous years, the number of nests significantly increased the following season. These results suggest that development of management plans for the salinas could become a valuable means of improving the quality of these potential breeding habitats for waders.

### Declining Kentish Plover populations: The case of Cadiz Bay Natural Park, SW Spain

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European Kentish Plover *Charadrius alexandrinus* populations have suffered a general decrease during recent decades. In comparison, the breeding and wintering populations of Spain have been far less affected. Nevertheless, the species has already been catalogued as "endangered" in Andalucía. Our study reviews these trends in Europe and Spain, and more locally in Andalucía and the Cadiz Bay Natural Park. This Bay has recently been declared a RAMSAR site, and is especially important for Kentish Plovers in both the wintering and breeding seasons, with 49% and 11% of national counts respectively. However, these important populations have declined and the impact of human activities on their habitat is generally accepted as the main reason. In order to test this assumption, aerial photographs have been analysed digitally and this has shown a general decrease in the area of salina habitat (saltpans) since 1940. Moreover, mapping surveys of Kentish Plovers indicate a clear preference for this habitat. We found that 43% of wintering and 36% of breeding Kentish Plovers chose active or managed

salinas against other habitats such as intensive aquaculture (14.2 % in winter) or abandoned salinas (5.4 % in winter). Therefore, maintaining and restoring salinas are essential to the recovery of the species.

### The wintering population of Eurasian Oystercatchers in the estuaries of Galicia, NW Spain: conservation status, distribution and relationship with biotic and abiotic factors

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The wintering population of Eurasian Oystercatchers *Haematopus ostralegus* on the estuaries of Galicia, NW Spain, amount to 79% of the total Galician population, which in turn amount to 67% of the Spanish population. We studied the conservation status of the species, its distribution and its relationship with several biotic and abiotic factors during 1996–1999.

We found a significant positive relationship between the numbers of Oystercatchers and (1) the total intertidal area, (2) the sheltered-intertidal area. We found a significant negative relationship between the number of Oystercatchers and the accessibility of intertidal habitat to humans. However, we did not find any significant relationship between the number of Oystercatchers and the availability of bivalves nor with the amount of human use of the intertidal habitat.

### Neap-tide roost selection by waders: maximizing feeding opportunities or reducing risks of predation?

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Tidal cycles determine the availability of mudflat feeding grounds for waders. During the rising tide, waders are displaced from their feeding areas on the mudflats and are forced to move to high-tide roosts. During spring tides, all the mudflat area is covered by water and all birds gather in supra-tidal sites. However, during neap tides, a narrow band of upper mudflats remain available and waders can choose to roost there or at the supra-tidal sites.

In our study area on the Tagus estuary, Portugal, the waders roost on nearby saltpans on spring tides. However, on neap tides, the great majority choose to roost on the upper mudflats, and not in the saltpans. We examined two potential explanations for this choice: (1) that staying on the upper mudflats enables them to continue feeding over the high-tide period or (2) the risk of predation by avian predators is lower on the upper mudflats than on the saltpans.

The risk of predation was evaluated on the basis of the number of avian predators that appeared above the roosts and the number of flock alarm flights. Disturbance by avian



predators was significantly higher on the salt pans than on the mudflats. Although remaining on the mudflats extended the potential feeding period, we found that food availability in the mud that remained exposed at high water was low and less than 13% of birds continued feeding. Consequently, the ability to feed did not seem to be the main reason for choosing to remain on the mudflats. Therefore risk of predation is likely to be the main factor determining the choice of high-tide roost site.

### Importance of the rice paddies of the Guadiana floodplains, Extremadura, Spain, for wading birds of the East Atlantic Flyway

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We studied the importance for wading birds of the rice paddies of the upper floodplains of the River Guadiana. The study area is the middle basin of the Guadiana as it passes through Extremadura, W. Spain. This region has been transformed through irrigation since the mid 20th century, and now a considerable proportion of its area (currently 17,000 ha) is devoted to rice growing. It has become an important area for the many waterbirds that use this agricultural habitat as a staging area. Although the turnover rate of migrating populations is unknown, there are concentrations (mainly roosts) that far surpass the figures at which they would be regarded as of international importance; examples include *Grus grus* and *Limosa limosa* with counts of 13,000 and 25,000, respectively. Other wader populations of interest are those of *Gallinago gallinago*, *Calidris alpina*, and *Vanellus vanellus*. During the breeding season, *Himantopus himantopus* and *Glareola pratincola* also attain population sizes of international interest. We discuss the importance to waders of the geographical location of these artificial wetlands, as well as that of similarly anthropogenic habitats for other groups of water birds in this region.

### Ruffs grow coloured primaries during the breeding period

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Ruffs *Philomachus pugnax* have a non-breeding (basic), a breeding (alternate) and a supplemental breeding plumage. The latter has a full development in males only and needs high plasma testosterone levels to be achieved. The colourful ruff and tuft feathers of breeding males attracted Italian bird collectors and ornithologists of the XXth Century. Ettore Arrigoni Degli Oddi and Tertulliano Pierotti collections include some of the largest series of male morphs stored in Italian museums.

