A BIRD'S EYE VIEW ON FLYWAYS

A brief tour by the Convention on the Conservation of Migratory Species of Wild Animals

UNEP CMS

IMPRINT

Published by the United Nations Environment Programme (UNEP) and the Secretariat of the Convention on the Conservation of Migratory Species of Wild Animals (CMS)

A BIRD'S EYE VIEW ON FLYWAYS
A brief tour by the Convention on the Conservation of Migratory Species of Wild Animals
UNEP/CMS Secretariat, Bonn, Germany. 68 pages.

Produced by	UNEP/CMS
Text	based on a report by Joost Brouwer in colaboration with Gerard Boere
Coordinator	Francisco Rilla, CMS Secretariat, E-mail: frilla@cms.int
Editing & Proof Reading	Hanah Al-Samaraie, Robert Vagg
Editing Assistant	Stéphanie de Pury
Publishing Manager	Hanah Al-Samaraie, Email: halsamaraie@cms.int
Design	Karina Waedt

Copies of this publication are available from the
UNEP/CMS Secretariat
United Nations Premises in Bonn
Hermann-Ehlers-Str. 10
53113 Bonn, Germany
Tel (+49 228) 815 24 01/02
Fax (+49 228) 815 24 49
E-mail: secretariat@cms.int
www.cms.int

ISBN 978–3–937429–99–1

Image on next page: Cattle Egret (Bubulcus ibis) during migration, © Mohammed Shobrak

ACKNOWLEDGEMENTS

Special thanks to

Robert Hepworth and Francisco Rilla (CMS), Gerard Boere (Netherlands), Crawford Prentice and Sara Gavney Moore (International Crane Foundation), Ward Hagemeijer and Taej Mundkur (Wetlands International), Bert Lenten (AEWA), John O'Sullivan (BirdLife International), Herbe Raffaele and Meenakshi Nagendran (U.S. Fish and Wildlife Service) for the intensive dedication to this publication, David Stroud (The Joint Nature Conservation Committee), Nicholas C. Davidson (Ramsar), Nicky Petkov (Wetlands International), Doug Watkins (Wetlands International - Oceania), Yus Rusila Noor (Wetlands International - Indonesia), Florian Keil and Sergey Dereliev (AEWA), Vergy Derelieva, Barend van Gemerden and Ania Sharwood Smith (BirdLife-Netherlands), Mike Crosby, Lincoln Fishpool, Vicky Jones, Richard Grimmett (BirdLife International), Mohammed Shobrak (BirdLife Global Council), Barbara MacKinnon de Montes (Amigos de Sian Ka'an), Martin Schneider-Jacoby (Euronatur), Carla Sbert (Nature Canada), Malcolm Davidson (European Space Agency), Paul Scholte (UNDP, Socotra), Patrick Triplet, Otto Overdijk and Dawit Semere (Eurasian Spoonbill Working Group), Mary Linkevich, Benjamin Hayes and Jeff Schmoyer (Hawk Mountain Sanctuary), Gill Bunting and Christoph Zöckler (Spoonbilled Sandpiper Action Plan), Samantha Petersen and Peter Ryan (WWF South Africa), Dennis Pegg (New Jersey, USA), Peter Dunne (New Jersey Audubon Society), Rodney Smith and John Vogel (Australia), Adrián Azpiroz (Uruguay), Omar Rocha (Bolivia), Sarah Taylor (Smithonian National Zoo), Albert Winkelman, Natuur en Boek, Tim Faasen, Ronald Groenink, Leo Zwarts and Dick Visser (Netherlands), Francisco Aceituno (Honduras), Tim Dodman (U.K.), and of course the team at the CMS Secretariat: Hanah Al-Samaraie, Curd Knuepfer, Aline Kuehl, Stéphanie de Pury and Robert Vagg.
The books of Nigel Collar and colleagues on birds and people, and of Ian Newton, Ken Able and Dominic Couzens on bird migration, provided much information and inspiration. So did the paper by Jeff Kirby and colleagues on migratory bird conservation.

FOREWORDS

***A Bird´s Eye View on Flyways* is the first ever publication** by CMS to bring together the key facts about migratory birds, their populations, the main routes they use ("flyways"), the threats they face along the way, the benefits they bring to people and the environment and the actions we must take to help them survive, which include strengthening the international framework through the UNEP Convention on Migratory Species and related agreements.

The unique nature of the life cycle of migratory birds illustrates, like no other phenomenon, the connectivity of ecosystems across the globe. Often in order to get to and from their breeding grounds, these migrants follow distinct paths, known as flyways. Bird migration spans vast areas comprising thousands of kilometres over land and sea and covering many countries. The birds play a crucial economic and ecological role affecting the millions of people who live along the migration routes. These journeys, perilous at the best of times, given that they involve crossing oceans, mountains and deserts, are made even more hazardous by human interventions.

Modern infrastructure is obstructing the flight pathways, and critical sites required for breeding, feeding, resting or moulting have shrunk in size and number to become islands in our human landscape. Indiscriminate hunting, which is particularly detrimental at key migration locations, and more recently climate change, have put populations of migratory birds under ever increasing pressure. Almost one fifth of the world's extant bird species are considered ecologically migratory. Of these more than a tenth are categorised as threatened or near-threatened by extinction according to the IUCN Red List. Migratory raptors in the Africa-Eurasia region are particularly threatened; just over half of the species listed have an unfavourable conservation status.

I would particularly recommend you to read chapter 4, which deals with the value of migratory birds. This includes their role in providing ecological services and direct economic benefits. One fact which surprised me was the very high income generated from people who enjoy watching birds during their migrations. The annual income generated by just four examples of tourist birdwatching in North & Central America and South Africa is estimated at over US$ 13 billion, largely through sales of equipment.

The monetary, environmental and spiritual wealth generated by migratory birds increases the incentive to conserve them. Virtually all countries of the world share a responsibility to halt the decline in numbers of affected avian species and the degradation of their habitats. Combating such threats can be best achieved by looking at bird migration in a broad context and by undertaking conservation work in a structured manner, along the entire extent of their flyways.

CMS, together with its daughter agreements, provides the international legal framework to facilitate this coordination. Many of its instruments such as the African-Eurasian Waterbird Agreement (AEWA) focus exclusively on flyways. Others, such as the new Raptors Agreement, target groups of species with a similar ecological role. This structure allows all stakeholders to work together in partnership to conserve these fascinating species for future generations.

R G Hepworth

Robert Hepworth,
Executive Secretary of the UNEP
Convention on Migratory Species

Migratory birds are the most visible group of migratory species worldwide. Everybody in their daily life has the experience of birds coming and going with the seasons. Migratory birds can flock together in large numbers providing a spectacular view to just observe and enjoy but also to be subject of mass taking and not always in a sustainable way. With the increased changes and reduction in the world´s natural habitats affecting migratory species throughout their lives – in the breeding areas, at stop-over places and in the non-breeding areas, the need for more international cooperation has become very obvious. Various initiatives, e.g., in Eurasia/Africa and North America, notably on waterbirds and their migration routes ('flyways'), stimulated this international cooperation long before 1972, when the Human Environment Conference in Stockholm decided to develop an international instrument aiming at the protection of all migratory species of wild animals.

Parallel research on migratory birds has been booming with long term ringing studies (now being published in excellent bird migration atlases), satellite transmitters, data-loggers, GPS systems, colour-code ringing schemes, etc. Expeditions to the remote breeding and non-breeding areas have collected better data on populations and distribution. This all has provided much better insight in flyways in general and of individual species. The 2004 Edinburgh Conference on 'Waterbirds Around the World' has put the need for the flyway approach strongly in people's mind: activities at one place in the flyway can affect the whole system. Instruments like the North American Migratory Birds Conservation Act and GEF funded projects like the Siberian Crane and WingsOverWetlands in Eurasia and Africa have been essential to combine science, policy and sound management and conservation on the ground in promoting the flyway approach. Of course more has to be done and the Bonn Convention is the instrument to stimulate and facilitate the flyway approach on the global level; what has to be done can be found in this publication!

Dr. Gerard C. Boere
Chair Steering Committee UNEP/GEF
WingsOverWetlands project.
Former Vice Chair of the Bonn Convention

Witnessing the amazing dance of the Baikal Teal swirling around several hundred thousand strong against the setting sun over the Chunam reservoir on the west coast of Korea a few years ago is a truly special memory for me. But what lies in store for this species and many others in the face of extensive changes in the landscape across the East Asian flyway?

Many migratory species are in decline around the world and they face ever increasing habitat loss and major challenges including global climate change and sea level rise that affect their survival. Rapid human development based on increased industrialisation and agriculture has resulted in the damming and canalization of rivers, degradation and pollution of natural wetlands, reclamation of massive intertidal flats and other land use changes. Finding ways to conserve these species and their habitats will depend on taking tough decisions to improve our land use planning to integrate sustainable development approaches to meet human needs balanced with those of nature.

This timely publication provides a valuable guide to the wonders of bird migration, the many challenges that these birds face and importantly, the many initiatives underway to promote the survival of migratory species and their environment.

Migratory birds are a common heritage and we have a joint responsibility to ensure that their future is secure. Reading this publication will bring to life the popular saying United we stand, divided we fall, which underpins how we can more effectively achieve our goals by working together to conserve these birds and their habitats.

We at Wetlands International, look forward to actively participating and joining you all in this important endeavour.

Taej Mundkur
Programme Manager – Flyways
Wetlands International

CONTENTS

1 INTRODUCTION

'Gatherings of angels', this is what early radar operators called the echoes on their screens caused by migrating birds and other unknown objects[1]. What a beautiful name for a miraculous phenomenon!

Crab Plover (Dromas ardeola), © Bert Lenten / AEWA

Migratory birds are part of the lives of many people around the world: little children, who are shown their first swallows' nest by their grandfather; farmers, who see the first arrival of storks, warblers or other migratory birds, and know that the new growing season should start soon; hunters, who eagerly await the arrival of ducks and geese; city people, who hear the calling of the same geese overhead, or see the number of vultures and kites change with the seasons; herdsmen, whose animals are followed by wagtails and harriers that feed on flushed insects; people visiting the countryside, who hear the song of larks and other birds in the background; fishermen on every sea, whose boats are followed by albatrosses, shearwaters or boobies.

In short: who is not touched by the passing of the seasons as marked by migratory birds? And who will not miss them if they no longer arrive?

It is assumed – but by no means certain – that these migratory birds will return each year. Many of them make long, sometimes very long voyages, in search of food and/or a place to nest/breed. Voyages are full of dangers: natural dangers, and many man-made dangers, such as through the increasing impacts of climate change. Populations of many migratory birds have been shown to be declining all over the world: in North America, South America, Europe, Africa, Asia, Australia and the Pacific. These declines often show a remarkable correlation with man-made changes.

For each species the migration chain is only as strong as its weakest link. If one link is broken, the population may decline. If we want our migratory birds to keep coming back each year in numbers sufficient to allow them to survive into the future, all links must be strong. Together we must protect those birds throughout the year along their entire distribution area, referred

Little Egret (Egretta garzetta), Asia, courtesy Wings Over Wetlands

Common Shelduck (Tadorna tadorna), Europe, © Tim Faasen

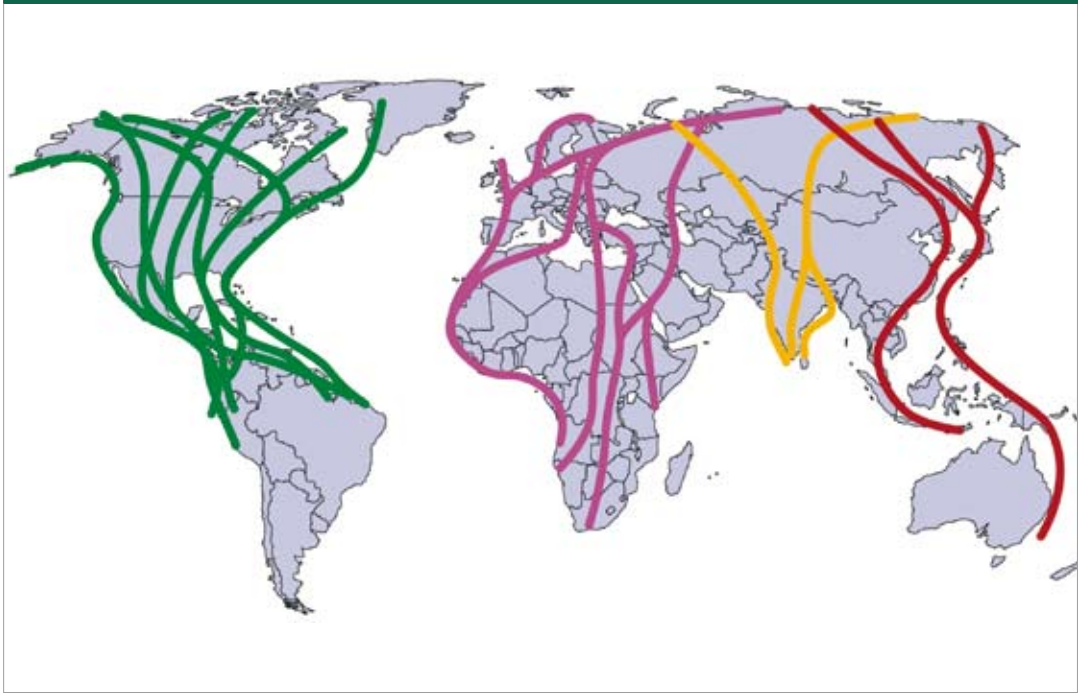
to as their 'Flyway'. That is the joint responsibility of governments around the world, and what this publication is about: the need for, and value of, protecting migratory birds and their habitats in a coordinated fashion along their entire flyway – in short, implementing the Flyway Approach.

The Convention on Migratory Species and its daughter agreements focus on the conservation of migratory animals and their habitats on their journeys – in the case of birds along their flyways. Hence, it plays a key role in flyway conservation.

Albatrosses and petrels, Antarctica, © Tim Dodman

Hooded Warbler (Wilsonia citrina), South America, © Adrián Azpiroz

Figure 1: The principal flyways of migratory waterbirds breeding in the Northern Hemisphere. (Note that many waterbirds migrate in directions other than those indicated here.)



© Bert Lenten, p. 352 in [i]

Flock of waders on Banc d´Arguin, Africa, © Gerard Boere

Rainbow Bee-eater (Merops ornatus), Australia, © Rodney Smith

2 BIRD MIGRATION

2.1 Why birds migrate – A definition of migration

Birds are amazingly adaptive creatures. But, they have specific needs to sustain themselves. At different times of their life cycles they require specific kinds of food, water, a place to rest and to breed and for a number of waterbird species also a place to moult all their flight feathers at once, where they do not run a great risk of being preyed upon when flightless.

In any one area, the availability or access to these essential resources may fluctuate with the changing of the seasons. But it also varies from year to year, depending on whether it is wet or dry, hot or cold, etc. Thus, birds must leave before abundance diminishes, and competition and other hazards to their survival become too great. They instinctively know when to set off on their journey before food supplies become critical and their natural "body clock" is often even timed to depart on a certain date each year.

Migratory birds evolved over millennia to fly long distances in order to make use of many different habitats and the seasonally abundant resources within various climates. Despite this high adaptability, they depend not only on one but all the habitats they occupy, which increases their vulnerability.

A general picture of bird migration world-wide is depicted in the introduction (Fig. 1, p. 9), taking the area where birds breed as a starting point. Please note that it does not imply that birds 'belong' to the area where they breed, but rather that they are a shared heritage, and a shared responsibility of all countries they visit. No detail is given here on how various migration systems developed. Possibly they evolved under the influence of climate change following the last Ice Age.

The best known migrations, those that link breeding grounds to non-breeding areas and take place on an annual cycle, probably originated as a strategy by birds of southern latitudes to occupy harsher, northern climates, regions with high seasonality. They therefore tend to be orientated from north to south, both in Eurasia and in the Americas. This is, however, not an absolute rule, and some birds, for instance in Eurasia, travel a distinct east-west course.

Other types of migration also exist, such as the well-known movements to moulting grounds by ducks, geese and swans, and the more recently appreciated large-scale movements of Mediterranean and Black Sea birds northwards, just after the breeding season.

Around the equator, in the wet tropics, rainfall, temperature and resource availability are generally more stable throughout the year than in other areas. Birds that breed there often remain in this zone. There is no need for a hazardous migration.

Long-tailed Cormorant, (Phalacrocorax africanus), courtesy of Wings Over Wetlands

A tropical bird, the Black-throated Mango (Anthracothorax nigricollis), male, © Sergey Dereliev

Egyptian Nightjar (Caprimulgus aegyptius) a semi-arid migrant, © Mohammed Shobrak

Northern fulmar (Fulmarus glacialis) an Arctic migrant at the nest, Scotland, © Tim Dodman

Further away from the equator to the north and the south in the semi-arid zones there is a well-defined rainy season. Many bird species breed there when food is abundant, and then move back to equatorial regions or beyond when the dry season commences.

At high latitudes, food availability is minimal during winter. Almost all birds that breed closer to the poles must leave and come back for the next breeding season. They travel to lower latitudes, to equatorial regions, and even on to higher latitudes in the opposite hemisphere.

Birds at Lago Chungará, Andean Lake, Región I, Chile, © Adrián Azpiroz

For high altitudes the same principle applies: Only limited food is available during the local winter or dry season. All the higher mountain ranges of the world have bird species that show altitudinal migration, moving up and down as resource availability changes.

In the temperate zones at median latitudes, roughly 30 to 60 degrees from the equator, some resources are available all year round, while others fluctuate with the seasons. Most birds that depend on these seasonally fluctuating resources have to go elsewhere every year. Some of them move only a little way, others fly all the way to the tropics, and some even fly to higher latitudes on the other side of the equator, to profit from the warmer climate there.

Female Blackcap (Sylvia atricapilla) behind fruits, in a temperate zone, © Albert Winkelman

Still other resources in one area such as locusts are rich one year and poor another. Birds that depend on those resources remain there in years when there is enough to eat, but move out in large numbers, in big eruptions, in years when there is too little food.

Greenland White-fronted Geese (Anser albifrons flavirostris) flying to staging areas in western Iceland. Recent research, including the use of satellite telemetry, has given a clearer understanding of the energetic implications of the lengthy two-stage migration undertaken by these geese. © Chris Wilson, p. 505 in [i]

Banded Stilts, Australian shorebird, (Cladorhynchus leucocephalus), Nomadic opportunists, © John Vogel

Lastly, in arid areas, rainfall, and the life it brings, shows no regular pattern. Therefore many birds in arid areas also show irregular movements. They move close to where it has recently rained, in no specific direction and at no specific time of year, to profit from the seeds and insects and other food to be found there, and often to breed. And when that place is no longer attractive, they move on again, to wherever it may be more advantageous to go next. This kind of opportunistic, nomadic movement is also included in the definition of migration. See the Glossary for definitions related to bird migration.

Gradual historical climate change altered the patterns of food availability to birds in various parts of the world. Rapid future climate change may require new changes in bird migration systems, and there is growing concern that not all species may have the time and the space to make such changes.

It is noteworthy that primarily waterbirds follow the same migration routes year after year. As a result the flyway conservation concept mostly applies to these birds since it is feasible to identify specific corridors that are critical to these species' survival. However, many other migratory birds such as North American songbirds tend to rely on secondary habitat and do not have stable migration routes. This means that it is not possible to designate specific regions that need protecting, but that throughout their range suitable habitat needs to be made available.

Bohemian Waxwings (Bombycilla garrulus) only migrate when food becomes scarce, © Albert Winkelman

2.2 The ability to migrate – A well organised journey

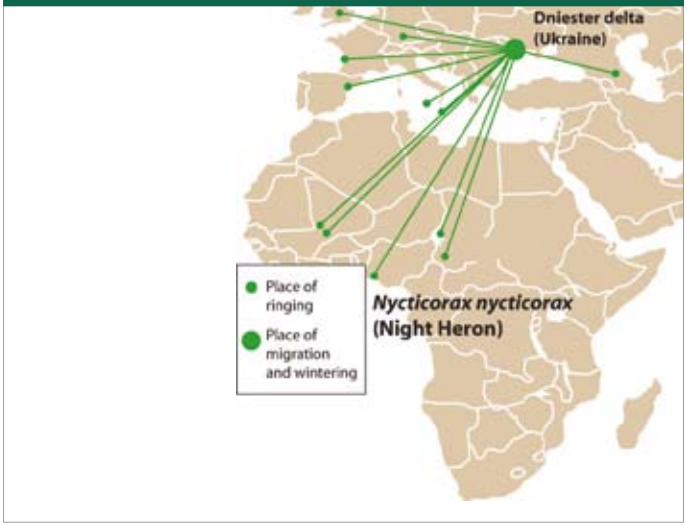
Bird migration is a highly complex phenomenon, both in its spatial and temporal organisation. The spectacular mass migrations of large soaring birds that fly by day using updrafts, which force the birds to pass through narrow corridors, in particular to avoid sea expanses, led early observers to adopt the concept of migration routes.

However, it is now known that this is not typical, and that migration patterns are highly species-specific. Thus, passerines, especially insectivorous birds, largely migrate by night, on a very broad front, crossing sea expanses and through the middle of deserts. Some, especially fringillids, e.g. finches and larks, migrate for a few hours just before and after sunrise. All need relatively closely spaced staging points where they can rest and feed. Shorebirds, on the contrary, tend to migrate long distances, between more or less fixed staging points, so that they are rarely seen in large stretches of land over which they nevertheless pass. Hence, different bird species have different migration behaviour and strategies. In certain species migration behaviour even differs between populations, or between individuals of the same population (Fig. 2). The key is that individuals arrive at their breeding grounds, in good time and good condition, and begin to breed early and in the best territories - two advantages in the battle for procreation. Following a mild winter, resident birds are at an advantage; after a harsh one, migrants that have avoided the local winter are best placed. In any case, through various migration routes of avian species, birds take their food sources from different regions of the world. Therefore, the nutrition available for both migratory and non-migratory species is sustained.

