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 novaezlandiae*), 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 Thinocoridae, 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 Rio Grande, Tierra del Fuego, where Knots spend their non-breeding season and San Antonio Oeste, Rio 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 Rio 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 Atlantic 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.

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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.