The number of males that cross Italy in full breeding plumage during spring migration has always been very small. Their rarity induced past bird-catchers to keep some individuals in captivity for a few weeks, waiting for them to turn

into supplemental breeding plumage. Then, they were killed and sold to collectors. These birds were usually kept in outdoor aviaries, and primaries of one wing were plucked to prevent escapes. Two of these captive-moulted birds are stored in the collection of INFS. We observed that primaries grown during the supplemental breeding moult were not black but mottled reddish-brown, white, grey and black, mirroring colours and patterns of the showy mantle and scapular feathers. The two specimens had similar primary colour and pattern, despite the fact that one bird was a satellite breeder (white ruff and tufts) and the other was a resident one (black ruff and tufts).

To investigate factors determining the origin of mottled primaries and the relationship of this character with sex, breeding and supplemental breeding plumages, we repeated the experience of past bird-catchers. Four adult females and one adult male were kept in captivity and some contour feathers, rectrices and remiges (scattered primaries, secondaries and tertials) were plucked in April–May. Females were held for 16 months (two breeding seasons: April 1999–July 2000), the male for 4 months (April–July 2000). Three females re-grew some plucked primaries with a mottled pattern (one in June 1999, two in June 2000), similar to male museum specimens. A female did not grow primaries during both breeding seasons, and the male did the same in 2000. High levels of sexual hormones probably inhibited the growth of most plucked feathers in May–June. The primaries that grew between July and April, i.e. during the post- and pre-breeding moults, were black. These data suggest that mottling on primaries grown during the breeding season does not depend on high levels of testosterone. Hence this pattern cannot be related to the supplemental breeding plumage. That castrated males develop a plumage similar to that of nuptial females suggests that mottling on primaries is more likely to be determined by factors controlling the development of the breeding (alternate) plumage in both sexes. Thyroxine (T4) has a seasonal cycle, affects feather size, shape, colour pattern and pigment deposition. It might therefore be a candidate for explaining the mottled primaries and the breeding (alternate) plumage of Ruffs.

### Extremely high aggression of waders on steppe water bodies in southwest Siberia

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Extremely high aggression in various waders was observed during their southward migration on several steppe water bodies in southwest Siberia in August 2002. Among the 24 wader species recorded, eight demonstrated aggressiveness and four, territoriality.

Most aggression by Broad-billed Sandpipers *Limicola falcinellus* and Wood Sandpipers *Tringa glareola* was interspecific. In addition, Ringed Plovers *Charadrius hiaticula* attacked Little Ringed Plovers *Ch. dubius* much more often than conspecifics. The rate of aggressive encounters recorded for some waders, such as Little Stint *Calidris minuta* and Ringed Plover, was much higher than for the same species at other stopover areas in Europe and the southwest Caspian Sea. Little Stints were the most aggressive waders – they



were recorded attacking five other species including the relatively large Wood Sandpiper and Curlew Sandpiper *Calidris ferruginea*. Waders displayed the highest level of aggression on water bodies with the highest abundance and variety of food – Chironomids, Corixids and extraordinarily numerous very small (<0.25 mm) Copepods and Ostracods.

### Underwater nesting? The implications of sea-level rise for breeding redshank in coastal zones

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Rising sea levels are amongst the most certain of climate change impacts, and for low-lying coastal areas, the threats are particularly severe. In East Anglia, S.E. England, this is exacerbated by downward isostatic land movements following the last glacial period. The key implications of sea-level rise for coastal breeding species are (i) a loss or decline in the availability and suitability of intertidal breeding habitats,

principally saltmarsh and (ii) potential losses of other coastal habitats such as grazing marsh, as a result of landward migration of intertidal habitats and sea defence strategies. Mitigation for the loss of these habitats may not be possible in the coastal zone, and so habitat creation and management at inland sites may be an important option. However, at present the relative quality of intertidal, coastal and inland habitats for breeding species is not known, making effective mitigation strategies difficult to devise.

The Redshank *Tringa totanus* is a key coastal breeding species in the UK and it has been estimated that 45% of the breeding population currently nests on saltmarsh (Brindley *et al.* 1998) with the remainder breeding on coastal and inland grazing marshes. This habit of breeding on both coastal and inland habitats makes the Redshank an ideal species for a comparative study of breeding habitat quality and the potential consequences of replacing coastal sites with inland sites.

Here, I present a comparison of Redshank breeding densities and preliminary measures of Redshank nest success and productivity on saltmarsh and coastal and inland grazing marshes in East Anglia.

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## Request for information on agri-environment schemes for breeding Northern Lapwing *Vanellus vanellus*

I am currently undertaking a review of agri-environment scheme management prescriptions for breeding Lapwing. I am attempting to determine how successful they are in delivering benefits for the species. To date I have reviewed most of the UK schemes and now plan to extend the review to other European countries. The type of information I need include:

- Details of the management prescriptions
- Whether breeding Lapwings are known to use the areas covered by the agreement
- Whether there are known benefits to Lapwings, e.g. increased nest survival, provision of chick foraging habitat etc.
- The cost of the management prescription
- Whether there are any benefits for other species

Any other useful information will be welcome. My aim is to write a comprehensive review of habitat management for Lapwings using agri-environment schemes to be published towards the end of 2004.

Contact me at Reserves Ecology, Conservation Management, Royal Society for the Protection of Birds, The Lodge, Sandy, Bedfordshire, SG19 2DL, UK; phone ++44 (0) 1767 680551; e-mail: [robert.sheldon@rspb.org.uk](mailto:robert.sheldon@rspb.org.uk)

Rob Sheldon