Fuelling up for the flight

Prior to any migration flight, birds need to be fully fledged, forage well and fatten up in suitable habitats with little disturbance. To gain the fat needed, the potential migrant will depend on a steady and food-rich environment. That extra fat, and sometimes also the energy stored in muscle, is the tank of fuel for the journey

Figure 2: Various migration routes of the Night Heron (*Nycticorax nycticorax*) from Dniester delta population



© I. Rusev & A. Korzuykov, p. 446 in [i]

Well-fed Purple Sandpiper (Calidris maritima), © Tim Faasen

to be undertaken. Some migratory birds can even double their weight prior to migration. On the other hand, certain species like the Bar-tailed Godwit *Limosa lapponica* even go so far as to reduce the size of their intestines, 'dead weight' on a long trip during which they do not eat[2]. Thus, they make better use of their weight allowance for a payload that can be converted to energy in order to power their flight.

A bird's weight, its flight efficiency determined by e.g. its wing shape and size, and how much fuel it can store pre-migration, decide how far it can travel in a single non-stop flight. It has been calculated that some shorebirds can cover up to 10,000 km in one go (Fig. 4, p. 16) , and many songbirds 1,000 km. Even the Ruby-throated Hummingbird *Archilochus colubris*, weighing less than 5 grams, can store enough fuel to fly from Yucatan across the Gulf of Mexico to Louisiana and neighbouring states.

With good flight conditions, birds will make it to their next stop-over site with fuel to spare. However, when conditions are or turn bad during their flight, the birds struggle to get through, or run out of reserves not even reaching their next target. For certain species, arriving back at their breeding area with sufficient energy reserves is essential for a reasonable chance of breeding success[3]. It is becoming clear that if the food source of any migratory bird, or its entire refuelling station, should disappear, the affected bird population will be in trouble (see also 2.3 Threats).

In addition to food, water also plays an important role. Flying generates a lot of heat, which is reduced by evaporating water. Most of this is lost through breathing and needs to be replaced by drinking at stopover sites.

Not all refuelling sites before and during migration are the same. Examples of this are the three categories in the continuum of stop-over sites for forest-dwelling, nocturnally migrating Nearctic birds in North America (see Glossary, Definitions: Fire Escape –, Convenience Store – and Full Service Hotel stop-over sites). Stop-over sites for other groups of migratory birds could be classified similarly.

The Bar-tailed Godwit (Limosa lapponica) breaks records with its long-distance migration, © Tim Faasen

Orientation

It is truly amazing how migratory birds can navigate with pinpoint accuracy. They can return, after a voyage of often tens of thousands of kilometres, to the precise island in the middle of the ocean or patch of forest where they were born, to the same refuelling site for instance in the Yellow Sea, or to the same garden in South America where they spent the non-breeding season the previous year. But also many first-year birds know how to find the traditional non-breeding grounds without assistance from older birds. Clearly, this must be a combination of innate programming and capacities for orientation and navigation.

It has been shown that migratory birds have the ability to navigate by the sun during the day, by the stars at night, and by the geomagnetic field at any time. Hence, no matter under which weather condition they fly, they will usually find their way to their destination. They also have an internal daily and yearly clock. Some can detect polarised light, particularly around sunset, which many night-migrating birds may use to calculate their course for the night ahead. There is further discussion, on whether migratory birds can navigate by infra-sound generated by e.g. air movement around mountains or at marine coasts, or even by smell, using a 'scent map' in their memories.

The White-rumped Sandpiper (Calidris fuscicollis) moves in a loop migration, © Adrián Azpiroz

Figure 3: Different types of migratory strategy shown by waders moving from coastal west Africa to sub-arctic breeding grounds: (from left to right) by Turnstone *Arenaria interpres* ('hop'), Dunlin *Calidris alpina* and Redshank *Tringa totanus* ('skip'); and Red Knot *Calidris canutus* and Bar-tailed Godwit *Limosa lapponica* ('jump').

© Theunis Piersma, p. 40 in [i]

Knowing when the winds are right to take off

Most migratory birds seem to instinctively 'know' when conditions are right to migrate, not only in terms of the time of year, but also with regard to the weather. They wait until there is a tailwind at their preferred migration altitude, before setting off. On long flights, they even adjust the migration altitude for different parts of their journey, to maximise their benefit from prevailing winds. Migrants have been measured to fly as high as 6,700 m, undoubtedly to maximise flight efficiency.

If they wait for good winds too long however, they may take off under unfavourable conditions. That can cause increased mortality, with birds simply not reaching their destination. Populations of less numerous species may take some time to recover from such a setback, if the setback is large enough. Birds in great need while crossing oceans may even use ships or oil platforms to land on. Bad weather can also cause individual birds, especially immature ones, to turn up in places where their species does not normally occur. A good example is the Azores Islands in the middle of the Atlantic Ocean, where many vagrants from both North America and the Palearctic are found.

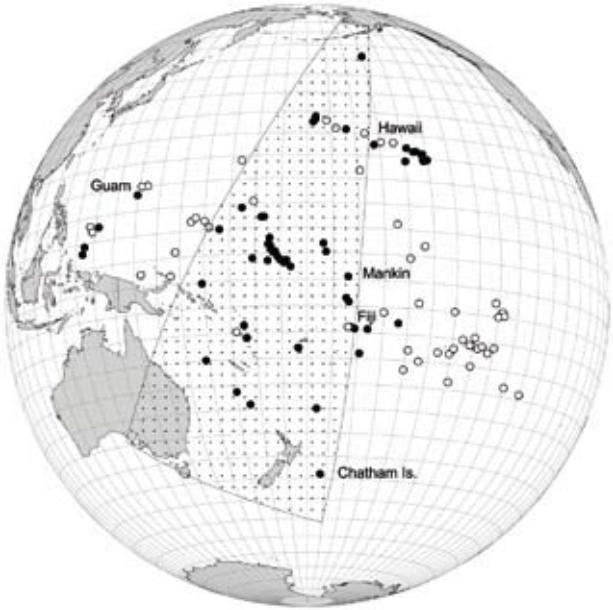
One long flight or a number of short ones

Birds that travel long distances can apply different strategies. What strategy they use depends on their energy reserves, but also on refuelling possibilities along the way. For the majority of species, flights across water offer neither refuelling nor resting possibilities. Flights across deserts give only limited opportunities for foraging, if any, but do allow many birds to touch down to recover.

The length of flights depends in part on the availability of suitable habitat for refuelling. For many songbirds stop-over sites, though patchily distributed, are found in many places. During migration over less extreme regions these songbirds apparently progress in flights of up to to 500 km per day[4], interrupted by several days of recovery and feeding. There is evidence from ringing programmes that small songbirds also use the same stopover sites every year, both on the way to and from their breeding areas. However, because they mostly migrate over a broad front, while there are only a few key habitats along their migration routes there are many small ones. Conditions along their flyways can therefore become worse without anyone really noticing.

At the other end of the spectrum are species that depend on a network of very few key sites for refuelling. This is mostly the case for waterbirds, such as the Red Knot *Calidris canutus*. An extreme example is the Bar-tailed Godwit, for which the refuelling stations, or staging sites, can be more than 11,000 km apart (Fig. 4).

Figure 4: Distribution of records of Bar-tailed Godwits *Limosa lapponica* throughout Oceania during the southward migration period (September- November).



Filled circles = sites reporting godwits; unfilled circles = sites at which no godwits were noted during the period. Map projection = Orthographic (central meridian = 180; reference latitude = –10). Lateral bounds of stippled region = plotted great circle routes
© Gill, Piersma, Hofford, Servrance, Riegen, p. 527 in [i]

For variation in migration strategy see also Fig. 3, p. 15, illustrating migratory waders that 'hop' short distances every day from one suitable site to another; 'skip' longer distances across ecological barriers, or 'jump' over long or very long distances, taking a number of days to reach each suitable site[2].

A distinction should be made between the number of sites essential for individual birds, and the requirements of entire populations, with some individuals perhaps needing only a couple of relatively small stop-over sites. It is at the population level that conservation measures should be applied: the belief that it is acceptable to lose certain stop-over sites, because other sites can take over that role, is all too often groundless. Furthermore, due to climate change the habitat of stop-over sites will change and thus alternative sites need to be available in future to ensure the connectivity of migratory pathways.

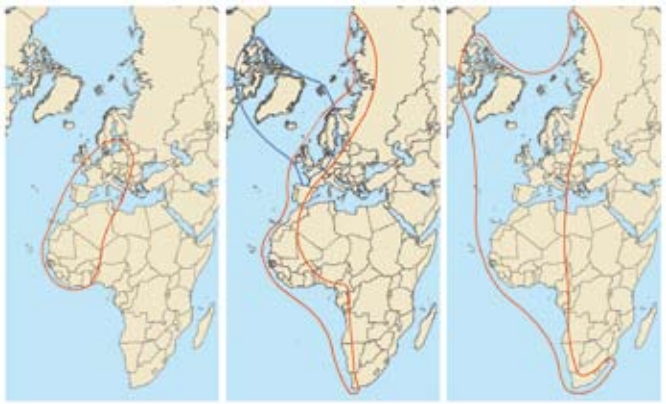
Soaring vulture, © Tim Dodman

Migration on a broad front or along well-defined routes

A number of species soar rather than flap their wings when on migration. They depend primarily not on their flight muscles, but on thermal currents or hot air rising to take them more or less straight up. They then glide in the direction of migration, losing height slowly until they find a new thermal to take them up again. Birds that soar include storks, pelicans and many birds of prey. They have long broad wings that allow them to glide long distances without losing much height. Thermal winds can in particular be found along mountain chains. During migration soaring birds are often concentrated along such ranges, especially if they run from north to south, e.g. the Andes.

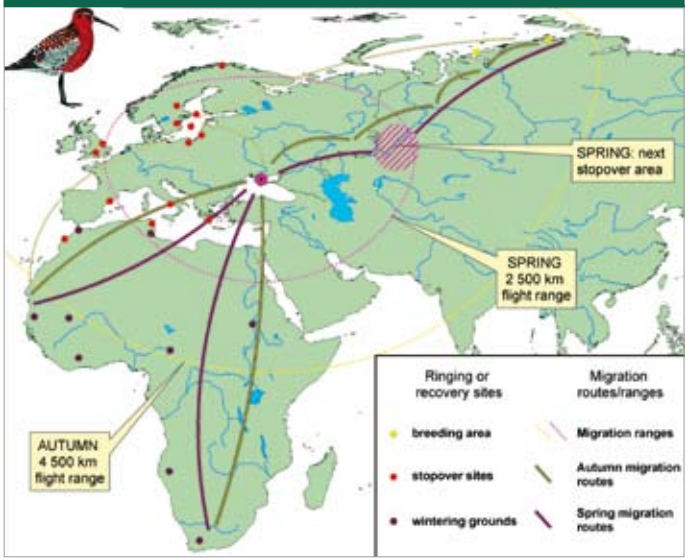
Because thermals occur only over land masses, soaring birds avoid flying over the sea. Where the land narrows, their flyway is therefore constricted, for instance along the Central American Isthmus and the Malaysian Peninsula. Concentrations of migrating land- and seabirds may be seen where headlands stick out into the sea, such as at Falsterbö in South-West Sweden, Cap Vert in Senegal, Cape May on the Atlantic coast of the USA, Point Reyes on the Pacific coast and off the southwest coast of Sri Lanka (Bridled terns *Onychoprion anaethetus*)[5]. If they cannot avoid crossing water, soaring birds also tend to accumulate where crossings are at their narrowest, for instance at Gibraltar, the Bosporus, and the southern tip of Sinai in Egypt.

Figure 5: Examples of three different species' migration systems within the East Atlantic Flyway for waders, showing broad migration routes from northern breeding areas to overwintering sites in Europe and Africa. Left to right, Kentish Plover *Charadrius alexandrinus*, Red Knot *Calidris canutus* and Sanderling *Calidris alba*.



© Smit & Piersma, p. 41 in [i]

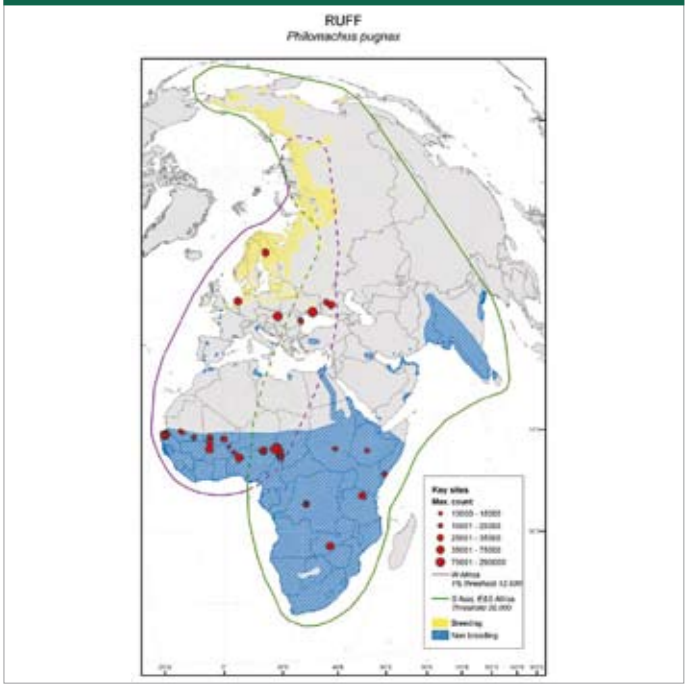
Figure 6: Recoveries of Curlew Sandpipers *Calidris ferruginea* ringed or recovered in the southern Ukraine by seasons (wintering, migration and breeding) and scheme of migration routes and estimated flight ranges



© Sergei V. Khomenko, p. 566 in [i]

Birds that fly mostly using their own energy, by flapping their wings, tend to migrate over broader fronts, and cross broader seas (Fig. 5, p. 17). However, these birds also tend to fly around mountains and deserts if that is not too much effort. This happens, for instance, at each end of the Caucasus between the Black and Caspian Seas. If barriers cannot be circumvented, birds have no choice but to cross them. In such cases concentrations of migrating birds may be found at more favourable spots within broad barriers, such as islands in seas and oceans and oases in deserts. But even if circumvention is possible, some birds do not appear to make use of this opportunity: Bar-headed Geese *Anser indicus* have been observed crossing the Himalayas at 8,000 m.

Figure 7: Ruff migration map



© Wetlands International 2009, [ii]

Migrating waterbirds depend on discrete sites of suitable habitat along their flyways, i.e. they are found concentrated at coastal and/or inland wetlands. If the distance between suitable sites becomes too great for a particular species, e.g. through wetland degradation or drainage, its population will be affected.

A special phenomenon is the so-called 'loop migration', where birds take a different route back to their breeding areas from the one they took to get to their non-breeding areas. A broad range of species all over the world exhibits loop migration, including the Blackpoll Warbler *Dendroica striata*[6], the White-rumped Sandpiper (see illustration earlier in this section) in the Americas, and the Bar-tailed Godwit in the Pacific (see illustration earlier in this section). In the Eurasian-African system the Curlew Sandpiper *Calidris ferruginea* is a clear example (Fig. 6, p. 17). It hardly needs be said that for such species conservation of the birds and their habitats is required along both the outward and inward flyways.

Direction of migration

Bird migration is by and large thought of as movement along a south-north axis. However, as discussed already, this is not always the case.

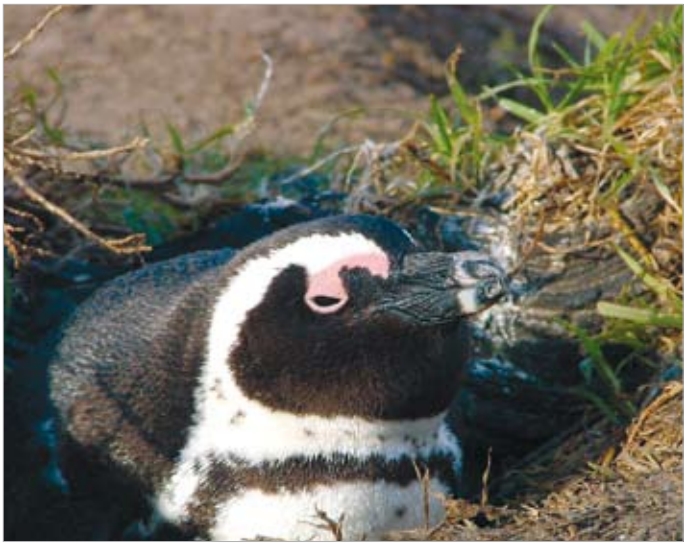
Altitudinal migration can of course be in any direction of the compass as demonstrated by the High Andean Flamingos *Phoenicopterus andinus* in South America or the Ibisbill *Ibidorhyncha struthersii* in Asia.

Some species show a considerable east-west and west-east component in their migration. Examples are the Double-banded Plover *Charadrius bicinctus*, which breeds in New Zealand and spends the non-breeding period mostly in coastal South-East Australia[7]; Northern Lapwings[8] and Common Starlings *Sturnus vulgaris*, that breed in Russia and winter in Western Europe; and Ruff *Philomachus*

The Wheatear (Oenanthe oenanthe) shows strong east-west migration, © Albert Winkelman

pugnax that breeds in Siberia and spends the non-breeding season in West Africa (Fig. 7). An extreme example of a passerine species that shows a strong east-west and north-south movement is the Northern Wheatear *Oenanthe oenanthe*. It breeds from western Alaska across Eurasia to Greenland and North-East Canada. Birds from across all these areas migrate to spend the non-breeding season in sub-Saharan Africa. The population that breeds in Canada and Greenland cross the Atlantic to Africa, one of the longest sea-crossings undertaken by a passerine, while the birds that breed in Alaska cross over into Asia via Siberia and then travel to Africa.

Many albatross and petrel species that breed in southern latitudes, during the non-breeding season ride the westerlies over the Southern Ocean, circumnavigating the Antarctic region in an eastward direction. Many of these movements/flyways have been discovered with modern techniques such as geo-locators, small data loggers on the leg of e.g. an albatross that record night-day changes, among other parameters. When the birds return to their nest the recorder can be retrieved and the data analysed reconstructing the migration routes and flight patterns.



African Penguin (Spheniscus demersus), ZA, © Tim Dodman

The ability to fly is not always necessary for migration

So far in this section it has been assumed that birds fly to their migration destination, but that is not necessarily so. Ostriches *Struthio camelus* and Emus *Dromaius novaehollandiae* both species of arid and semi-arid areas cannot fly, whose movements are regulated by the availability of food and water. In areas where they need to move to find new food or water, those movements are often nomadic, showing no regular pattern. However, in parts of the Sahel, Ostriches tend to walk north during the rains and south again when it is dry. In Western Australia Emus walk towards the coastal areas in the south for the winter rains there, and to inland areas further north for any summer monsoonal rains.[9]

Antarctic penguin species swim northward at the onset of the cold season, away from the pack ice. To breed they swim south again, and some walk. Emperor Penguins *Aptenodytes forsteri* start their breeding in the cold season up to 200 km from the open sea, and for them there is only one way to get there: on foot. By the time the young become independent, in January-February, the Antarctic summer, the open water is much closer.

Avoiding hazards such as heat and water stress, predators, parasites

Bird migration is not only focused on getting what birds need during their travels, but also on avoiding what they do not want. Overheating from muscular exertion while migrating for example is obviously a problem migratory birds try to overcome. Some species reduce temperature rise by flying at greater altitude. Many other species migrate at night, perhaps also to reduce heat stress.

Nocturnal migration definitely reduces predation by birds of prey. And again others such as many waders use a different tactic by frequenting saline shallows during the non-breeding season. In addition to the availability of food in large quantities, they may also do so to avoid the parasites that are so numerous in fresh water areas[10].

2.3. Migration and its dangers

Key threats to migratory land- and waterbird species world-wide are shown in Fig. 8.

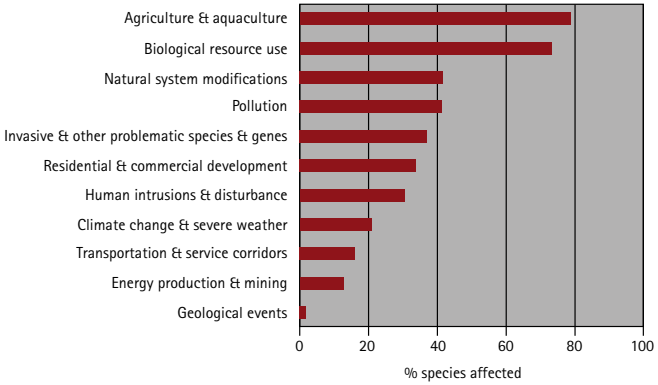
Foremost among them are agriculture and aquaculture, affecting nearly 80% of migratory birds, and the use of biological resources (i.e. logging, collection of wood for fires and construction etc.) affecting more than 70% [11], based on [12].

Agricultural land use change not only encompasses clearing, but also land use intensification [14, 15, 16], landscape fragmentation [17], and overgrazing. It is in part related to human population increases: In Burkina Faso for example, the large decrease in natural vegetation in just 25 years is no doubt related to the simultaneous doubling of the local population (approximately 3% annual growth rate) [18].

Land use changes with negative effects on migratory birds occur in breeding areas, in non-breeding areas, and in stop-over areas. Even though the relative importance of changes in these three types of area will differ between species, effects at stop-over sites should in any case not be underestimated. The drastic decline of the subspecies of the Red Knot *Calidris canutus rufa*, breeding in the northern Canadian tundra and migrating as far as the southern tip of South America, is linked to the decline in Horseshoe Crab eggs in Delaware Bay, due to overharvesting of adult crabs for fishery bait. From an estimated 100,000 birds in 1989, numbers were drastically reduced to only 17,200 in 2006.[19, 20] A similar situation has been described for the Red Knot subspecies *C.c. canutus* and *C.c. islandica* that fuel up in the Dutch Wadden Sea. The shellfish species they feed on have been greatly reduced in number due to commercial shellfish harvesting [21, 22]. For raptors, finding less food at stop-over areas while migrating, can lead to increased competition for food and roosting space, interspecies predation, and greater vulnerability to further natural and human-induced environmental hazards [23].

Modification of natural systems (40% of species, Fig. 8) encompasses for instance the construction of dams and drainage of wetlands. In the People's Republic of China and the Republic of

Figure 8: Main factors affecting threatened and near-threatened migratory bird species [11], based on [12]; threat categories follow [13]



© Kirby et al.

Human use of wetlands and migratory birds, mainly terns (Crimea, Ukraine), © Ronald Groenink

Korea, 37% and 43% respectively of inter-tidal wetlands have disappeared due to land reclamation; 80% of existing wetlands in East and South-East Asia are classified as threatened, with more than half under serious threat.[24] The fate of wetlands in almost all other parts of the world is similar: The loss of the Aral Sea due to diversion of rivers for agriculture; the degradation and loss of many freshwater wetlands across Asia due to pollution, eutrophication, damming, siltation and deforestation in the catchments; and introductions of exotic and invasive alien plant species have all changed the characteristics, plant, insect and fish diversity and abundance and carrying capacities of the wetlands.

Man-made structures were estimated to cause the death, mainly by collision, of an estimated 1.3 million migratory birds in the 1970s[25]. By 2000, numbers of such structures had increased roughly fourfold, and the number of migratory birds of 350 species killed had increased to 4–5 million per year, - mostly long-distance migrants that fly at night[26].

The toll of **obstacles** such as modern wind turbines on migratory birds does not seem very large as yet, and has been estimated at 33,000 birds per year in the USA[26]. However, wind farms sited across narrow migration routes of soaring birds, or near wetlands with many birds, can cause relatively large losses[27]. Effects concern not just direct mortality (probably underestimated because of corpses not found), but may also include disturbance[28]. Effects will increase, possibly in a more than linear fashion, as new wind farms become operational. Careful location of future wind farms and more peer-reviewed studies of their effects on migratory birds, are required.

The dangers of power lines include collision, especially for larger migratory birds (e.g. Great Bustards), and electrocution, especially for birds that often perch on pylons, such as raptors and storks. Careful location and design modifications can help reduce these problems.

Habitat change and migratory threats occur also due to **climate change**, with at least 20% of migratory bird species affected. This impact is expected to increase dramatically over the next decade, not least in Arctic regions[29] and includes:

Pelican killed by wind turbines, © Mihail Iliev

White Storks killed by collision, © Mohammed Shobrak

- Changes in food availability (a derivative of habitat change)
- Increased competition between resident and migratory birds, and between short-distance and long-distance migrants;
- An increase in incidences of severe weather;
- Changes in the distribution of avian diseases and parasites;
- Changes in migration behaviour, routes and timing;
- Changes in timing of breeding and its relation to optimum food supply and consequently in breeding success;
- Changes in survival rates, due to e.g. temperature and/or rainfall changes

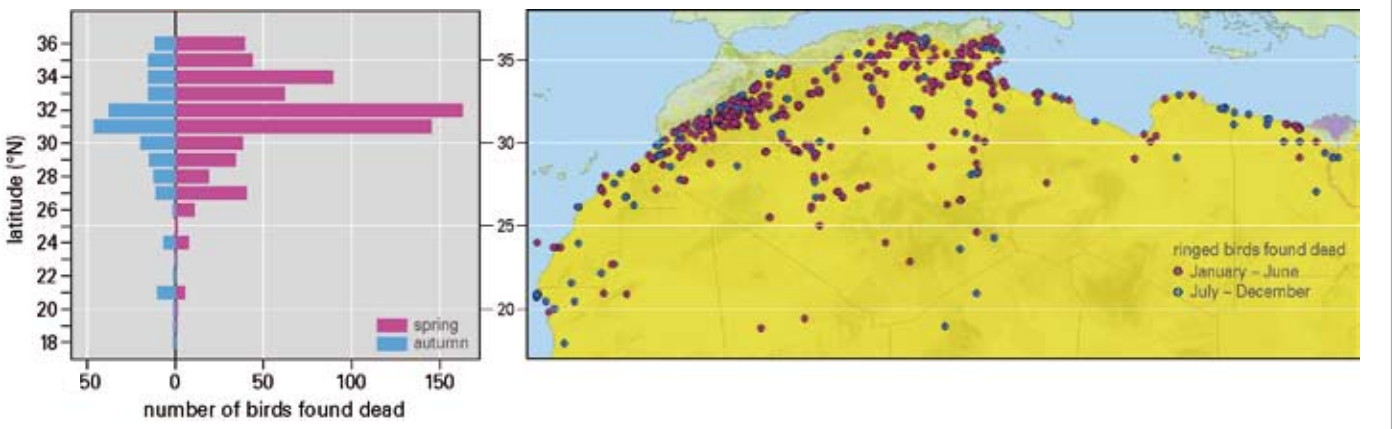
([14, 30-35]; see also 4.1, on birds as indicators of climate change)

More songbirds die while crossing the Sahara than in the six months they spend in the sub-Sahara. Thus, the annual mortality during the north-bound migration is not related to the force of the prevailing headwind above the Sahara, but to the rainfall in the Sahel half a year before the annual migration. Apparently, more birds have insufficient body reserves when they take off from the Sahel following a dry year[36]. Similarly, breeding success of Barn Swallows *Hirundo rustica* in Germany has been correlated with rainfall conditions the year before in the Sahel, the last refuelling station before crossing the Sahara (Fig. 9). If climate change leads to a decrease in suitability of habitat in the Sahel, populations of small passerines that have to go back across the wide extensiveness of desert to breed in Europe are likely to suffer.

Hunting of birds as an economic and cultural phenomenon is discussed in section 4.3. There is no doubt that hunting can affect population size. Consider for example the fate of the Dodo, *Raphus cucullatus*, on Mauritius the Great Auk *Alca impennis* in the northern Atlantic Ocean, the Saker Falcon *Falco cherrug* in Eurasia and North Africa and the Siberian Crane *Grus leucogeranus* in West and Central Asia. After the establishment of reserves and/or reduced hunting, populations of waterbirds have increased in Western Europe and for example those of the Trumpeter Swan *Cygnus buccinator*, Whooping Crane *Grus americana* and Canada Goose *Branta canadensis* in North America[28].

Hunting is a common socio-economic activity in the Mediterranean region as a whole, particularly in rural areas: the Trans-Saharan songbirds mentioned earlier suffer another hit. In total

Figure 9 from [36] and [37]: The number of recoveries of ringed passerines in North Africa per degree of latitude, during autumn (blue, n=229) and spring (red, n=715). Note the much larger number of recoveries during spring migration, when the birds arrive in North Africa exhausted from just having crossed the Sahara desert (indicated in yellow)



one half to one billion migratory birds are killed each year, some 10 million hunters are involved and an estimated 60,000 tonnes of lead are discharged into the environment. The estimated 4 million birds killed annually in the Mediterranean island state of Malta consist of approximately three million finches, half a million swallows and martins, half a million thrushes, 80,000 Eurasian Orioles *Oriolus oriolus*, 13,000 shearwaters, 1,000 Black-necked Stilts *Himantopus himantopus*, etc.[38].

As the global human population continues to grow and the demand for wildlife products increases, exploitation levels of migratory birds are likely to soar. In regions where traditional local game species dwindle in numbers, migratory species may increasingly be targeted. For a variety of reasons there are many countries where the control and management of bird hunting is considered to be poor. It is important for hunters to ask themselves how sustainable their current take levels are and whether the exploited population is threatened by extinction through their practice. Clearly, if we want to conserve migratory birds for future generations, hunting must be sustainable and well-managed. It is vital that international standards such as the Addis Ababa Principles and Guidelines for the Sustainable Use of Biodiversity are enforced and adhered to, not least through the numerous hunting associations. There is a risk of public backlash which may result in hunting bans as seen in the United Kingdom in recent years.

Snow Geese (Anser caerulescens), © Michael Samuel, p. 205 in [i]

It is noteworthy that hunting, when well-managed, can also have a positive effect on populations, as shown in the case of the Snow Goose *Anser caerulescens* in North America. Formerly, more intensive hunting may have balanced out man-made improvements in conditions on the wintering grounds, and kept numbers in check. More recently, a reduction in hunting pressure has led to such an increase in its numbers that its habitat in arctic breeding areas is suffering from overgrazing. However, the killing of threatened species at migration bottleneck sites is likely to have negative effects on population sizes[23, 31, 39, 40]. Either way, it is important that sustainable hunting is included in a systems approach to the integrated management of migratory birds along their entire flyway.

Pollution is an important threat too, with 40% of species affected (see Fig. 8, p. 20), so are parasites and diseases, especially at breeding colonies and other sites where (water) birds congregate, e.g. avian botulism and avian influenza[11]. In particularly managing the risk of avian influenza is important in relation to migratory birds given its potential threats to people. Here CMS plays an important role in coordinating and stimulating global activities on research and risk factors (find out more at www.aiweb.info).

Populations of 52% of all migratory raptors world-wide are considered threatened by habitat loss; 31% by direct persecution; and 21% by environmental contaminants. Significantly, 30% are threatened by at least two of these factors and 8% by all three factors. Long distance migratory raptors are considered particularly vulnerable.[23]

Most of the threats mentioned above have not arisen recently e. g.[41], but have increased in impact due to increases in human populations and economic growth[42].

3 FLYWAYS OF THE WORLD

Some of the information in this brochure might easily lead to despair: there is such a variety of migratory birds to conserve; a vast amount of migration strategies and migration routes; many different threats affecting breeding and non-breeding areas. How can one ever hope to be effective in conserving all these birds?

Fortunately, we can discern and follow key threads. Bird migration does not take place haphazardly, but by and large along a number of well-defined flyways for a great number of birds. The bulk of these are waterbirds that obtain all or most of their food from water. Based on these flyways the organisation of the world-wide conservation of migratory birds can therefore be effective and efficient.

3.1 The flyway concept – Its definition, history and role in conservation of migratory birds

Definition of the 'flyway' concept

For the purposes of the Convention on Migratory Species UNEP/CMS, the term **'migratory species'** is defined as

"the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries".

For a biological definition, the crossing of national jurisdictional boundaries is of course not necessary. Boere and Stroud[43] defined **flyways** as "... the biological systems of migration paths that directly link sites and ecosystems in different countries and continents".

Thus defined, a flyway is a geographical region within which single or various species or some populations of single or various species complete their annual cycle. It includes the areas where the birds breed, the areas of the main non-breeding or contra-nuptial range, migration stop-over areas, areas where birds that have not yet reached breeding maturity may spend the breeding season, moulting and post-breeding expansion areas. Migratory orientations of many species may more or less follow the axis of the overall area, but as they are biological entities, they may decide not to do so.

Using the term 'wintering areas' instead of 'non-breeding areas' would cause confusion where cross-equatorial migrants or altitudinal migrants are concerned. It would also cause confusion in the case of migrants that respond to irregular events such as localised rainfall events in arid parts of Africa and Australia.

The Ramsar Strategic Framework includes the following remark about flyways:

"There are no clear separations between flyways, and their use is not intended to imply major biological significance; rather it is a valuable concept for permitting the biology and conservation of waterbirds, as with other migratory species, to be considered in broad geographical units into which the migrations of species and populations can be more or less readily grouped."[44]

Because waterbirds are attached to habitats that are sparsely distributed in the landscape, the effective geographical area thus envisioned is never the entire land or sea surface over which flyover takes place. It rather takes more the appearance of an archipelago or network of sites, hence the emphasis placed by all flyway and related concepts on networks of sites (see 3.3). These networks need to be articulated and have close functional connectivity. Indeed, each site has a role to fulfil as a breeding, non-breeding, stopover or moulting site for one or several of the species involved in the flyway. Each of these roles requires different ecological characteristics. The sites must be complementary to each other, or some parts of the migratory cycle will be poorly supported. The weakest link will, of course, set the overall efficiency of the network.

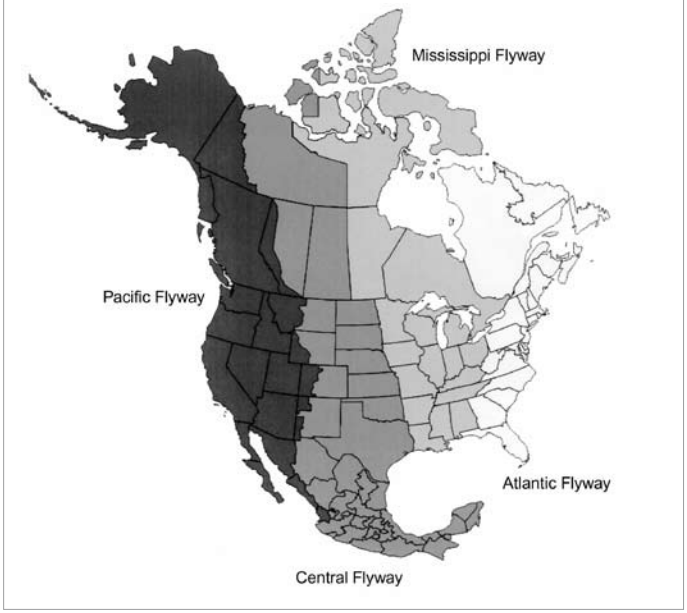
Many terms have been proposed to describe the routes taken by migrating birds. One of the early terms was 'route of migration'[45]. This term, however, can refer to both the route of individual birds and a route taken by a whole population or an entire species. After it became clear that many birds take more or less the same route, the word 'flyway' came into use. The concept of 'flyways' was first used in relation to the relatively narrow migration routes of big groups of larger birds, such as waders, swans, ducks and geese, cranes and storks, soaring raptors, etc.

Historical development of the 'flyway' concept

The multi-species flyway concept was developed in North America in the 1930-40s to provide a management framework for waterbirds. Four flyways were recognised: Atlantic, Mississippi, Central and Pacific (Fig. 10). For each flyway a Council and Technical Committee were established in 1947-1952 [46, 47].

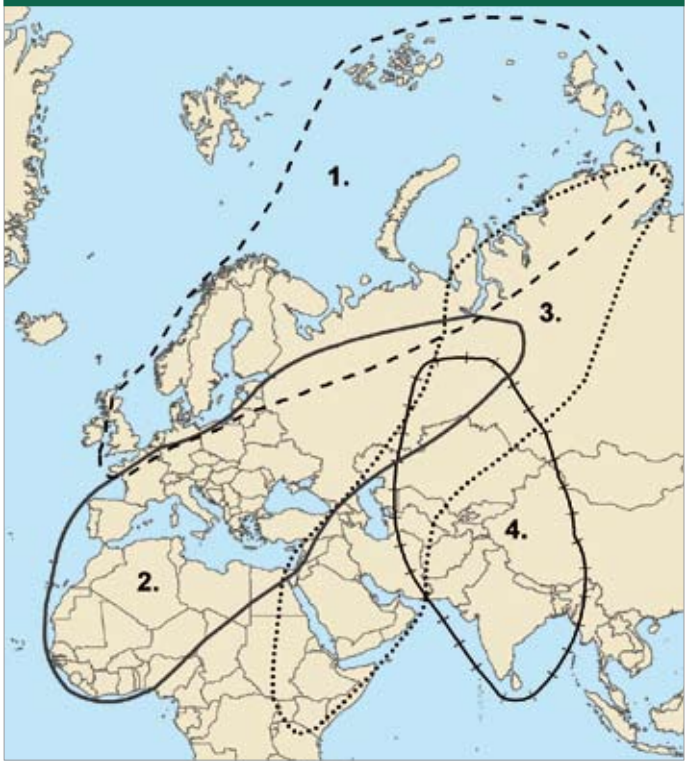
In Eurasia and North Africa, a sustained programme of international co-operation for waterbird conservation commenced after the Second World War[48, 49]. The first flyway maps for waterbirds in western Eurasia were published by the International Waterfowl Research Bureau (IWRB, now part of Wetlands International) and the USSR Academy of Sciences[50, 51] (Fig. 11). The

Figure 10: The waterfowl flyways of North America



© Blohm, Sharp, Padding, Kokel, Richkus, p. 201 in [i]

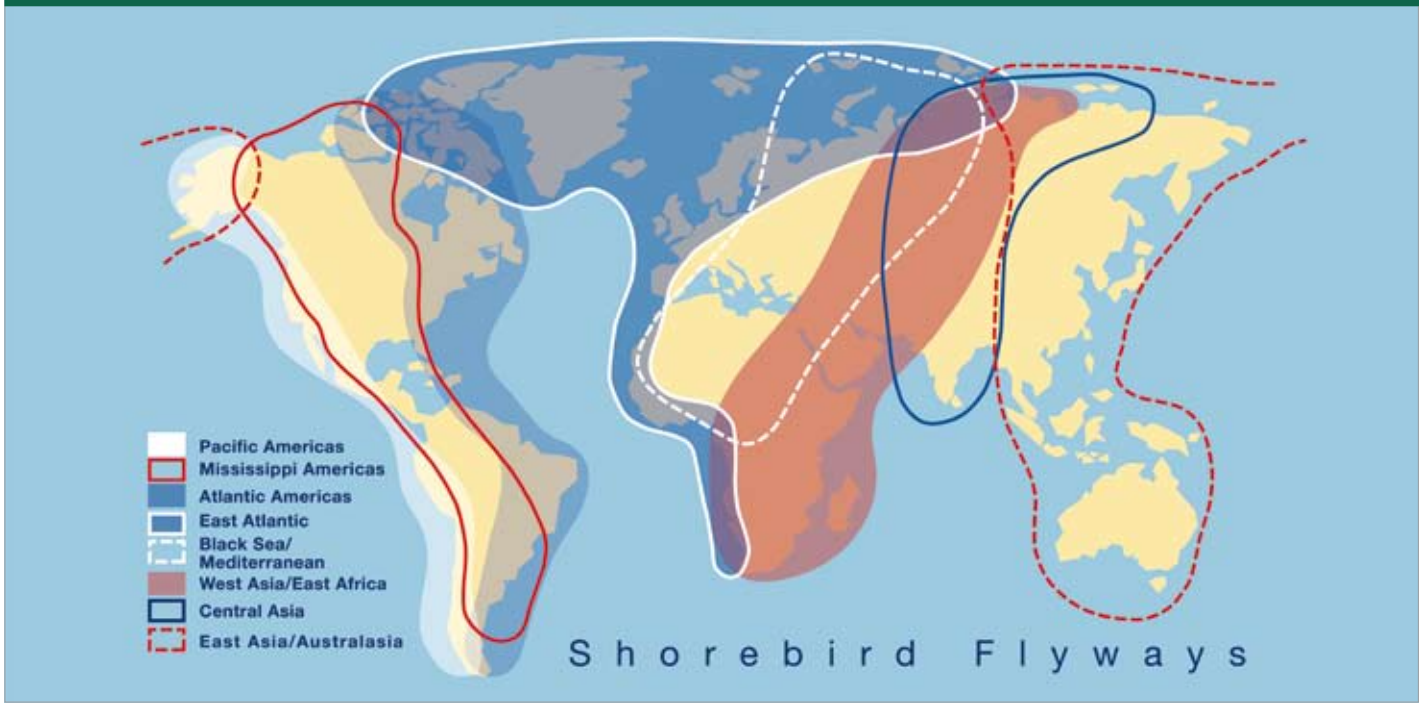
Figure 11: Isakov's (1967) main geographical populations of Anatidae in western Eurasia. Flyway coding: 1. Northern White Sea/North Sea population; 2.European Siberia/ Black Sea-Mediterranean population; 3. West Siberian/ Caspian/Nile population; and 4. Siberian-Kazakhstan/ Pakistan-India population.



© Isakov´s, p. 43 in [i]

Russian ornithologist Isakov recognised four major flyways for ducks, swans and geese in the Western Eurasian region. These maps of the main 'geographical populations' of ducks, swans and geese were published in the context of discussions being held at that time about an international legal instrument for the conservation of wetlands and migratory waterfowl. The discussions resulted in the establishment of the Ramsar Convention in 1971 [52, 53].

Figure 12: The eight broad flyways of waders/shorebirds. Source: International Wader Study Group. A more detailed evaluation by Brown et al. 2001 distinguishes five shorebird flyways in North America: Pacific-Asiatic, Intermountain West, Central, Mississippi, and Atlantic.



Boere and Stroud, p. 42 in [i], © International Wader Study Group

IWRB refined the flyway concept, organising a specific symposium in 1976 on the mapping of waterfowl distributions and habitats in Europe[54]. The other continents followed later.

It should be noted that flyways illustrated on different map projections can appear quite different, and the use of different projections can in itself give useful insights. A polar projection, for instance, highlights the fact that the majority of the world's flyways converge in the Arctic (Fig. 14, p. 35).

The Ramsar Conference held at Heiligenhafen, Germany, in 1974 already called for 'increased cooperation on a regional and "flyway" basis'. The Strategic Framework of Ramsar grouped the migrations of shorebirds/waders into eight broad flyways (Fig. 12): the East Atlantic Flyway, the Mediterranean/Black Sea Flyway, the Middle East/Africa flyway, the Central Asia/Indian sub-continent Flyway, the East Asia/Australasia Flyway, and three flyways in the Americas and the Neotropics. At the 1997 CMS Conference of Parties the flyway concept was first used in relation to a conservation initiative for migratory waterbirds in Eurasia known as the Central Asian Flyway (CAF). The African-Eurasian Waterbird Agreement (AEWA), focusing on African-Eurasian Waterbirds and their flyways, came into force in 1999 under the auspices of CMS. In 2004 the Agreement on the Conservation of Albatrosses and Petrels (ACAP) another CMS Family member was created to conserve these migratory seabirds. Today, CMS has narrowed the global waterbird flyways down to five.[44]

3.2 The flyway approach in practice

Regarding flyways neither as biological phenomena, nor as administrative management units but as geographical entities, i.e. precisely defined areas of the earth,[43] considerably simplifies reviews and comparisons of the sometimes contradictory flyway arrangements proposed by researchers, administrators or conservationists. An additional advantage of this definition is the facilitated management through regional agreements and other legal instruments.

Different divisions of the world into flyways have been proposed depending on whether the focus is on waterfowl, landbirds, shorebirds, or whether a continental perspective is taken. Thus, for ducks, geese and swans (Anatidae), eight relatively short flyways are usually mapped. On the North American continent they are the four classical flyways (Pacific, Central, Mississippi, Atlantic), which North American experts see as "converging at Panama". They do not take into consideration what might happen to them in South America. In Western Eurasia, the flyways essentially represent the ranges of the three "main geographical populations of Anatidae" defined by Isakov in 1967: Northern White Sea/North Sea, European Siberia/Black Sea-Mediterranean, West Siberian/Caspian/Nile[43]. In Central and Eastern Eurasia, the Central Asian Flyway (which includes and extends westward, northward and eastward Isakov's Siberian/India population), and the East Asian Flyway, which reaches southward to the Greater Sunda Islands, have been identified.

From a shorebird research, management and conservation point of view, eight flyways have been proposed by the International Wader Study Group[43]. In the Americas they now include a Pacific Americas, a Mississippi Americas and an Atlantic Americas flyway. These differ from the North American Anatidae flyways in that they extend to the Southern end of South America, that the Central and Mississippi flyways are combined into one, and that the Pacific Flyway is extended somewhat more into the Pacific Ocean (Fig. 12,).

The reason for the flyway approach to conservation is to facilitate political cooperation in the conservation of migratory birds, and to reduce the number of formal instruments for which cooperation would need to be established, a further narrowing to four or five broad flyway areas appears to be opportune[43].

Many of the agreements mentioned in this brochure are 'all encompassing'. Because it is impossible to be in the same place at the same time, practical projects usually focus on a single species, a type of habitat, a specific site (e.g. Wings over Wetlands, WOW) or a particular threat (see section 3.2 Memoranda of Understanding (MoUs)).

Protection of individual species

There are a number of MoUs and Action Plans focusing on single species, so called Single Species Action Plans (SSAPs). Details can be found for example on the websites of the Convention of Migratory Species (CMS), the Western Hemisphere Shorebird Reserve Network (WHSRN), the African Eurasian Migratory Waterbird Agreement (AEWA), BirdLife Europe, BirdLife Africa, BirdLife Pacific, Wetlands International, the Hong Kong Bird Watching Society, ArcCona Ecological Consulting. See the boxes on Spoon-billed Sandpiper *Eurynorhynchus pygmeus* (East and South-East Asia), Eurasian Spoonbill *Platalea leucorodia* (Europe, Asia and Africa), and Hawk Mountain Sanctuary (USA and Central and South America).

Site Networks and Site protection

Conservation of migratory species that depend on a network of sites along their flyways strongly benefits from the proper management of these regions. Various initiatives have been established across the world to promote such conservation efforts; WHSRN in the Americas, the East Asian - Australasian Flyway Site Network and the newly established West/Central Asian Site Network for Siberian Cranes and other waterbirds (WCASN). Sites listed on the Networks give them international recognition, and provide a framework for training and research activities and a focus for public awareness and education activities. Authorities are encouraged to prepare plans for the listed sites (sections 3.3 &3.4). Efforts are underway in the African-Eurasian Flyway region under the Wings over Wetlands project and the WCASN to identify and manage networks of critically important sites.

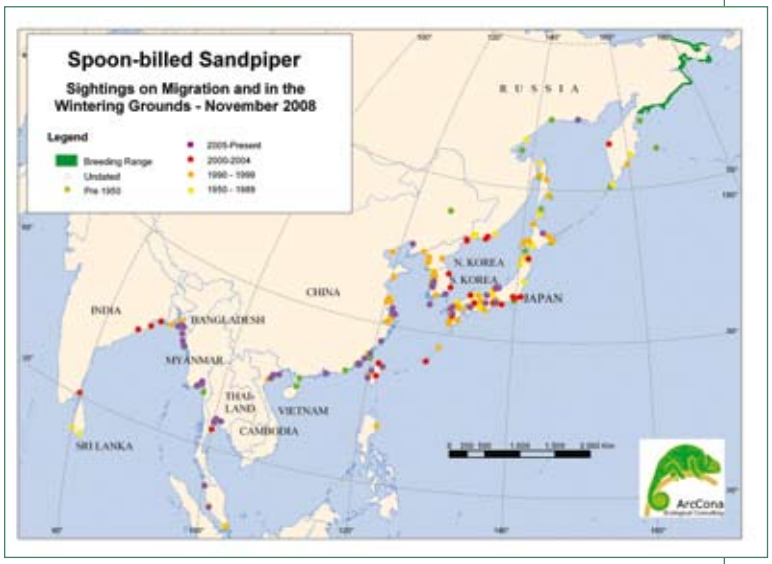
The concept of Site Networks in the Asia – Pacific region has evolved over time as it has become evident that conservation efforts for migratory waterbirds and their habitats can be more effectively undertaken under a common framework. Three sep-

Spoon-billed Sandpiper *Eurynorhynchus pygmeus*

www.arccona.com/spoonbilled.htm

The Spoon-billed Sandpiper has declined dramatically over the last 30 years to an estimated 150-450 pairs and has been recently up-listed to 'critically endangered'. With its spatulate bill, it is unique among the sandpipers. Its breeding grounds are entirely confined to coastal habitats in Chukotka, Russia. The species regularly migrates more than 8,000 km, covering 14 countries in Eastern and Southern Asia, where it is also confined to coastal habitats.

Spoon-billed Sandpiper, © Christoph Zöckler, p. 641 in [i]



© ArcCona/Gillian Bunting

The greatest threat to the survival of the Spoon-billed Sandpiper is the destruction through reclamation of intertidal mudflats along its migration route in China, Japan and Korea, and on its staging and non-breeding/wintering grounds in Vietnam, Thailand, Myanmar and Bangladesh. In addition, hunting and trapping of sandpipers in Russia, China, Vietnam, Myanmar and Bangladesh are serious and continuing perils. Other threats include in general pollution and climate change, and, on the breeding grounds, egg and skin collection, human disturbance and subtle changes in the habitat due to climate change.

All range countries and regions should list the Spoon-billed Sandpiper as a species of high conservation priority and should protect all important breeding, staging and non-breeding sites known for the species. All major reclamation projects along the flyway being undertaken/proposed on intertidal mudflats that are known to be of importance for the species should be put on hold and where possible the restoration of formerly reclaimed areas should be encouraged. Hunting and trapping should be discouraged and education and awareness programmes for specially targeted audiences should be undertaken. Education and outreach material should be produced for the general public on the status of and threats to this species and the required conservation activities.

Continued research is required to further define the wintering areas and more clearly understand the needs of the species while on migration. Continued monitoring is necessary to establish an understanding of the population status and development and to monitor the success of conservation activities. International and regional cooperation and coordination are essential for the survival of this migratory species and its habitats, in order to provide effective conservation activities. CMS and regional flyway partnership agreements, such as the East Asian - Australasian Flyway Partnership (EAAFP), can provide powerful instruments to ensure consistent conservation efforts across their species' range.

Eurasian Spoonbill *Platalea leucorodia* • AEWA International Single Species Action Plan

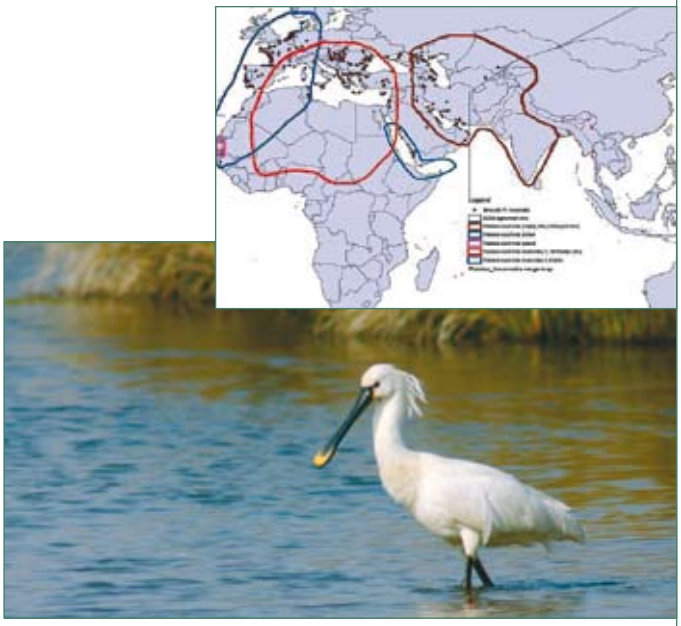
www.unep-aewa.org/meetings/en/mop/mop4_docs/meeting_docs_pdf/mop4_30_ssap_spoonbill.pdf

Eurasian Spoonbill, courtesy of Wings Over Wetlands

The Eurasian Spoonbill *Platalea leucorodia* is distributed from the East Atlantic to India and China. Four or five populations/subspecies can be distinguished: *Platalea leucorodia leucorodia*, the nominate subspecies, is distributed from Western Europe (4,800 breeding pairs) to Central Europe/ Southeast Europe (5,500 pairs). The population which breeds in Eastern Europe and throughout Asia (5,000 pairs) has been designated as a separate subspecies, *Platalea leucorodia major* on the basis that it is larger in size than the nominate subspecies. Two subspecies are found in Africa, *P. l. balsaci* (750 pairs) whose distribution is limited to the Banc d'Arguin (Mauritania) and *P. l. archeri* (1,100 pairs), the Spoonbill of the Red Sea.

The Central and Southeast Europe population *P. l. leucorodia*, and probably the "major" population, breed partly in non-protected sites and particularly in artificial fish-ponds. The decline of these populations seems to be due to a combination of different threats linked to human activities. The Pannonian population is still subject to heavy illegal hunting pressure, particularly in staging areas between its breeding and non-breeding/wintering areas; reduction of illegal hunting in these staging areas is a priority. Rehabilitation of former wetlands is considered as important to improve post-fledging survival and would be also a major factor in promoting an increase in Spoonbill numbers. Cooperation with the owners of fishponds is important to protect the breeding sites.

The *balsaci* subspecies is the most at risk, with a sharp decline in numbers in the breeding population, which is restricted to a single site, the Banc d'Arguin (Mauritania). A large proportion of juveniles is killed by predators (jackals) and the breeding site faces an increasing risk of sea flooding. Measures to be taken for this subspecies include strict control of predators. The study of sea defences for protecting the nesting sites must start as soon as possible.



Eurasian Spoonbill, © Tim Faasen

P. l. archeri is not protected in four countries; therefore birds are liable to persecution. Some data indicate that colonies of this subspecies are often disturbed by human activities. For *P. l. archeri*, the priority is to encourage the relevant governments of the Range States to protect the subspecies and its key sites during the breeding and non-breeding periods. For each population, the study of migratory movements and demographic parameters are necessary. This will depend on coloured ring schemes and, if possible, on satellite telemetry. This Action Plan was prepared by the International Spoonbill Working Group, an informal group hosted by Eurosite. The Action Plan is based on answers from 75 countries in Europe, Asia and Africa. Implementation of this action plan is foreseen in 54 range states.

arate site networks were initiated under the framework of the Asia-Pacific Migratory Waterbird Conservation Strategy in 1996. The three species groups concerned were shorebirds, cranes and Anatidae and the networks covered over 100 internationally important sites in 14 countries. The concept of site networks was successfully promoted, as was a wide range of conservation awareness raising, habitat management and capacity building activities[56]. These networks have now been brought together under the East Asian-Australasian Flyway Site Network, which recognises the importance of the sites for a multitude of species under the framework of the East Asian – Australasian Flyway Partnership (section 3.4 and text boxes on EAAFP & Wetlands International Flyway Atlas Series).

Protection of habitats

A number of initiatives target habitat-oriented rather than species-oriented conservation actions, such as AEWA (section 3.2), the Ramsar Convention (conservation of waterbirds and their habitats), and the East Asian-Australasian Flyway Site Network (section 3.4). Protection plans for groups of species can sometimes also be considered to be habitat-oriented e.g. the MoU on the Conservation of Southern South American Migratory Grassland Bird Species (section 3.2) and the newly established WCASN. See also text boxes on Shade-grown coffee, WHSRN and the Pine Oak Forest project.

Management of threats

If a threat is important and easily identifiable, it can also be tackled in its own right. A case in point is the often unsustainable by-catch of seabirds during long-line and trawlfishing operations. These types of fishing in their original form are considered the most important threat to albatrosses. It was a major reason for the founding of ACAP, the Agreement on the Conservation of Albatrosses and Petrels (section 3.2). Significant progress has been made in the reduction of bycatch of albatrosses and several other species of sea birds during long line- and trawl-fishing operations. See the box on reducing the bycatch of albatrosses, and also the box on hunting of migratory birds in the Mediterranean region.

Buy shade-grown coffee to help protect our migratory birds

- **http://nationalzoo.si.edu/ConservationAndScience/MigratoryBirds/Coffee/**
- **www.coffeeresearch.org/politics/birdsafe.htm**

Many birds that breed in North America spend the non-breeding season in forested parts of Central and South America, in coffee-growing areas with above average rainfall. In order to grow coffee, the forest is cleared. Originally all coffee was shade grown: the available varieties did not tolerate much direct sunshine and many of the original forest trees were left standing to provide shade. These trees provided mulch for the soil, habitat for insectivorous birds that eat pest insects, and regulation of the hydrological cycle.

However, in the 1970s coffee bush varieties became available that did not need to be shaded and could increase profit per hectare. Conversion to shade-less coffee varieties meant the cutting of trees, and an increase in the use of mineral fertiliser and pesticides. Problems of soil depletion, soil erosion and increased run-off and downstream flooding were often the result, but there was also a reduction in the amount of habitat for migratory birds. The decline of many migratory insectivorous birds from North America (see Migratory Bird Trends in section 5) is attributed in part to the conversion from shade-grown to shade-less coffee. As a result in 1996 the Smithsonian Institute's Migratory Bird Center began a campaign to promote the buying of shade-grown coffee, which is often also organically grown. Farmers and coffee companies as well as environmentalists became involved. Users of shade-grown coffee pay a premium but in return buy a product that is better for the environment and offers fair conditions for the people that grow it. On the package it often says what species of migratory birds winter in the region of production and may profit from the purchase of that particular brand of coffee. **Today, sales of organically grown, shade coffee represent about 1%, or US$30 million, of the U.S. market for coffee beans.**

The Alliance for the Conservation of the Pine-Oak Forest in Mesoamerica

The Pine-oak forest Ecoregion of Central America gets its name from forests composed of an association of pines and oaks (*Pinus* spp. and *Quercus* spp.). This Eco-region is found in altitudes ranging from 600 to 2,300 metres above sea level (m.a.s.l.). Geographically, it ranges from south central Chiapas, Mexico to northwestern Nicaragua.

This Eco-region is very important because it contains not only a high diversity of conifers and oaks, but also it provides habitat for many species that are considered globally endangered or endemic. Because of the large number of endemic species that occur there, the Eco-region is considered an Endemic Bird Area (BirdLife International) and a High Priority Terrestrial Eco-region (PTE or Hot Spot, Conservation International). In addition, the region is considered the most important trans-regional migratory route for Neo-tropical migratory birds (≥ 225 species) in the Americas [c,d].

The Eco-region covers an area consisting of 103,842.71 km² but has suffered considerable habitat loss due to forest fragmentation and degradation. Of the total area, only one quarter, 26,728 km², remains forested. The principal threats for the region are fires, incompatible conservation management practices, logging and the extraction of wood for firewood. The average deforestation rate for the region is 60,000 ha/year which, if continued, will eliminate all forest cover within the next 45 years.

The Endangered Golden-cheeked Warbler (*Dendroica chrysoparia*) is one of many migratory birds present in the Eco-region. This species breeds exclusively in central Texas and winters in the Neo-tropics (from Chiapas, Mexico to north-central Nicaragua) where it inhabits pine-oak forest between 900 – 2,200 m.a.s.l.

The Alliance for the Conservation of the Pine-Oak Forest in Mesoamerica was created in 2003 due to the richness of biodiversity and endemic species present in the Eco-region. The Alliance consists of eight institutions located in the United States, Mexico, Guatemala, El Salvador, Honduras and Nicaragua. These institutions hope to conserve the pine-oak ecosystem in order to guarantee the survival of the migratory songbird *Dendroica chrysoparia* through joint efforts of all stakeholders involved.

Tropical Forest, © Adrián Azpiroz

Golden-cheeked Warbler (Dendroica chrysoparia), © Steve Maslowski / USFWS

The Alliance has already developed a regional conservation plan entitled "Pine-Oak Forests of Central America and the migratory bird *Dendroica chrysoparia*", which is meant to guide conservation efforts for the region. The Plan was developed through a series of workshops, held in each of the member countries, followed by three meetings designed to coordinate and integrate opinions of all of members of the Alliance, stakeholders, and other institutions interested in the conservation of pine-oak forests. This Alliance is one of the few regional conservation initiatives being implemented in Central America. The Alliance hopes to be viewed as a model for future regional activities in Central America.

Reducing the by-catch of albatrosses in longline fisheries

- **www.savethealbatross.net/** • Albatross Task Force, BirdLife International partners
- **www.acap.aq** • Seabird By-catch Working Group, Agreement on the Conservation of Albatrosses and Petrels (ACAP)

An estimated 100,000 albatrosses die each year on fishing hooks. They are being killed in such vast numbers that they cannot breed fast enough to keep up. This is putting them in real danger of extinction. Of the 22 species of albatross in the world, all are threatened with extinction largely because of longline fishing.

Longline fishing fleets, which operate throughout the world's oceans, target vast numbers of tuna, swordfish, Patagonian toothfish and other species. The boats set fishing lines that can stretch for 130 kilometres (or 80 miles) into the ocean. Each line carries thousands and thousands of hooks baited with squid and fish. These attract albatrosses, which get caught, dragged below the water and drown. The large fish these boats catch are in high demand. Single bluefin tuna have fetched as much as US$100,000 on the Japanese market.

Albatrosses are exceptionally susceptible to longlining. They cannot breed fast enough to cope with the rate at which they are being killed. This is because

- Albatrosses are long-lived birds, some reaching up to 60 years.
- They only breed once they are fully mature – this can take as long as 12 years.
- They only produce one chick at a time, and some species only breed every second year.

Around a third of albatross deaths are caused by illegal, unreported and unregulated fishing fleets. Government action to stamp out pirate fishing could stop many thousands of albatrosses from dying. It is, however, also necessary to reduce by-catch of albatrosses in legal fisheries. There are two main options for doing this. The birds can be kept away from the bait using a curtain of plastic streamers dangling from a piece of rope positioned over long lines. Or the bait can be kept away from the bird by making it sink rapidly.

Fishermen are often unaware of the simple, cost effective techniques that can rapidly reduce albatross deaths. Dramatic results can be achieved by showing them how to use these techniques and telling them about how albatross numbers are declining.

© Samantha Petersen, WWF South Africa

Black-browed Albatross (Diomedea melanophris), © Samantha Petersen, WWF South Africa

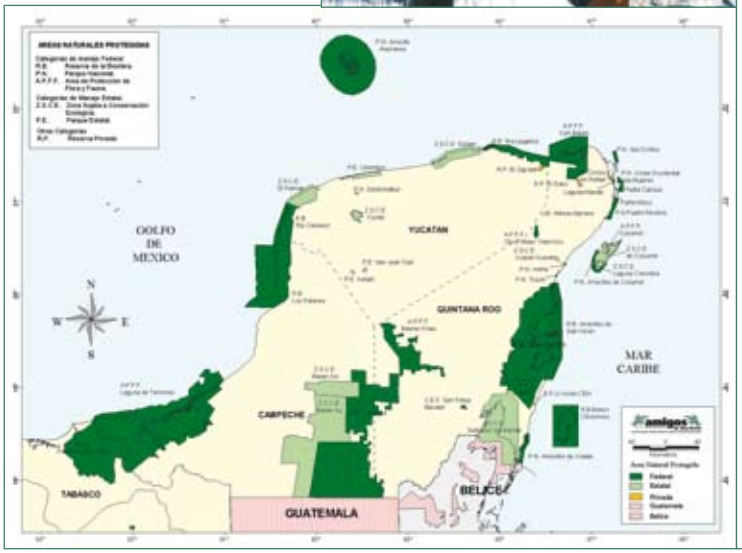
By-catch, © Peter Ryan, WWF South Africa

Present research focusses on, among other techniques, the development or further development of:

- streamer (bird scaring) lines for pelagic systems
- underwater bait-setting capsules and bait pods
- safe lead weights for pelagic longline gear
- natural deterrents such as shark liver oil
- blue-dyes for camouflaging bait
- smart hook development for pelagic fisheries.

Incentives for local people and capacity building

As was stated right at the beginning of this publication, the contribution of individuals towards conservation depends on the information they receive, their motivation to act and the financial incentives involved. If people are not aware, not sufficiently motivated or simply do not have the capacity to assist, conservation progress is limited. Therefore a key component of conservation work focuses on capacity building and awareness raising. That applies to migratory bird conservation projects as much as to any other kind of project, meaning that conservation and development must go hand in hand. A number of examples are given in section 4.3 on the economic value of birds, but see also the boxes in this section on the Sian Ka'an ecotourism project on the Yucatan Peninsula in Mexico and the box on shade-grown coffee, which aim to help protect migratory breeding birds



Combining migratory bird conservation with local development: Sian Ka'an Biosphere Reserve, Quintana Roo province, Mexico *

www.siankaantours.org

Community Tours is the name under which the Maya ecotourism guides in Chunyaxché operate. Chunyaxché lies in the Cooperative Zone of the 528,000 hectare Sian Ka'an Biosphere Reserve, on the east side of Mexico's Yucatan Peninsula, not far from Cancún. The Reserve has been recognised as a UNESCO World Heritage site and an Important Bird Area. Some 374 species of birds occur there, of which 135 are migratory and 26 are (very) abundant breeders in Canada. This was reason for Nature Canada to help conserve the area by supporting the local conservation NGO Amigos de Sian Ka'an in the development of the Community Tours ecotourism cooperative.

The guiding of birdwatchers is an important activity for the cooperative, which is dedicated to tours for the top end of the market. To limit disturbance they do not want mass tourism and are keeping prices up while limiting the number of tourists per boat and the number of boat rides. Before starting the business in 2005, the average monthly income of the six cooperative members was approximately US$ 300 per month. That has not changed so far, because they have reinvested the majority of their earnings.

Through this dedicated re-investment the cooperative has become the proud owner of a van to transport clients; six boats and six motors; a travel agency in nearby Tulum, a computer and a website. At present they are constructing their own office and storeroom in Chunyaxché, as well as a kitchen and restaurant and handcraft outlet. They employ four non-members and also own a mini-supermarket. And they have received funding from the World Heritage Site Fund to build a Bird Monitoring Center where students and researchers can stay while carrying out their bird studies with members of the cooperative. All the guides in the community have received training in English. One has even become an independent bird guide.

In addition to the initial funding and training by Nature Canada, the cooperative profited from support by the National Fish and Wildlife Foundation and the Houston Audubon Society via The Nature Conservancy (all from the USA). Later support was received from the RARE organisation (USA) and UNEP. All funding and activities were carried out by Amigos de Sian Ka'an A.C.

all images © Amigos de Sian Ka´an A.C.

** references: a, b*

Key points to consider using the flyway approach

The complexity of the migration strategies and systems of individual bird species was noted above. Simplifying and lumping all the world's bird migration systems into a very limited number of flyways of necessity brings with it the loss of certain information. Such grouping is without a doubt advantageous and even necessary for migratory bird conservation in general, not least for administrative and financial reasons. However, it is important to be aware of and consciously act upon this lack of detail lost by implementing the flyway concept.

First of all, by looking at the distribution of the five major flyways for waterbirds one can be mislead to believe that all birds migrate along a north-south axis. As mentioned in section 2, a number of species show movement along an east-west axis. Circumpolar movements over the Southern Ocean and altitudinal movements also do not appear in such composite maps.

In addition, maps of generalised flyway systems conceal a considerable inter-species variation in individual migration systems. As mentioned in section 2, the broad front migration exhibited by many passerines is quite different from the more channelled migration shown by many waterbirds and raptors. And even within a species, migration routes can vary. A series of publications on the results of bird ringing provides insight into how the flyway concept could be applied to bird species that do not show the well-defined migration routes of many waterbirds.[10, 57-60] But also among more or less closely related waterbirds there are substantial differences in migration systems.

Such limitations should not detract from the application of the flyway concept. But when they are not taken into consideration they can give rise to serious confusion. One example has been the use of inappropriate flyway maps to predict the possible spread of highly pathogenic avian influenza viruses by migratory waterbirds across Eurasia in late 2005. Thus the global map of wader flyways has been widely reproduced as relating to all waterbirds and even more erroneously, as describing the movements of all migratory birds (e.g. [61-63]). Such confusion is unhelpful, especially in contexts where potentially important policy formulation can be influenced by such misinformation. Fortunately, these limitations of the flyway concept have been recognised in policy fora such as the Avian Influenza Task Force (e.g. [64]).

3.3 The application of the flyway approach by the CMS Family

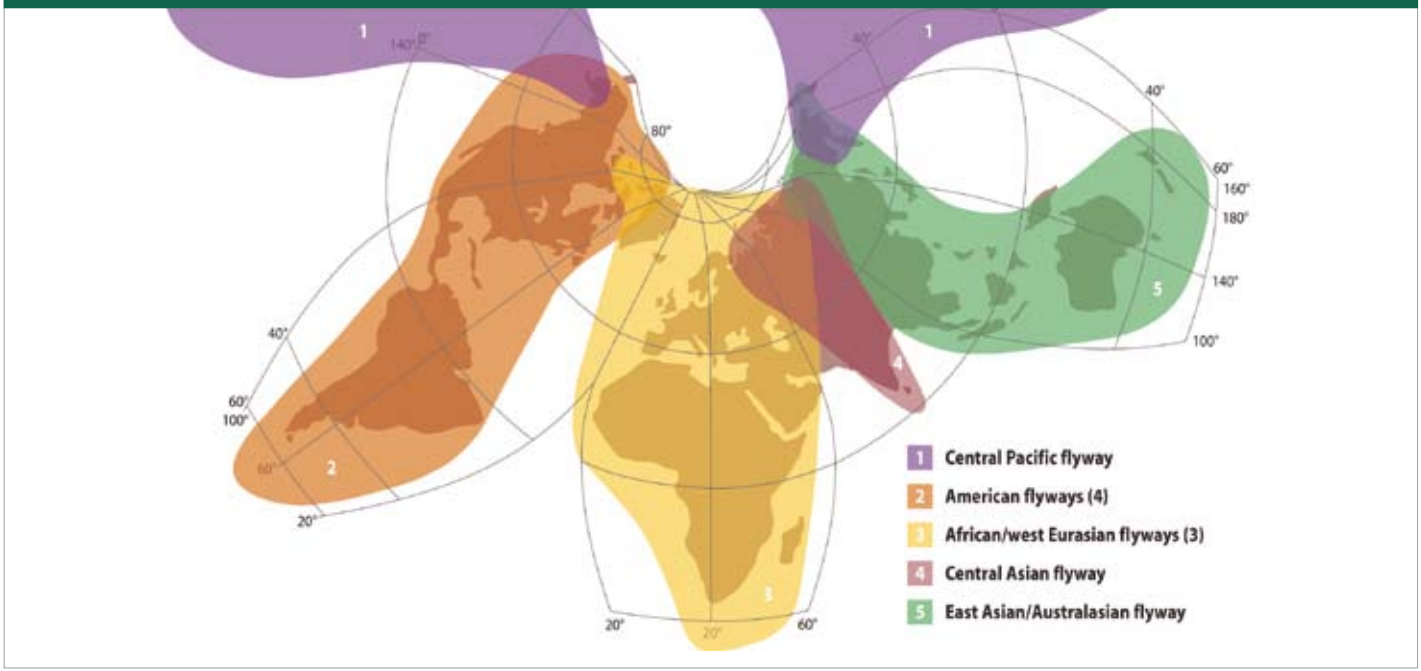
For clarity, the world map was divided into five flyway areas for waterbirds, with some overlapping at their margins:

1. The **African Eurasian Migratory Waterbird Agreement (AEWA)** area, including North-eastern Canada, Greenland, Europe, Western Siberia, the Western Central Asian Republics, the Caucasus, the Middle East, the Arabian Peninsula, all of Africa, Madagascar and its associated islands (Fig. 13).

Figure 13: AEWA MAP

Courtesy of AEWA

Figure 14: The five international migratory waterbird flyways originating in the Arctic



© Kenton D. Wohl, p. 120 in [i]

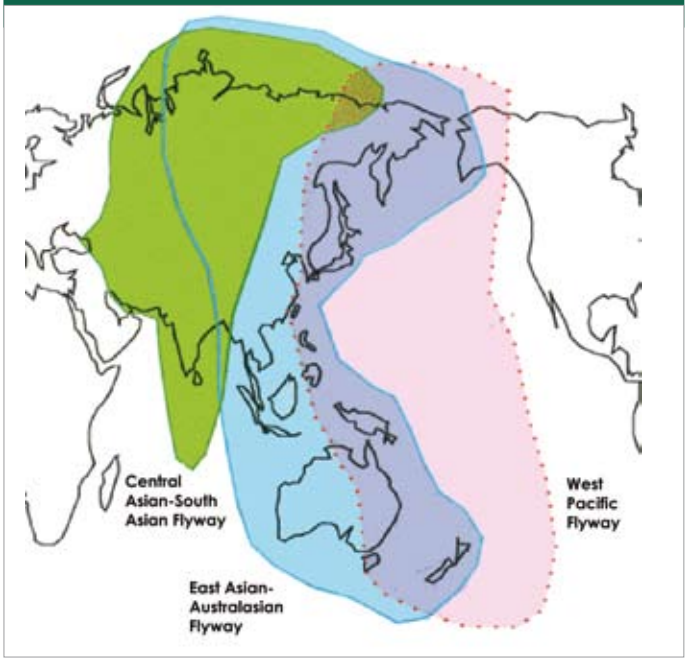
2. The **Central Asian Flyway (CAF)** area, including Central Siberia, Mongolia, the Central Asian Republics, Iran and Afghanistan, the Gulf States and Oman, the Indian subcontinent and the Maldives (Fig. 14).

3. The **East Asian Australasian Flyway (EAAF)** area, including Eastern Siberia, Alaska, Mongolia, Korea, Japan, China, Eastern India, Bangladesh, South-eastern Asia, the Sunda Islands, the Philippines, New Guinea and Australia. New Zealand is often included (Fig. 14, 15, p. 36).

4. The **Americas**, an area including North, Central and South America and the Caribbean and the four traditional North

Surfbird (Aphriza virgata), © Adrián Azpiroz

Figure 15: The Central Asian-South Asian, East Asian-Australasian and Western Pacific Flyways



© Wetlands International, p. 328 in [i]

American flyways (Pacific, Central, Mississippi, Atlantic) and the area over which a number of South American initiatives are in progress (Fig. 14, p. 35).

5. The **Central Pacific Flyway**, an area extending over the Pacific Ocean from Alaska and Far Eastern Russia to New Zealand. It is travelled by a relatively small number of species, which, however, undertake some of the most spectacular migrations on earth. The flyway, recognised by many shorebird researchers, is often appended to either the East Asian Australasian Flyway or the North American Pacific Flyway, neither of which is a happy solution. Its uniqueness is worth emphasising (Fig. 14, p. 35).

In order to fully understand the vital role of this Convention in the flyway approach, a summary of CMS, its agreements and Memoranda of Understanding, related to flyways, is given below.

Convention on the Conservation of Migratory Species of Wild Animals (UNEP/CMS) and related agreements – the Bonn Convention: This global treaty was concluded in 1979 in Bonn, Germany. It requires Parties to strive towards the conservation and sustainable use of migratory species listed in Appendices I and II. It is highly challenging to conserve migratory species because their ranges are often part of several countries, each governed by their individual jurisdiction and national conservation strategies. Out of this need, CMS was born to bring range states to one table to facilitate the international coordination of conservation action on a species-specific basis. This collaboration can be achieved through different agreements focused on particular groups of animals, e.g. birds. At the Conference of the Parties (CMS COP9) in December 2008, CMS established an open-ended working group on global bird flyways. It acts as a think tank on flyways and frameworks, as the basis for future CMS policy on flyways, and contributing to the work on the future shape of CMS. See Resolution 9.2 under the COP pages of the CMS websites.

African Eurasian Migratory Waterbird Agreement (AEWA): This is the largest agreement under the Bonn Convention in terms of listed species and the largest flyway agreement globally. It came into force in 1999. AEWA provides for coordinated and concerted action to be taken by the Range States throughout the migration systems of the waterbirds to which it applies. A comprehensive Action Plan and subject-specific conservation guidelines address key issues such as: species and habitat conservation, management of human activities, research and monitoring, education information and implementation. (www.unep-aewa.org/). One of its recent conservation initiatives, the Wings Over Wetlands project is trialling a number of small-scale applied conservation strategies in 12 countries aimed at conserving AEWA waterbirds (www.wingsoverwetlands.org). The project is funded by GEF and the German Government and is coordinated under the auspices of UNEP with various partner organisations such as Wetlands International and BirdLife International.

Wings Over Wetlands

www.wingsoverwetlands.org/

1. **Estonia** Haapsalu-Noarootsi Bays
2. **Hungary** Biharugra Fishponds
3. **Lithuania** Nemunas River Delta
4. **Mauritania** Banc D'Arguin National Park
5. **Niger** Namga-Kokorou Complex
6. **Nigeria** Hadejia-Nguru Wetlands
7. **Senegal & The Gambia** Saloum-Niumi Complex
8. **South Africa** Wakkerstroom Wetlands
9. **Tanzania** Dar Es Salaam Wetlands
10. **Turkey** Burdur Gölü
11. **Yemen** Aden Wetlands

The Wings Over Wetlands (WOW) Project is the largest international wetland and waterbird conservation initiative ever to take place in the African-Eurasian region. It aims to improve and conserve healthy and viable populations of African-Eurasian migratory waterbirds. This will be achieved by assisting a wide range of partners to conserve the key critical wetland areas which these birds require to complete their annual migrations across Africa and Eurasia, by improving international cooperation and by building local professional capacity.

The project supports field projects in eleven important wetland areas in 12 countries (see above). These projects focus on a number of wetland-related conservation issues including community mobilisation, management planning, ecotourism, field research, wetland restoration, control of invasive species, trans-boundary management, education and alternative livelihoods.

A training and capacity development framework is being elaborated in consultation with a wide range of partners across the region. This will focus on enhancing the professional capacity and understanding of flyway-scale conservation concepts among conservation professionals and decision makers at various levels across the AEWA region.

A new web portal is being developed by the WOW technical team and will provide unprecedented access to information on approximately 300 migratory waterbird species, their migration routes and the key wetland sites these birds use in the African-Eurasian region. Once developed, the Critical Sites Network (CSN) Tool will unify the conservation efforts of countries along the entire Flyway by providing decision-makers and conservation organisations with the improved data access needed for timely and focused wetland and waterbird conservation.

Common tern (Sterna hirundo), © Tim Faasen

Wings Over Wetlands is a joint effort between Wetlands International (hosting the project's coordination unit in the Netherlands) and BirdLife International, supported by the UNEP-GEF (the Global Environment Facility), the Government of Germany and a wide range of other donors and partners. The United Nations Office for Project Services (UNOPS) is engaged to support project implementation. There is close coordination with the UNEP/AEWA Secretariat, the Ramsar Convention on Wetlands, UNEP-WCMC and with many local partners along the African-Eurasian flyways.

Black-browed Albatross chick (Diomedea melanophris), © Samantha Petersen / WWF South Africa

Siberian Crane © Irina Gavrilova / Oka Crane Breeding Center

Agreement on the Conservation of Albatrosses and Petrels (ACAP): This multilateral agreement came into force in 2004. It seeks to conserve albatrosses and petrels by coordinating international activity to mitigate the threats to populations of these birds. The greatest threat to albatrosses is the incidental, but substantial bycatch during longline and trawlfishing operations. Petrels face greater threats through the introduction of predators at many of their breeding localities.
http://www.acap.aq/

Memorandum of Understanding (MoU) on Conservation Measures for the Siberian Crane: Established in 1993, it was the first MoU developed under CMS. The serious threats to the Siberian Crane *Grus leucogeranus* must be attributed firstly to hunting along their flyways and habitat deterioration in their "non-breeding / wintering grounds". Although the shooting of Siberian Cranes is prohibited in most of the Range States, illegal shooting persists. Overall aims of the three plans (for the Western, Central and Eastern Siberian Crane populations) are to reduce mortality, to protect and manage their habitats and enhance co-operation

among the Range States and other concerned agencies. The plans for the western and central populations strive also to increase numbers and genetic diversity.

The project, financed by a multimillion-dollar grant from GEF and similar amounts in cash and in kind from the governments and other participating organisations, is being implemented on three levels - site, national and regional. The involvement of local communities is an important element with public awareness raising, environmental education and development of sustainable livelihood options being undertaken alongside the implementation of site management plans and the enforcement of legal protection. The project has also provided the framework for the establishment of the West/Central Asian Site Network for Siberian Cranes and other waterbirds. http://www.sibeflyway.org/

© Ji Weitao

© International Crane Foundation

Siberian Crane Wetland Project

www.scwp.info

In 2003 the International Crane Foundation, in collaboration with the governments of China, Iran, Kazakhstan and Russia, launched the UNEP/GEF Siberian Crane Wetland Project (SCWP). The six-year project focuses on a network of 16 globally important wetlands in Eurasia which are of critical importance for migratory waterbirds and other wetland biodiversity. The SCWP is implemented through the United Nations Environment Programme, as Implementing Agency of the Global Environment Facility grant, in cooperation with the Convention on Migratory Species. The SCWP activities are implemented at three levels:

At the project site level, activities aim to reduce external threats and ensure necessary water flows to maintain the ecological health of wetlands. Activities include strengthening legal protection and enforcement, training nature reserve staff, involving local communities, and developing site management plans, environmental education and public awareness programmes, and projects that promote sustainable livelihoods for local communities.

At the national level, the SCWP supports monitoring, training, education and public awareness programmes across sites, and applied research to inform sound management decisions, including ongoing study of seasonal waterbird movements and wetland system dynamics. The SCWP also works to improve legislation, policy and planning to support wetland and waterbird conservation. These activities are coordinated with other national wetlands initiatives to strengthen integrated wetland management through collaboration with different organisations.

At the international level, the focus is on flyway conservation—the network of wetland sites along the entire migratory pathways of the cranes. To achieve this, the SCWP promotes cooperation among the four countries and other Siberian Crane range states, enhancing interaction among sites and engaging communities in the management of the wetlands along the West/Central and East Asian flyways for migratory waterbirds. Conservation actions within these flyways are coordinated with other initiatives for migratory waterbirds and closely integrated with the Conservation Plans created through the CMS MoU (see section 3.2).

Slender-Billed Curlew (*Numenius tenuirostris*) MoU: The MoU entered into effect on 10 September 1994 when the first range states signed it. The Action Plan for the Conservation of the Slender-billed Curlew *Numenius tenuirostris* was prepared by BirdLife International (Council of Europe, 1996), approved by the European Commission and endorsed by the Fifth Meeting of the CMS Conference of the Parties. It is the main tool for conservation activities for this extremely uncommon bird. Conservation priorities include: effective legal protection for the Slender-billed Curlew and species of similar appearance with which it is readily confused; locating its breeding grounds and key wintering and passage sites; the appropriate protection and management of its habitat, and awareness-raising amongst politicians, decision-makers and hunters.
http://www.cms.int/species/sb_curlew/sbc_bkrd.htm

Great Bustard (*Otis tarda*) MoU: The Great Bustard *Otis tarda* MoU entered into force on 1 June 2001 after the signature by the fifth range state. It covers the residual Middle-European populations of the species which numbers less than 45,000 individuals worldwide and spans individual pockets of Eurasian grassland. Modern agricultural practice has caused a rapid decline in much of Central and Eastern Europe. The remaining population is dispersed in several small pockets. Its habitat is intensively used agricultural land and mixed extensive agricultural and pasture or fallow land. Conservation measures focus on active habitat management and on maintaining large areas of non-intensive farming systems.

The MoU has an Action Plan listing activities appropriate for each Range State, addressing habitat protection, hunting and disturbance, cross-border conservation, monitoring, research and public awareness raising. It calls for cooperation to promote the conservation of the species and its strict protection as well as the maintenance and restoration of its habitat.
http://www.cms.int/species/otis_tarda/otis_tarda_bkrd.htm

Aquatic Warbler (*Acrocephalus paludicola*) MoU: This MoU concluded in Minsk, Belarus, under CMS auspices becoming effective on 30 April 2003 aims to safeguard this small waterbird. Its population is estimated to have declined sharply at a rate of 40 % over the last ten years. Its dependence on specialised and vulnerable habitat means it has become globally threatened, as its habitats have suffered from constant decline. This decline is mainly due to human induced changes in the hydrological regime in key sites (both drainage and flooding), changes in land use and habitat fragmentation caused by infrastructure building. The effects of pollution pose a further threat. The MoU covers 14 Range States in Europe and Africa:

A detailed Action Plan is annexed to the MoU. It summarises the distribution, biology and conservation status of the Aquatic warbler, and describes precise actions to be taken by relevant countries. The main objective of the Action Plan is to maintain the Aquatic warbler *Acrocephalus paludicola* throughout its range and, in the medium to long term, promote the expansion of the breeding population to other suitable areas.
http://www.cms.int/species/aquatic_warbler/aquatic_warbler_bkrd.htm

Ruddy-headed Goose (*Chloephaga rubidiceps*) MoU: Signed in 2006 by Argentina and Chile, it is a contribution to the Wildlife Conservation Protocol signed between the two countries in May 2002. It is the first CMS agreement targeted towards the conservation of an American migratory bird species.
http://www.cms.int/species/ruddy_goose/ruddy_goose_bkrd.htm

Southern South American Migratory Grassland Bird Species MoU: This MoU came into force in 2007. Signatories agree to work together towards better conservation of migratory species of grassland birds of Southern South America. The main problems of conservation of these birds are the fragmentation of grassland habitats as well as illegal capture and trade. The countries involved are Argentina, Bolivia, Brazil, Paraguay and Uruguay.
http://www.cms.int/species/Grassland_birds/grassland_birds_bkrd.htm

Migratory Birds of Prey in Africa and Eurasia MoU: Twenty-eight states signed this MoU at its concluding negotiation meeting in Abu Dhabi, the United Arab Emirates, on 22 October 2008, the city, which will host the MoU's secretariat. This MoU is aimed at the conservation of migratory populations of birds of prey occurring in Africa and Eurasia. Its objectives are: the halting and reversing of the declines of globally threatened and near-threatened birds of prey; to halt and reverse the population declines of other birds of prey with an unfavourable conservation status within Africa and Eurasia; and to anticipate, reduce and avoid potential and new threats to all bird of prey species in order to prevent any population undergoing long-term decline.
http://www.cms.int/bodies/meetings/birds_prey.htm

Saker Falcon (Falco cherrug), © Qatari / Wikipedia

High Andean Flamingos and their Habitats MoU: The populations of the two species of Andean Flamingos *Phoenicopterus andinus* and *Phoenicopterus jamesi* are included in Appendix I of the CMS. The populations of these flamingos have been subject to a drastic reduction and fragmentation of their habitats. According to IUCN, the global conservation status of the Andean flamingo is "Vulnerable" and that of James's Flamingo is "Nearly Threatened". A MoU aimed at improving the conservation status of the species and their habitats was concluded among the Range States (Argentina, Bolivia, Chile and Peru) during COP9 on 4 December 2008.
http://www.cms.int/species/flamingos/flamingos_bkrd.htm

A practical arrangement that seems to best accommodate and integrate the traditions of waterbird management agencies and the practices of researchers and conservationists in various fields of avian migration studies is outlined below. It takes fully into account the existence of established or proposed regional agreements and is a slight modification of the scheme outlined by Boere and Stroud[43].

Andean Flamingos (Phoenicopterus andinus), © Omar Rocha

3.4 Other conventions, instruments and organisations using the flyway approach

Table 1: Some other organisations and frameworks related to the conservation of migratory bird species and their habitats, working in a relatively large geographical area.

Conventions, Instruments & Organisations	Objectives	Website
Flyway approaches covering more than one flyway area		
Convention on Wetlands of International Importance especially as Waterfowl Habitat: the Ramsar Convention on Wetlands	Global convention launched in 1971 at Ramsar, Iran. Its mission is 'the conservation and wise use of all wetlands through local, regional and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world'. Based upon the fact that to protect waterbirds, one has to protect their habitat and to manage them wisely. Parties to the Ramsar Convention are obliged to nominate at least one wetland in their area of jurisdiction as a Wetland of International Importance.	www.ramsar.org
BirdLife International	Global conservation federation with a worldwide network of over 100 different Partner organizations. It strives to conserve birds, their habitats and global biodiversity. It works with people towards sustainability in the use of natural resources. Each NGO Partner represents a unique geographic territory.	www.birdlife.org
Wetlands International	Science-based organisation founded in 1954 as the International Wildfowl Inquiry. It provides information to assist governments in the protection and restoration of wetlands. It works on the conservation of networks of sites that support migratory waterbirds (flyways), by checking their condition through regular monitoring programmes, raising awareness among the people living around these wetlands about their value and by enabling stakeholders and governments to conserve and manage them.	www.wetlands.org
Flyway approaches in the Americas flyway area		
Migratory Bird Treaty Act Canada-USA-Mexico, Japan, Russia	Convention between Great Britain (for Canada) and the U.S.A. came into force in 1918. It is the oldest international legal instrument for the conservation of migratory birds. The Convention recognizes (1) migratory Game Birds, (2) migratory Insectivorous Birds, and (3) other migratory Non-game Birds.	www.cwsscf.ec.gc.ca/legislations/laws1_e.cfm
Convention on Nature Protection and Wild Life Preservation in the Western Hemisphere	Convention that came into force in 1942. It commits its signatories to the establishment of national parks and other reserves, including for the protection of migratory birds. It can serve as a basis for further multilateral protection of migratory birds and their habitats in Latin America.	www.fws.gov/migratorybirds/intrnltr/treatlaw.html http://intfish-preview.net/igifl/treaties/related/western.htm
North American Waterfowl Management Plan	It is a tri-national collaboration (Canada and United States in 1986, Mexico in 1994) to conserve dwindling wetland habitat as well as upland habitat, and restore diminishing populations of ducks and geese.	www.nawmp.ca/
Western Hemisphere Shorebird Reserve Network (WHSRN)	Conservation strategy launched by scientists in 1985 to protect shorebirds and their habitats across the Americas through a network of key sites (see text box for more details).	www.whsrn.org/
Partners in Flight	It was launched in 1990 in response to growing concerns about declines in the populations of many land bird species, and in order to emphasize the conservation of birds not covered by existing conservation initiatives. It pursues its different goals through ensuring an active scientifically-based conservation design process, creating a coordinated network of conservation partners, securing sufficient commitment and resources.	www.partnersinflight.org/

Table 1 (cont.)		
Conventions & Organisations	**Objectives**	**Website**
North American Bird Conservation Initiative (NABCI)	Launched in 1999 by representatives from government and NGOs in Canada, the United States and Mexico, with assistance from the Commission on Environmental Cooperation of NAFTA (North American Free Trade Agreement). The NABCI Declaration acknowledges that to safeguard migratory birds and their habitats for future generations, conservation must take place in every stage of a species' lifecycle, throughout the geographic range of nesting, migration, and wintering habitats.	www.nabci-us.org/
The Western Hemisphere Migratory Species Initiative	Founded in 2003 in Chile, in response to the Plan of Action from a Summit of the Americas meeting. It aims to contribute significantly to the conservation of the migratory species of the Western Hemisphere by strengthening communication and cooperation among nations, international conventions and civil society, and by expanding constituencies and political support.	www.fws.gov/international/whmsi/whmsi_Eng.htm www.partnersinflight.org/
Flyway approaches in the Central Asian flyway area		
The Central Asian Flyway (CAF) process	CAF extends between the Arctic Ocean and the Indian Ocean and Gulf of Bengal and covers 175 seabird and wader species. An Action Plan was launched in 2008 following the consultation of the 30 range states of this instrument.	www.cms.int/bodies/meetings/regional/caf/caf_meeting.htm http://www.cms.int/species/CAF/news.htm
Flyway approaches in the East Asian - Australasian flyway area		
The East Asian - Australasian Flyway Partnership (EAAFP)	Launched in November in 2006, it extends from within the Arctic Circle in Russia and Alaska, through East and South-East Asia to Australia and New Zealand encompassing 22 countries (see text box for details)	www.eaaflyway.net/
Other examples of instruments, programmes and organisations concerned with flyways		
Conservation of Arctic Flora and Fauna (CAFF)	CAFF is the Biodiversity Working Group of the Arctic Council. CAFF's mission is to address the conservation of Arctic biodiversity, and communicate its findings to the governments and residents of the Arctic, helping to promote practices which ensure the sustainability of the Arctic's living resources	http://arcticportal.org/en/caff/
International Council for Game and Wildlife Preservation (CIC); Ducks Unlimited Federation of Associations for Hunting and Wildlife Conservation in the EU (FACE); Oiseaux Migrateurs du Palearctique Occidental	Hunting organizations active on the global or regional level are also active in the field of migratory bird conservation, often with emphasis on waterbirds and their habitats.	www.cic-wildlife.org www.ducks.org www.face.eu www.ompo.org
EURING, US Fish and Wildlife Service, AFRING, Global Flyway Network	Organisations coordinating the work of bird ringing centres, in Europe, the Americas and Africa as well as major coordinated activities on flyway research.	www.euring.org www.fws.gov www.afring.org www.globalflywaynetwork.com.au/

WHSRN: A Strategy for Saving Shorebirds
Western Hemisphere Shorebird Reserve Network

www.whsrn.org/

Mission: to conserve shorebirds and their habitats through a network of key sites across the Americas.

During the mid 1980s, scientists from around the Americas were recording serious population declines in shorebirds. The recognition that these birds were in trouble prompted the scientific community to take action and develop the framework for an international strategy to protect shorebirds and their habitats.

The Western Hemisphere Shorebird Reserve Network (WHSRN) is a conservation strategy launched in 1985. The Network follows the simple strategy that key habitats throughout the Americas must be protected in order to sustain healthy populations of all native shorebird species. During the last 20 years, over 21 million acres of shorebird habitat has been brought under the auspices of WHSRN.

Coastal Lagoon, Laguna de Rocha, Rocha, Uruguay, © Adrián Azpiroz

Lesser Yellowlegs (Tringa flavipes), © Adrián Azpiroz

Guiding Principles

WHSRN site designation and conservation actions are based on the appropriate application of the best available information. Site-based conservation is the centrepiece for accomplishing WHSRN's mission within the larger ecological context of each site. Traditional and local ecological knowledge and cultural practices are recognised, valued and respected. Integration and collaboration at local, national and international scales with other conservation groups and programmes enhances WHSRN's capacity to achieve its vision. Communication and voluntary partnerships are vital for an effective network and achieving common conservation goals.

WHSRN works to:

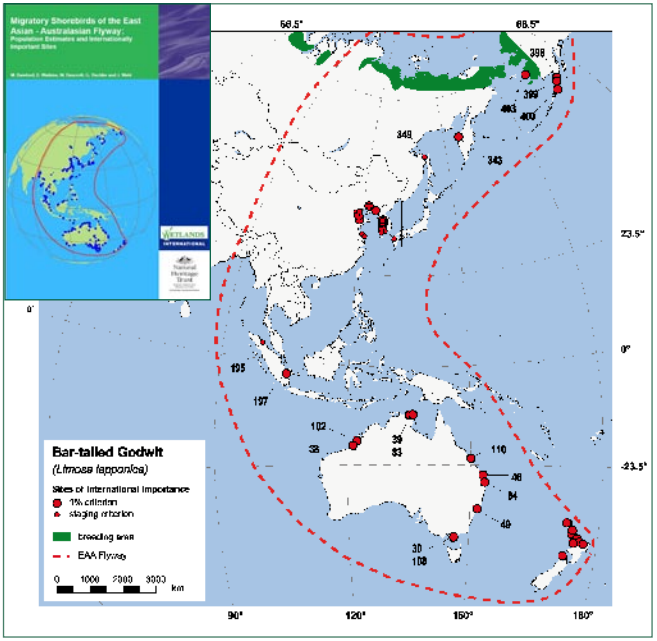
- Build a strong system of international sites used by shorebirds throughout their migratory ranges.
- Develop science and management tools that expand the scope and pace of habitat conservation at each site within the Network.
- Establish local, national and international recognition for sites, raising new public awareness and generating conservation funding opportunities.
- Serve as an international resource, convener and strategist for issues related to shorebird and habitat conservation.

Wetlands International's Flyway Atlas Series

www.wetlands.org

Waterbird conservation takes place increasingly at the level of flyways of individual biogeographic populations. Wetlands International provides triennial updates of waterbird population estimates at global level on behalf of the Ramsar Convention on Wetlands. Practitioners using these estimates as the basis of waterbird conservation policies and plans need to know which estimates to apply in which geographical areas, and Wetlands International has produced a series of Flyway Atlases to facilitate this process. The Atlas of Anatidae Populations in Africa and Western Eurasia was produced in 1996 on behalf of the Secretariat of the African-Eurasian Migratory Waterbird Agreement (AEWA). This was followed by atlases of Anatidae and cranes in East Asia, which formed the basis of the site networks for Anatidae and cranes established under the Asia-Pacific Migratory Waterbird Conservation Strategy. Goose Populations of the Western Palearctic followed in 1999, and work on an Atlas of Wader Populations in Africa and Western Eurasia was completed in 2008[e,f,g,h]. Plans for future atlases include volumes covering all the other waterbird populations included in AEWA and other major flyways.

A majority of waterbird populations are congregatory at some stages of their life cycles, and their survival depends on a network of sites that are used for breeding, staging, moulting, and spending the non-breeding season. These sites may be many thousands of kilometers apart, and waterbirds undertake some of the longest and most spectacular migrations. Wetlands International's flyway atlases identify key sites used by congregations of each population. A key site is defined as one at which 1% or more of a population regularly occurs. The identified sites provide the information base to support the development of flyway networks of internationally important sites. The networks provide a basis for implementing internationally coordinated conservation efforts to conserve the wetlands that migrating birds need to survive. Staging sites form a large component of these internationally important sites. Whilst birds may use staging sites more intermittently than breeding or non-breeding sites, the staging sites are extremely important



© Wetlands International 2008 [iii]

for successful migration. A large number of staging sites are in countries and regions where impacts and threats are highest and often require more urgent conservation effort. The Atlases also highlight areas and countries with least information that are often areas where waterbird field skills and general education and awareness are also needed. Data limitations indicate where more information is needed, including for species, habitats, regions and periods that are poorly surveyed.

The mapped population boundaries and key sites for waterbird populations presented in Wetlands International's flyway atlases provide information vital for the conservation of the world's waterbirds in a readily useable form. This information will increasingly be made available on the internet, which will further increase its usefulness.

The East Asian - Australasian Flyway Partnership (EAAFP)

www.eaaflyway.net

The East Asian-Australasian Flyway (EAAF) extends from within the Arctic Circle in Russia and Alaska, southwards through East and South-East Asia to Australia and New Zealand, encompassing 22 countries (see Fig. 15, p. 38). Migratory waterbirds share this flyway with 45% of the world's human population. The area is home to over 50 million migratory waterbirds from over 250 different populations, including 28 globally threatened species.

The Partnership for the EAAF is an informal and voluntary initiative, aimed at protecting migratory waterbirds, their habitats and the livelihoods of people dependent upon them, within the EAAF area. Launched in November 2006, as of 1 January 2009, the EAAF Partnership consisted of 20 partners, including 10 national governments, 3 intergovernmental agencies and 7 international non-government organisations.

The Partnership builds on the achievements of the Asia-Pacific Migratory Waterbird Conservation Committee and Asia-Pacific Migratory Waterbird Conservation Strategies (last one for 2001-2006), and their Action Plans for the conservation of Anatidae (ducks, geese and swans), Cranes and Shorebirds.

The Partnership provides a framework for international cooperation, including:

- development of a Flyway Site Network (for sites of international importance to migratory waterbirds)
- collaborative activities to increase knowledge and raise awareness of migratory waterbirds along the flyway
- building capacity for the sustainable management and conservation of migratory waterbird habitat along the flyway.

© Maki Koyama

Its current Implementation Strategy is for the period 2007-2011.

Under the Asia-Pacific Migratory Waterbird Conservation Strategies more than 700 sites of international importance for migratory waterbirds were identified in the EAAF area. There are 79 sites officially under the Flyway Site Network.

Barnacle Goose (Branta leucopsis), © Tim Faasen

4 THE VALUE OF MIGRATORY BIRDS

4.1 Role of birds in ecology

Birds play a vital part in the web of life. Their contribution to ecosystem services, which are increasingly starting to be measured in monetary terms, is not to be underestimated. Migratory birds provide ecological functions not only in their breeding areas but also in their non-breeding areas, including in the areas they pass through while on migration.

Insect control

Probably the most recognised ecological function of migratory birds is pest control. The value of insect-eating birds is well known by scientists and those working in agriculture. However, the public is not sufficiently aware of the role birds play. In the Sacramento Valley migratory Western Meadowlarks *Sturnella neglecta* were recently estimated to require 193 tons of insects daily during the breeding season[38].

In 1749, bounties on blackbirds and their relatives in North America as well as subsistence hunting of gamebirds greatly reduced their numbers. This allowed a plague of 'corn worms' (beetle larvae) to develop, which wrecked the corn crop. As a result, the U.S. President Benjamin Franklin himself commented on the positive change of public opinion on these birds. As early as 1921 it was estimated that birds reduced insect damage to forest and agriculture in the USA by 44% or US$ 440 million in one year. Many of these birds would have been migratory insectivores. In the UK major plagues of caterpillars resulted from the persecution of birds that were thought to eat much-needed grain and fruit during World War I[38].

Swedish Willow Warbler (Phylloscopus trochilus) with prey, © Albert Winkelman

Saffron-cowled Blackbird (Xanthopsar flavus), male, © J. Leiberman

Nest boxes for flycatchers, titmice and other insectivorous birds, many of them migratory, are used as a forest management tool in Europe. In the USSR, 25 million nest boxes were supplied for Common Starlings to encourage their spread as 'a friend of the collective farmer'. Nest boxes were provided for the same purpose to the migratory Purple-backed Starling *Sturnus sturninus* in the Republic of Korea. Purple-backed Starlings spend the non-breeding season in South-East Asia, while millions of Common Starlings from the former USSR spend it in Western Europe.

In the non-breeding areas, other migratory birds such as Wattled Starling *Creatorphora cinerea* in Africa, Rosy Starling *Sturnus roseus* in Asia, and bustards and storks, living in large groups, eat many grasshoppers. Each year in September-October, at the end of the wet season, migratory birds such as Abdim's Storks *Ciconia abdimi*, Black Kites *Milvus migrans* and Cattle Egrets *Bubulcus ibis* converge on the Diffa region in South-East Niger, to feast on millions of the Senegalese Grasshopper *Oedalus senegalensis*. Because of their grasshopper devouring capacities, Abdim's Storks and Cattle Egrets are held in high esteem by local farmers. Migratory White Storks *Ciconia ciconia* visiting the Sahel during the dry season, are appreciated by farmers in this region for the same reason. Other insectivorous migratory birds in all parts of the world provide a similar function. Spreading awareness of their insect-eating role may be a way to encourage the conservation of migratory birds, as is being tried for Montagu's Harriers *Circus pygargus* in West Africa[65].

Sometimes, insectivorous or omnivorous birds are introduced into certain areas precisely because of their dietary preference. Mallards, *Anas platyrhynchos*, were introduced to undrained ponds in Pennsylvania to reduce the number of mosquito larvae[38]. When the ponds froze over in winter the Mallards migrated. This seemed to have been an environmentally friendly solution, but unfortunately the Mallards also hybridised with and

Cattle Egret (Bubulcus ibis) during migration, © Mohammed Shobrak

outcompeted the native American Black Duck *Anas rubripes* which led to a decline in this native population. The message is clear: one needs to be aware of the whole ecosystem before attempting to alter a part of it.

Pollination, seed dispersal, nutrient concentration and finding fish at sea

Hummingbirds, white-eyes, honey-eaters and lorikeets are essential for the pollination of certain plants. All these taxonomic groups include a number of migratory species. Other migratory birds assist in the life cycle of certain wild plants through the dispersal of the seeds of economically important crops, including flowers and fruits, etc.

Migratory seabirds help fishermen to find fish out at sea. Through the fish they eat and bring to their young, seabirds also transfer up to 100,000 tonnes of phosphates from the sea to the land each year via their droppings (guano)[66]. The mining of the resulting layer of droppings or guano, sometimes tens of metres thick, is discussed in section 4.3. Phosphates from bird droppings are also concentrated under waterbird breeding colonies in freshwater wetlands. In the Inner Niger Delta in Mali, in the village ponds and shallow wetlands of South India and in many other places, this high phosphate concentration boosts primary production of algae and plankton and through that fish production[67].

Migratory birds as indicators of pollution

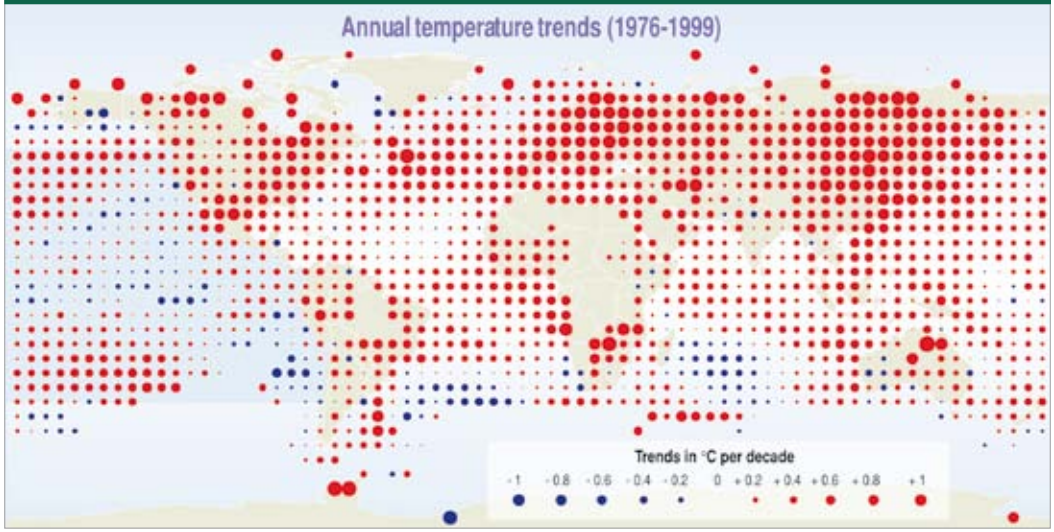
A further very important but unvalued ecological service that birds provide is that they can act as environmental indicators, especially of pollution. Counts of migrating raptors at Hawk Mountain in North-Eastern USA were used to show the damaging effects of DDT and other organochlorides on raptor reproduction, and also the recovery once organochloride use was greatly curtailed[23,38]. The effects of these pesticides on humans can be similarly devastating. In North-Western Europe the decline and recovery of breeding colonies of Sandwich Tern *Sterna sandvicensis* is a classic example of the effects of the increase and then the decrease of the same organochloride pesticides. Recovery may have been aided by the species being migratory, allowing parts of the populations to survive in a better environment elsewhere and come back to recolonise later.

Oiled seabirds, almost all of them migratory, that are washed up on beaches, are often the first indicators of oil spills at sea. Barn

Oiled Cormorant © Still Pictures

Swallows were used to monitor effects of radiation post-Chernobyl.

Figure 16: Observed changes in global average surface temperature



© IPCC 2001, p. 90, in [i]

Migratory birds as indicators of land use change

The composition and number of migratory birds on a plot of land reflect the effects, changes in farming and other types of land use have on our environment[38]. Regular surveys and monitoring programmes of breeding and non-breeding birds can bring these effects to light. Some land use changes are more or less natural, e.g. vegetation degradation related to prolonged drought cycles. But the majority of land use changes affecting migratory birds are caused by man. Reductions in the populations of certain migratory species may have knock-on effects: other species, whose populations are less affected, could then occupy permanently the niches left open by the weakened migratory species.

Migratory birds as indicators of effects of climate change

Birds have been marking the first effects of climate change on biodiversity: migratory birds have been arriving at their breeding grounds earlier and earlier, in many places, such as Canada as well as across Europe (from France to Russia) almost four days earlier every ten years at the end of the 20th century (see relation to Fig. 16).[38]

Migrants in Europe and the USA have been delaying their southward departure. In addition, migration routes are changing, e.g. eastward and northward in Northern Europe for White-fronted Geese and for Whooper *Cygnus cygnus* and Bewick's Swans *C. bewickii*. New routes require new protection measures[38], and possibly fundamental changes to international instruments like the Bonn and Ramsar Conventions and Agreements such as AEWA.

Arctic shorebirds, © Rob Robinson, p. 197 in [i]

In Antarctica, on the contrary, Adélie Penguins *Pygoscelis adeliaea* and six petrel species have been for unknown reasons arriving at their colonies 9.1 days later at the beginning of the 21st century than in the early 1950s, and are laying eggs 2.1 days later. Adélie Penguins breeding on Anvers Island in the Antarctic Peninsula have declined by 70% owing to retreating ice, and the Emperor Penguin in Terre Adélie declined by 50% in the late 1970s in response to abnormally warm temperatures. Neither has recovered since. Populations of other long-lived, slow-breeding species like albatrosses may not show any adverse effects yet, but may suddenly crash if there are no young birds when the old ones are too old to breed. Similar effects have been observed in other long-lived species such as marine turtles[38].

Higher temperatures in the North Sea in 2003 and 2004 led to a collapse in sand-eel numbers and near-total breeding failure of the region's seabirds. Rising sea temperatures have led to the virtual disappearance of some five million Sooty Shearwaters *Puffinus griseus* 'wintering' on the California Current off the South-West coast of the USA. Warmer waters off the west coast of Canada have led to a dramatic local decline in Tufted Puffins *Fratercula cirrhata*. Interestingly, reproductive success of Elegant Terns *Sterna elegans* and Heermann's Gulls *Larus heermanni* in the Eastern Pacific can be used to envisage the outcome of fishing efforts and climatic events like El Niño[38].

If migratory birds disappear, then these environmental indicators will vanish as well.

Migratory birds in December, Ghana, © Tim Dodman

The value of the conservation of migratory bird habitats

Migratory birds add to the value of habitats that many people world-wide want to conserve[68]. This can be demonstrated by the work of the Ramsar Convention attending to the protection of wetlands. The initiative of the Ramsar Convention came from people concerned about the fate of waterbirds, especially migratory waterbirds. They realised that, for the well-being of those migratory birds, the well-being of their wetland habitats was essential (Table 1, p. 42).

In parallel, it was observed that wetlands are not just potential agricultural land or airport sites, but that they provide very valuable services just as they are. Flood control, coastal protection, trapping of sediments and removal or nutrients, production of fish and other natural products, trapping of CO_2, and maintenance of traditional uses are just some of those services. There is general agreement that their value runs into billions of dollars.

It is no exaggeration to say that a considerable number of wetlands around the world still exist today, thanks to actions undertaken by various multi-environmental agreements to protect migratory birds and their habitats. An example is the marketing of shade-grown coffee in North America (section 3.3) as a product that helps protect migratory birds that spend the non-breeding season in the forested areas of Central or South America.

4.2 Bird watching and tourism

Bird watching and eco-tourism are commercially developed in many industrial countries and the focus on them in developing countries has also increased (Table 2). It is virtually impossible to separate the income generated by migratory birds from the income generated by resident birds. There is no doubt, however, that migratory birds contribute much to birdwatching and eco-tourism business. Several examples of the economic impact of bird tourism are illustrated below. It is noteworthy that migratory birds are a shared international good rather than a national natural resource. The value of birds from the recreational enjoyment of pet birds alone is considerable.

In South Africa, two 'birding routes' are generating an estimated revenue of US$ 6.4 million annually for local people. Tourists are provided with route descriptions that take them to a number of birdwatching areas, where they can watch resident bird species, intra-African and Palearctic migrants. Birding- and environment-friendly accommodation is provided, as well as local bird guides. Outstations offer marketing and other support for the local people providing the various services and a single all-encompassing information point for the tourists. More than 140 guides have already been trained and six new routes are planned. The project

Table 2: Some annual values of bird-dependent activities, bird products and services.*

Country	Activity	Annual value (US$)	Year (approx.)
Bird watching and tourism			
South Africa[69]	two birding routes: local travel accommodation and birding guides	6,400,000	2007
USA[70, 71]	bird watching trips	7 400,000,000	2001
	bird watching and related equipment	24,300,000,000	2001
USA[70, 71]	migratory bird hunting trips	657,000,000	2001
	Equipment for migratory bird hunting	732,000,000	2001
Costa Rica[38]	Ecotourism that includes birding	400,000,000	1999
Hunting of migratory birds			
Mediterranean region[72]	value of birds killed only, assuming a price of $ 0.50 per bird	250,000,000	2006
Malawi[73]	waterbird hunting	215,000	1999
Nauru[66]	guano export	20,000,000	1991
Nauru[66]	guano export	640,000	2004
Iceland (estimate)	eider down collection	28,000,000	2006

** Note that reliable economic data is scarce.*

simultaneously addresses social, economic and environmental needs, resulting in greatly increased local conservation awareness[69].

Another example is shown in the box describing one of the biggest raptor observation points, Hawk Mountain in the USA. In the USA 46 million people watch birds, i.e. go somewhere explicitly to observe birds and/or try to identify them around the home. That is nearly one in five people of 16 years or older, of which 54% are female. In comparison, there are 3.0 million bird hunters, of which just 5% are female.

Black-throated Mango (Anthracothorax nigricollis), female, © Vergy Derelieva

Birdwatching, Sudan, © Tim Dodman

In 2001 bird watchers in the USA spent a total of US$ 32 billion in retail sales on all wildlife-watching activities (Table 2). In doing so they contributed US$ 86 billion to economic output (add-on effect factor of 2.7) and created 863,000 jobs, as well as US$ 13 billion in State and Federal income taxes. Of the money they spent US$ 7.4 billion was spent on travel and associated costs (e.g. food, lodging, transportation costs, guide fees), and US$ 24.3 billion on equipment and other expenses (binoculars, field guides, bird food, bird houses, camping gear, big equipment like boats, cars, campers).[70, 71]

At Cape May for instance, 300 km south of New York, an estimated US$ 25-30 million per year is spent by bird watchers, equivalent to some 700 jobs, on a county population of approximately 100,000.

The net economic value of bird watching per day is estimated at US$ 35 for State residents and at US$ 134 for interstate visitors. Almost four-in-five bird watchers, 78%, watch waterbirds, most of which are migratory.[70, 71]

Costa Rica in 1999 received US$ 1 billion from tourism, of which 41% stemmed from birdwatching ecotourists[38]. Mostly this related to resident birds perhaps, but some also related to altitudinal migrants and long distance migrants.

A submission by the Royal Society for the Protection of Birds to an EC project argued that 'the natural environment should be protected for its intrinsic value, its contribution to our quality of life, and to bestow a healthy, sustainable planet to future generations'. In addition to its contribution to our health and wellbeing, the natural environment also supports economic activity directly, through nature conservation, and indirectly, through tourism, overall contributing 500,000 jobs to the UK economy.[74]

Well-known migratory bird watching sites around the world already attract a large number of birdwatchers. Different regions, aware that migration is a phenomenon receiving a greater and greater interest from the public, develop migration watching facilities: Falsterbö, at the south-western point of Sweden, where its east and west coast meet; the head of the Gulf of Eilat in southern Israel; Aqaba, its neighbour in Jordan. Others include Cape May in New Jersey (see above); Hawk Mountain in Pennsylvania, USA; Veracruz in Mexico; Gibraltar and Istanbul, stretching across the Mediterranean Sea. Beidaihe on the east coast of mainland China and the Heng-chun Peninsula of Taiwan are the most important sites for raptor migration in East Asia. This area is also an excellent example of how science, awareness raising and conservation efforts by government has reduced pressure of a traditional major hunting practice for export:[75].

Hawk Mountain, Pennsylvania, USA – Celebrating 75 Years of Raptor Conservation, 1934-2009

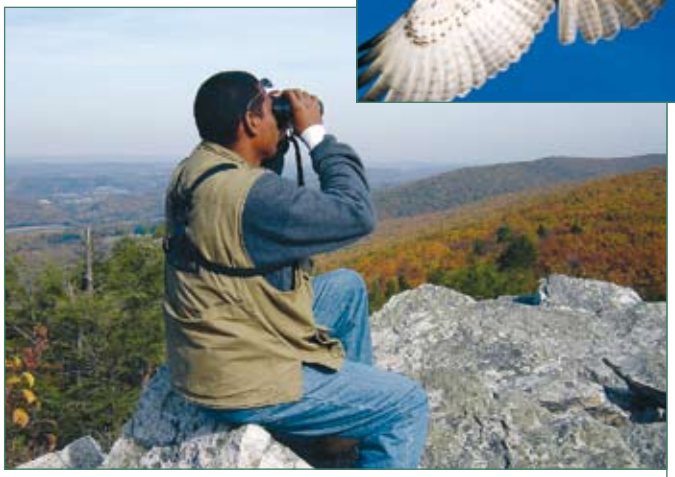
www.hawkmountain.org/

Located along the Appalachian Flyway in east-central Pennsylvania, Hawk Mountain Sanctuary is the world's first refuge for birds of prey.

Hawk Mountain's mission is to conserve birds of prey worldwide by providing leadership in conservation science and education on raptors, and by maintaining Hawk Mountain Sanctuary as a model observation, research and education facility.

To advance the mission, a full-time staff team of 16, assisted by a 200-member volunteer corps, carries out integrated conservation programmes in education, research, and monitoring, including operating a Visitor Centre and the Acopian Centre for Conservation Learning,and managing the 2,600-acre sanctuary. Hawk Mountain Sanctuary provides a high quality, year-round nature experience to 60,000 visitors annually.

Red-tailed Hawk (Buteo jamaicensis), © Jeff Schmoyer



Birdwatching at Hawk Mountain Sanctuary, © Hawk Mountain Sanctuary

Hawk Mountain's raptor conservation science includes:

Autumn Hawkwatch: The Sanctuary's annual count of hawks, eagles and falcons—the world's longest record of raptor populations—provides valuable information on changes in raptor numbers in north-eastern North America.

North American Monitoring Programme: A Hawk Mountain bio-statistician works with partner sites to assess the health of raptors across the continent.

Global Studies of Raptor Migration: Hawk Mountain works in partnership with raptor biologists worldwide to study the biology of raptor migration. Local and Regional Ecology: Hawk Mountain's Acopian Center for Conservation Learning hosts visiting scientists, scholars and academics for collaborative studies on local and regional ecology. Because half of the raptors that pass the Sanctuary winter south of the United States, Hawk Mountain has a specific conservation focus on Central and South America. The Sanctuary is currently working, including raising funds and offering technical assistance, with partners on raptor conservation projects in Cuba, Mexico, Costa Rica, Panama, Bolivia, and Venezuela. Its goal is to establish and maintain an active network of conservation and research partners in Latin America and along the rest of the world's major flyways. The Sanctuary continues to identify and train conservation leaders, working with BirdLife International partners and other conservation organisations, for training in its Conservation Internship Programme.

Migratory bird events

The spectacle of bird migration has led to the organisation of migratory bird festivals in many places, in developing and developed countries.

In Lebanon in spring 2005, the passage of 60,000 cranes in one day led to the organisation of the World Bird Festival in Ebel es-Saqi in October that year[72]. At El Haouria in Tunisia, female Sparrowhawks *Accipiter spp.* caught early in the year for falconry purposes are released during a festival in mid-June. In Morocco annual festivals mark the start of the hunting and falconry seasons[72].

Another example of a festival is the Crane Celebrations organised through the Siberian Crane MoU and the Siberian Crane Wetland Project: First held in Russia, Kazakhstan and Uzbekistan in 2002, the celebrations have grown into a regional programme and are now held at more than 100 sites in eight countries. The celebrations aim to increase public awareness of the Siberian Crane and wetland conservation, while providing community members an opportunity to showcase art, performances and writing focusing on cranes. Active festivals were also organised at Eilat, a key site for millions of migratory birds in south Israel.

Children celebrating waterbirds dance at the launch of World Migratory Birds Day at Laikipia, Kenya, 9 April 2006, © David Stroud, p. 34 in [i]

Lesser White-fronted Geese (Anser erythropus) flying alongside a microlight (inset), © Christian Moullec, p. 634 in [i]

For the USA dozens of migratory bird festivals are listed, celebrating the arrival or departure of hummingbirds, swallows, pelicans, shorebirds, cranes, raptors, seabirds, songbirds, geese, or just migratory birds in general. Several websites give an overview of festivals all across the country, during all months of the year. Many of the activities are also fundraisers for migratory bird conservation, including the very successful World Series of Birding at Cape May, New Jersey. In 2008 this annual team race, at peak migration time in early May, was held for the 25th time. With teams sponsored by individuals and companies to observe as many species as possible, the event has raised more than US$ 8,000,000 for bird conservation to date. Similar bird races are held annually throughout the world, for instance in China and Hong Kong, Malaysia, Singapore, India and Australia.

Bird festivals also take place in Mexico (Mazatlan, Yucatan), the Republic of Korea (Gunsan), Thailand (Chumphon), the Philippines (Puerto Princesa) and Malaysia (Sabah). BirdLife International coordinates the biennial World Bird Festival, with activities in countries from China to Italy and Poland to Ecuador. The first World Bird Festival was celebrated in 2001 and attracted over 300,000 people to more than 1,450 events in 88 countries. http://www.birdlife.org/action/awareness/world_bird_festival/index.html.

In October 2008 the World Bird Festival theme was 'Migratory Birds and their Flyways'. This theme is close to the heart of the annual World Migratory Bird Day, www.worldmigratorybirdday.org. Since 2006 this initiative has been run by the AEWA Secretariat in close cooperation with the UNEP/CMS Secretariat in Bonn in May. In 2008 alone more than 136 events in 59 countries all over the world were registered under the umbrella of World Migratory Bird Day.

Many publicity activities are also organised around the International Waterbird Census, the largest volunteer-based biodiversity programme in the world coordinated by Wetlands International, held each year in January.

4.3 Role of birds in the economy

Birds as sources of scientific and technological innovation

Insights into various aspects of human behaviour have been triggered by studies of bird behaviour, including that of migratory birds. Many of the best fliers are migratory birds, thus technology has also 'borrowed' much from birds, especially in relation to trying to profit from their innate structure and skills. Bird plumage patterns, including of migratory nightjars, are a source of inspiration for camouflage.

Live migratory bird trade

The trade in wild live birds, including some migratory ones, is still an important factual but disputed economic activity. Many bird species are kept as pets for their beauty and their song. In the four years 2000-2003 three million wild birds (and 800,000 captive-bred ones) were imported into the European Union. In Asia as well there is an enormous trade in wild birds. These are mainly sedentary birds, but a certain percentage consists of migratory species.

In West Asia there is also a market for stuffed birds, many of which are migratory[72]. The same can be said for other parts of the world.

Osprey (Pandion haliaetus), courtesy of Wings Over Wetlands

Saker Falcon, (Falco cherrug), © Mohammed Shobrak

Breeding Knot (Calidris canutus), © Gerard Boere

A Black-winged Kite (Elanus caeruleus) in Cairo Bird Market, © EWS BirdLife

Falconry

A number of migratory raptors are used to catch other birds and mammals, especially in the West and Central Asia, including the Saker Falcon *Falco cherrug*, Lanner Falcon *Falco biarmicus*, Peregrine Falcon *Falco peregrinus* and Gyr Falcon *Falco rusticolus*. Falconry has probably existed since about 2000 BC, when it developed in Central Asia, from modern day Iran to China. It is often, but not exclusively, associated with nobility. Falconry is still practised mostly for traditional recreational purposes in desert and steppe communities from Iran to Mongolia. In other places, especially the Arabian Peninsula, falconry is a much prized tradition primarily done for pleasure[38, 72].

Although the practice has been reduced, migratory falcons, eagles and other raptors, and their eggs, are still taken from the wild for falconry purposes. Sometimes the falcons are released after the hunting season is over, e.g. in Tunisia during the Sparrowhawk

festival of El Haouaria[72]. More often they stay in captivity. An individual falcon can fetch thousands of dollars, a considerable sum for poachers, who are often driven to hunt for income[72]. The newly established MoU on Migratory Birds of Prey in Africa and Eurasia is aiming at making these activities sustainable. Several countries in the Middle East have taken conservation measures and are working towards sustainable falconry including curing injured and sick falcons at high costs.

Hunting for food and market, then and now

Humans have hunted wild birds for their meat and plumage for tens of thousands of years. Hunting for the market is of course a more recent phenomenon, possibly going back some 10,000 years, when the development of agriculture made the establishment of villages and professional specialization possible. In Europe and West Asia there is quantitative information on professional hunting from the past three or four centuries. The numbers are staggering and reflect what a considerable impact these hunters had on their ecosystem. In the 17th century 600,000 Fieldfares *Turdus pilaris* were taken in Prussia in one day. In the early 19th century five million birds were sold per year in nearby Leipzig, Germany, according to tax receipts. Leadenhall Market in London received 400,000 Skylarks *Alauda arvensis* in 1854. At Dieppe, France, 255,500 birds were sold at market in the 1867/68 winter. During the 19th century, in parts of Germany Great Bustard *Otis tarda* were so common that children were given days off school to drive flocks from the fields. Nowadays, this bird is vulnerable to extinction. In the late 19th century 100,000 Common Quail *Coturnix coturnix* were killed in one day along a short stretch of Italian coastline, and almost two million were exported from Egypt in 1913.[38]

Colonisation has affected the landscape in North America, too. In the 19th century, renowned ornithologists estimated a single flock of Passenger Pigeons *Ectopistes migratorius* to contain more than one billion birds, and a single breeding colony in Wisconsin, in 1871, 136 million birds. A good forty years later, in 1914, the last Passenger Pigeon died in captivity. Hunting, fragmentation of the landscape and damage to the social structure of their colonies resulted in the species' extinction. Similarly the Eskimo Curlew *Numenius borealis* was hunted into extinction. For other species such as American Golden Plover *Pluvialis dominica* and

Hunter, © Else Ammentorp, p. 861 in [i]

Red Knot, Wood Duck *Aix sponsa*, Wild Turkey *Meleagris gallopavo* and Whooping Crane *Grus americana*, conservation laws, and on-the-ground conservation activities, often carried out by hunter organisations, came in time.[38] Hunting caused the decimation of Siberian Crane populations in Western and Central Asia, where only a few individuals now remain.

On the other hand, one could have some understanding that a limited period of mainly ten days of hunting is allowed in the Russian Federation for people living in the high north. This is a short period at the arrival of the first migratory birds, they will observe, after the long dark and severe winter period.

Harvesting of bird products

The harvesting of bird products, rather than the birds themselves, is also a multi-million dollar business. The oldest such activity is probably the collection of eggs, and colonially nesting birds are an obvious target. Many of these are migratory seabirds flying away from their large colonies during the non-breeding season.

In seabird breeding colonies **eggs** have been collected by local populations for thousands of years. Once seafaring developed, more distant colonies became much sought after by mariners. Thus the Great Auk in the North Atlantic was exterminated, but elsewhere seabirds suffered greatly, too. On New Zealand's Macquarie Island, 150,000 eggs of King Penguins

Sustainable hunting of migratory birds in the Mediterranean region (North Africa and the Near East)

- **www.birdlife.org/action/change/sustainable_hunting/index.html**
- **www.cms.int/species/raptors/index.htm**

Hunters kill an estimated 500 million birds as they migrate through the Mediterranean each year. Most are from species and populations that breed in Europe and spend the non-breeding season in Africa. Hunting is an important socio-economic activity in the region, particularly in rural areas, involving hundreds of thousands of people and hectares, and supporting a variety of groups. The interests of these groups must be considered if conservation measures to address the plight of migratory birds are to succeed. Management of bird hunting in the region is inadequate with often poor legal regulation and law enforcement, lack of resources and capacity among relevant government institutions and NGOs. Awareness of the impact of hunting is poor among the public and even hunters themselves. Hence, there is an urgent need for a regional agreement on action to protect migratory birds better and to avoid further conflicts between hunters and conservationists, as those that have appeared in the past.

In response to the above, BirdLife International, in partnership with AAO in Tunisia, SPNL in Lebanon and AEWA, with additional financial support from the European Union's LIFE Third Countries fund, BirdLife–the Netherlands and UNDP-GEF, completed a 3-year initiative (2004-2007) to tackle these issues in Morocco, Algeria, Tunisia, Egypt, Palestine, Lebanon, Jordan and Syria.

A collection of trapped songbirds, © S Baha El Din/BirdLife

Project activities included

1. Review of information on hunting of migratory birds in each country, including current bird hunting, its management and impact, socio-economic and cultural importance, potential alternatives, and 'best practice'.
2. Development of guidelines for sustainable hunting of migratory birds
3. Promotion of sustainable hunting behaviour
4. Improving public awareness
5. Development and enforcement of hunting legislation
6. Resolving conflict and building partnerships
7. Strengthening co-operation and compliance with international agreements
8. Development of a Regional Action Plan for Sustainable Hunting and Conservation of Migratory Birds.

All resulting documents, in French, Arabic and English, are available from the BirdLife website.

Common eider (Somateria mollissima) at nest, Scotland, © Tim Dodman

Nest of Pontic gull (Larus cachinnans), © David Stroud, p. 559 in [i]

Aptedonytes patagonica and Royal Penguins *Eudyptes schlegeli* were collected annually for 50 years; on the Falkland Islands/ Islas Malvinas 2.5 million eggs mostly of Rockhopper Penguins *Eudyptes crestatus* were harvested in sixteen years. 14 million Jackass Penguin *Spheniscus demersus* eggs were taken just from Dassen Island, South Africa, in the period 1900-1930. Albatrosses were also targeted, with almost 300,000 Short-tailed Albatross *Diomedea albatrus* eggs taken each year from 1887-1903. There were dramatic declines of sea bird colonies in North America and Novaya Zemlya, Russia, where there was no local tradition of collection and management prior to commercial egging enterprises, which took their toll. [38]

Where local interest is high, long-term population management is more likely: certain seabird colonies in the North Atlantic, Macaronesia, Seychelles and Tasmania are good examples.[38] But all too often the 'Tragedy of the Commons', applies meaning a situation whereby access to the natural resource is free, there is unrestricted demand for this finite resource and the individual who harvests retains the full private benefit, while the costs are born by all[76]. This situation frequently applies to seabird colonies, their birds and eggs, even when declines in numbers are obvious: everyone wants to profit, no-one feels responsible.

Much more sustainable is the collection of the **down** of the Common Eider *Somateria molissima*. "Molissima" means 'extremely soft', and the down has been collected for use in bedding and clothing by native peoples in Northern Eurasia and America for thousands of years. In Iceland, some 400 collectors annually still gather about 17 grams of down from each of 180,000 nests, either waiting until after the eggs have hatched or replacing it with hay[77]. Their total harvest of about 3,000 kg of down is about 75% of the annual world production. In May 2006, a wholesale price of US$ 7,000 per kg of eider down was quoted on the internet in the USA, which would put the value of eider down trade at about US$ 28 million per year. Much of the down is used in exclusive sleeping bags and bed covers.

In modern times **guano**, sea bird droppings, has been used for many years as fertiliser in different countries (some guano deposits are 2,000 years old, more than 90 metres deep and were valued by the Incas). The guano in Peru was the country's single largest source of income for more than a century. The mining of guano takes place on islands in tropical oceans. Guano is rich in phosphorus, nitrogen and organic matter, and can be used as a fertiliser either directly or after processing. When it was realised in the mid-19th century how important resource guano was, the United States Congress adopted the Guano Islands Act, enabling citizens of the U.S. to take possession of islands anywhere containing guano deposits, so long as they were not occupied and not within the jurisdiction of other governments. Britain, France and Spain similarly claimed seabird islands all over the world. [38]

In many places the guano has been mined too quickly and deposits have been almost or completely exhausted (see the data for Nauru in Table 2, p. 50), also due to over-fishing and subsequently reduced populations in seabirds (guano producers). In the 20th century there were efforts to make extraction sustainable, but for many deposits it was too late.

5 NUMBERS AND TRENDS IN POPULATIONS OF

An estimated 1,855 out of the 9,856 bird species world-wide are migratory. Of these 262 are seabirds, 343 are altitudinal migrants, 181 are nomadic, and 1,593 are migratory land- and waterbirds[12,78]. In 2008, 11% of the 1,593 migrants mentioned were considered threatened or near-threatened (13 'Critically Endangered', 25 'Endangered', 73 'Vulnerable', and 66 'Near-Threatened').

An overview of numbers of (near-) threatened species per region is given in Table 3. Remarkable are the low percentage of (near-) threatened migratory soaring birds in the Americas (2%), and the high percentages of (near-) threatened soaring birds in the Asia-Pacific (33%) and Palearctic-Africa (24%) regions. Also notable are the high percentages of (near-) threatened waterbirds in the Asia-Pacific (23%) and Palearctic-Africa (16%) regions.[12]

The regular population estimates and status reviews for all waterbird populations world-wide, coordinated by Wetlands International, indicate that

- 40% of waterbird populations for which trend data are available at the global level are decreasing,
- 34% are stable,
- 17% are increasing
- 4% have become extinct[79].

Although not all waterbirds are migratory the trends for just the migratory populations are very likely to be similar.

Red List Indices give an impression of how the status of (near-) threatened species on IUCN Red Lists has changed over a certain period. A Red List Index shows that since 1988, 33 species of migratory land- and waterbirds have deteriorated in status, and only 6 have improved.[80, 81]

Breeding Bird Surveys (BBS) have been used to show that, over the period 1978-1987, 44 of 62 species that breed in eastern North America and spend the non-breeding season in Central or South America, declined in abundance. Only 48% (15 out of 32) resident bird species, and species that migrate within North America, did so[79]. More recent BSS analyses showed negative population trends over the period 1980-2005 for

- 62% of bird species that breed in Eastern-North America and spend the non-breeding season in Central or South America
- 65% of bird species that breed in Western-North America and spend the non-breeding season in Central or South America
- 70% of bird species that breed in western North America and migrate within in North America
- 86% of grassland-breeding birds continent-wide[82].

In South America a group of migratory species that rely on grassland habitats in Southern-South America has been identified as being of conservation concern. They breed primarily in the grasslands of North-Eastern Argentina, Southern Paraguay, Southern Brazil and Uruguay, and spend the non-breeding season in the campo grasslands of the "cerrado region" of Central Brazil[83].

http://www.cms.int/species/Grassland_birds/grassland_birds_bkrd.htm

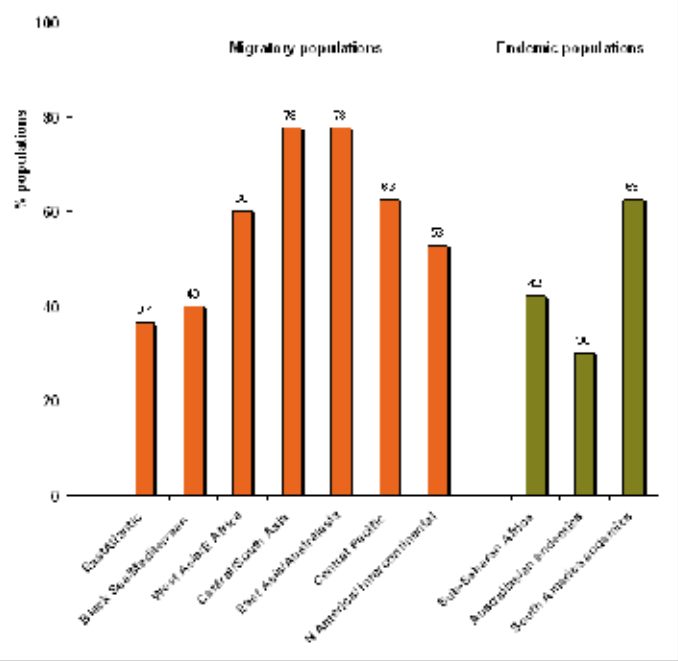
Table 3: Numbers and percentages of threatened or near-threatened migratory bird species by type and region [12, in 11].

Broad regions	Landbirds	Waterbirds	Soaring birds	TOTAL
Americas	47 of 579 8%	18 of 202 9%	1 of 45 2%	65 of 819 8%
Europe, Central Asia, Africa & The Middle East	29 of 365 8%	26 of 162 16%	16 of 67 24%	55 of 582 10%
Asia–Pacific	52 of 477 11%	46 of 201 23%	24 of 73 33%	98 of 728 14%

NB: The sum of the totals by region or type exceeds the total number of migratory species (1,593) because some species occur in more than one region, and soaring birds include landbirds or waterbirds.

MIGRATORY BIRDS

Figure 17: The status (percentage of biogeographic populations of known trend which are in decline) during the mid-1990s to mid-2000s of migratory wader populations on different global flyways, and the status of endemic populations. The number above each bar is the percentage of decreasing populations, from N.C. Davidson, in preparation.



© Nick Davidson, Data source: derived from Wetlands International (2002 & 2006 - Waterbird population estimates, 3rd & 4th editions).

In Europe, long-distance migrants are declining significantly more than short-distance migrants, irrespective of breeding habitat. Of 118 intercontinental migrating species, 48 (40%) showed substantial negative trends over the period 1970-2000. Species spending the non-breeding season in semi-arid parts of Africa appear to be especially affected.[14] See also Fig. 9, p. 22, discussed in section 2.3.
http://www.cms.int/species/sb_curlew/sbc_bkrd.htm

Of 77 migratory raptor species in Africa and Eurasia, at least 39 (51%) are globally threatened or near-threatened or declining. In Europe 62% of raptor species have an unfavourable conservation status, nearly a third are declining rapidly (i.e. by more than 1% per annum), and 21% have suffered large declines averaging over 3% per year in the last 10 years.[31]
http://www.cms.int/species/raptors/index.htm

Along the East Asian-Australasian flyways, a regional analysis of trends in populations of migratory birds has not taken place yet. However, judging by the rate of mangrove loss in the Thai-Malay Peninsula (90% in recent times) and of lowland forest loss (80%), it is estimated that mangrove specialist birds must be at least Near-Threatened, and lowland forest specialists Endangered[84]. In Japan serious range contractions of breeding birds also appear to be associated with long-distance migration[85].

In Asia as a whole, 62% of waterbird populations are now decreasing or have become extinct and only 10% show an increasing trend[79]. In inland eastern Australia migratory waterbird populations have plummeted by 79% over a 24-year period[86]. In Central, Southern and Eastern Asia, 17 (33%) of the 51 migratory raptor species considered currently exhibit an unfavourable conservation status[31]. See also http://www.cms.int/bodies/ScC/15th_scientific_council/15th_ScC_documents.htm#scc13_docs for the serious status of albatross and petrels.

A global summary of population trends can be found in Fig. 17.

6 CONCLUSIONS AND RECOMMENDATIONS

Monitoring: The data available on bird migration and individual populations has grown steadily within the last century. Nevertheless, there are still considerably gaps in our understanding of the distribution and ecology of migratory species. These gaps not only concern behaviour but also the threats these animals face, as well as the habitat status, and the conservation strategies that might be most suitable to conserve them. To help fill these gaps, new technologies such as radio and satellite tracking, the recording of geographical location data through a small signalling device attached to a bird, as well as genetic analyses can be extremely useful and provide more detailed information than classic ringing studies. The same applies to isotopic analysis of feathers of individual birds, which can be used to determine in which region the birds were living when those feathers were formed. The Millennium Ecosystem Assessment was one of the first global attempts to collect detailed information on the status of ecosystems and of migratory bird habitats. However, to optimally conserve the many species travelling along the flyways discussed in this publication, a great deal more monitoring data is required.

Conservation action: Worldwide migratory bird populations are declining at unprecedented scales (section 5). While monitoring provides the foundation for informed decision-making it is vital that conservation action is not limited by uncertainty. This is particularly important in the light of climate change. The best available scientific understanding should drive precautionary conservation action. However, sometimes political and socio-economic factors are limiting action rather than our lack of ecological understanding. This is why efforts must focus on all the available conservation tools from monitoring and research to interdisciplinary conservation action to juridical measures.

With regards to applied action in the field, a network of critical sites, not least along the world's flyways, is likely to maximise the potential of migratory birds to adapt to climate change. Such a network would provide a mosaic of the widest possible range of available habitat. Thus, whichever way the climate might locally change, such a diverse critical site network would keep as many doors as possible open to provide potentially suitable habitat in future. The WOW project discussed in this publication provides a promising start to support the development and management of critical sites along avian flyways. It is important to note that these networks, such as BirdLife International's Important Bird Areas (IBAs), need to grow fast to cope with the predicted habitat and species changes facing our planet in the immediate future. Habitat composition is already changing throughout the world in connection with direct anthropogenic land use, but also more indirectly through climatic factors. The spatial and temporal migratory behaviour of many birds such as Trans-Saharan songbirds are also shifting fast. It is evident that international cooperation is needed as a framework to facilitate the wide-reaching conservation action required. Flyways provide a good structure to base this cooperation upon. It is vital that conservation and management activities remain practical and target location-specific needs. Incentives need to be created for community-based conservation where appropriate, ideally growing from the bottom-up which will naturally make these initiatives adapt well to the specific situation. Where the exploitation of a migratory species or the habitat of such a species is dependent upon the socio-economic situation of the people living within its range, it is vital that conservation action is taken in close liaison with human development aspects.

Awareness raising: Awareness on migratory birds and their plight certainly needs to be improved among the general public. Activities like World Migratory Bird and World Bird Day, Crane Celebrations as well as the many Migratory Bird festivals in the Americas (see section 4.2) must continue to be developed further. Awareness raising through schools and other educational institutions which are relevant to local traditions must be encouraged. All of this can form part of a capacity building strategy to improve the general knowledge of local people on migratory birds and their flyways.

Measuring success: When can conservation measures aimed at migratory birds be determined as successful? Indicators to measure progress should be identified right at the very outset of the planning phase when projects are formulated. The indicators identified, such as bird population size or attitudes of the local population, must be clearly measurable and linked to the project aims, need to be monitored before, during and after any intervention. It is not sufficient to measure outputs, instead a holistic approach incorporating ecological as well as socio-economic changes is required.

Global policy can be informed initially through large scale species status assessments, such as the Red List Index. However, this only provides an overview of where further investigation is needed and is a good tool to highlight threatened species[80, 81]. The Red List Index has recently been included as an indicator for Millennium Development Goal 7, to ensure environmental sustainability.

International environmental legal framework: The ecological concept of a flyway can be translated into policy through an international agreement, which facilitates collaboration and sharing of tasks between the various range states. Furthermore, it permits the harmonisation of national environmental law, such as hunting laws, to reflect the needs of the birds and local people living within an individual flyway zone. In theory one could initiate international cooperation through bilateral agreements between adjacent countries. However, the advantage of several multi-lateral agreements on flyways, possibly one for each of the five large flyway systems, becomes immediately obvious if one started to calculate how many bilateral agreements would be required to cover even a single flyway. CMS provides an ideal framework for such agreements and the success of the African-Eurasian Waterbird Agreement, for example, illustrates how cost-effective and powerful such a multi-lateral agreement can be.

Development of legislation that can adapt to changes in threat status and range shifts of bird species is important, especially if action is to be taken on a global scale. This is a challenge that current and future agreements face, especially in the light of climate change.

In conclusion it is evident that migratory birds, especially long-distance migrants, will benefit considerably from protection all along individual flyways. Such a coordinated approach between the countries concerned must include:

- Coordinated gap analyses to identify location-specific needs as well as opportunities for the conservation of migratory birds
- Habitat protection along a critical site network, including all the migratory flyways; such a network needs to be developed with future changes in mind, especially those related to climate change, to maximise the adaptation potential of individual bird species
- Careful planning and adaptation of man-made physical threats such as renewably energy structures (e.g wind turbines, Concentrated Solar Power plants) and power lines to flyways and the critical site network
- Coordinated management of pollutants such as pesticides, harmful chemicals, certain plastics and lead shot
- Coordinated research of biological threats such as pathogens, parasites, predators and (introduced) competitors
- Provision of conservation action and habitat to ensure that threats facing birds during migration and at breeding and non-breeding grounds are minimised, including any exploitation that exceeds sustainable levels
- Implementation of national legislation taking into consideration changes in threat status of migratory bird species
- Support of civil society in awareness raising, monitoring, management and conservation work for migratory species; support for ordinary citizens to act as watchdogs for environmental matters

It is ecologically essential that migratory birds are able to return to their breeding and non-breeding grounds each year. This not only benefits the entire ecosystem, but humans as well. Therefore, it is necessary for each range state not only to undertake "individual" national measures to conserve migratory birds and their habitats, but also to join forces with the other range states to maximize the cost-effectiveness of their action.

The implementation of global conservation measures is not only advantageous for the birds but also beneficial for humanity: through such a framework, common and fair solutions for farmers, for example, can be found whose crops have been ravaged by birds, the global community can most effectively limit the transmission of pathogens such as highly pathogenic avian influenza H5N1 to domestic birds or humans. Only an effective and efficient cooperation between the individual flyway countries is likely to lead to the effective conservation of these birds, which form part of the greatest animal movement on earth.

GLOSSARY

Defining bird migration ([30], p. 73 in [10])

Afro tropical: From the bio-geographical region formed by Africa south of the Sahara, Madagascar and the southern part of the Arabian Peninsula.

Altitudinal migration: Seasonal return movement between higher and lower elevations in the same region. For instance in the Andes, Himalayas and the Australian and New Zealand Alps

Broad-front migration: Migration across a region, with no apparent streaming by topographic or other features. See also 'Leading line'.

'Convenience store' stop-over sites: Where birds can briefly rest for up to two days and easily refuel, e.g. on the way between higher quality sites. Ideally such sites are structurally heterogeneous and provide fresh water and a variety of food resources

Dispersal: The movement of an individual bird from where it was born in no fixed direction and no fixed distance.

Eruption: A massive emigration of birds of a particular species from a particular region.

'Fire-escape' stop-over sites: Infrequently used, but vital in emergencies. Often next to significant hurdles such as large water or desert crossings, or large areas that have become inhospitable because of man-caused changes. Typically small and isolated refuges surrounded by unusable habitat.

Flyway: The total area of distribution of a bird 'population' throughout the year and all life cycle-stages'.

'Full service hotel' stop-over sites: Extensive suitable areas with all necessary resources (food, water, shelter) relatively abundant and available, low risks, and serving many birds of many species for up to several days, and in the case of waterbirds even weeks. Here birds can really fuel up as much as necessary.

Guano: The excrement (faeces and urine) of seabirds, bats and seals. Guano consists of ammonia, along with uric, phosphoric, oxalic and carbonic acids, as well as some earth salts and impurities. Guano also has a high concentration of nitrates.

Intra-tropical migration: Migration entirely within the tropics.

Inward migration: Movement from non-breeding to breeding areas.

Irruption or invasion: In migration studies, a massive immigration to a particular region. More generally, a form of migration in which the proportion of individuals that participate, and the distance they travel, varies greatly from year to year.

Leading line: A topographical feature, such as a coastline, escarpment or river valley, along which migrating birds tend to fly. Usually runs approximately in the preferred direction of migration, leading to concentrated streaming for part of the journey. For instance along the east coast of Asia, all the way to the tip of Malaysia and Singapore.

Loop migration: The situation in which birds take markedly different routes on their outward and return journeys.

Migrant: A bird that undertakes special movements between widely separated breeding and non-breeding areas.

Migration: Here: a regular seasonal movement, between separate breeding and non-breeding (wintering) areas.

Migratory divide: An imaginary line which separates breeding populations of the same species that migrate in different directions. On one side of the line, birds migrate in one direction (say

south-west), and on the other side of the line in another direction (say south-east). For instance in Europe, with one population migrating to Africa via Gibraltar, and the other via the Bosporus and The Middle East. There is often a zone of overlap rather than a strict divide.

Nearctic: From the bio-geographical region formed by North America, including Greenland and part of Mexico

Neotropical: From the bio-geographical region formed by South and Central America, including part of Mexico, and the Caribbean.

Nomadic: Having no fixed spatial pattern of migration, and no fixed directional preferences.

Outward migration: Movement from breeding to non-breeding areas.

Palearctic: From the bio-geographical region formed by Europe, Asia north of the Himalayas, North Africa and the northern part of the Arabian Peninsula.

Staging area: A place where large numbers of birds break their migratory journeys, usually to refuel but sometimes also to moult.

Stopover: A pause in a migratory journey.

"Wintering" area: In migratory birds, the area where a population spends the non-breeding season, usually at lower latitudes (or in the case of altitudinal migration, lower altitudes). E.g. waders along the coast of Africa, where locally it may be either the dry season or the rainy season, rather than 'winter'. As the term "winter" is dependant on the hemisphere, the term "non-breeding area" was introduced. The migration phase of the year is often limited in time (although some species perform complex, semi-continuous . migrations, which make it difficult to distinguish such phases). The 'wintering' phase can be a very substantial part of the annual cycle. For many species, expressed in time, the non reproductive season has much more weight than the breeding season. E.g. for many Arctic breeding species the proportion of the year spent in the Arctic is relatively small.

NB. Note that the concept of 'wintering area' includes the notion that populations leave the breeding areas, migrate (cover a certain distance) and then reach an area where they spend the remainder of their non breeding season. Thus, the wintering area is often smaller than the area in which the non-breeding season is spent (since the latter includes the whole area over which migration takes place).

CMS FLYWAYS REFERENCE LIST

1. **Able, K.P.** 1999. Gatherings of Angels. Migrating birds and their ecology. Cornell University Press. 193 pp.
2. **Piersma, T.** 1987. Hop, skip, jump? Constraints on migration of arctic waders by feeding, fattening, and flight speed. Limosa 60: 185–194.
3. **Drent, R.H. & Daan, S.** 1980. The prudent parent: energetic adjustments in avian breeding. Ardea 68:225-252
4. http://www.guardian.co.uk/environment/2009/feb/13/songbird-migration
5. **De Silva, Rex I.** 3 Apr 2008. Observations on the mass migration of Bridled Terns *Sterna anaethetus* off the coast of Colombo. Ibis. Volume 129 Issue 1, Published Online 88-92pp.
6. **Baird, J.** 1999. Returning to the tropics. The epic autumn flight of the Blackpoll Warbler. In: Gatherings of Angels. Migrating birds and their ecology. Ed. K.P. Able. Cornell University Press. pp. 63-77.
7. **Marchant, S. & Higgins, P.J. (eds)** 1993. Handbook of Australian, New Zealand and Antarctic Birds. Volume 2: Raptors to Lapwings. Oxford University Press, Melbourne.
8. **Veen, J., Yurlov, A.K, Delany, S.N, Mihantiev, A.I., Selivanova, M.A. & Boere, G.C.** 2005. An atlas of movements of Southwest Siberian waterbirds. Wetlands International, Wageningen, The Netherlands. 60 pp.
9. **Del Hoyo, J., Elliott, A. & Sargatal, J. (eds)** 1992. Handbook of the Birds of the world. Vol. 1. Lynx Edicions, Barcelona.
10. **Spina, F. & Volponi, S.**, 2008. Atlante della Migrazione degli Uccelli in Italia. Non-Passeriformi. Ministero dell'Ambiente e della Tutela del Territorio e del Mare. Instituto Superiore par la Protezione e la Ricerca Ambientale (ISPRA). Tipografia SCR-Roma. 800 pp.
11. **Kirby, J.S., Stattersfield, A.J., Butchart, S.H.M., Evans, M.I., Grimmett, R.F.A., Jones, V.R., O'Sullivan, J., Tucker, G.M. & Newton, I.** 2008. Key conservation issues for migratory land- and waterbird species on the world's major flyways. Bird Conservation International. 18:S49-S73.
12. **BirdLife International** 2008b. Threatened birds of the world 2008. CD-ROM. BirdLife International, Cambridge, UK.
13. **Salafsky, N., Salzer, D., Stattersfield, A.J., Hilton-Taylor, C., Neugarten, R., Butchart, S.H.M., Collen, B., Cox, N., Master, L.L., O'Connor, S. & Wilkie, D.** (in press) A standard lexicon for biodiversity conservation: unified classifications of threats and actions. Conservation Biology 22:897.911. DOI: 10.1111/j.1523-1739.2008.00937.x
14. **Sanderson, F.J., Donald, P.F., Pain, D.J., Burfield, I.J. & van Bommel, F.P.J.** 2006. Long-term population declines in Afro-Palearctic migrant birds. Biol. Conserv. 131:93–105.
15. **Pain, D.J. & Pienkowskil, M.W.** 1997. Farming and birds in Europe: the Common Agricultural Policy and its implications for bird conservation. Academic Press, London.
16. **Donald, P.F., Green, R.E. and Heath, M.F.** (2001) Agricultural intensification and the collapse of Europe's farmland bird populations. Proc. R. Soc. Lond. Ser. B Biol. Sci. 268: 25–29.
17. **Robbins, C.S., Sauer, J.R., Greenberg, R.S. & Droege, S.** 1989. Population declines in North American birds that migrate to the Neotropics. Proc. Nat. Acad. Sci. 86: 7658–7662.
18. **Gray Tappan**, US Geological Survey, EROS Center, pers. comm.
19. **Baker, A.J., Gonzalez, P.M., Piersma, T., Niles, L.J., deLima Serraro do Nascimento, I., Atkinson, P.W., Clark, N.A., Minton, C.D.T., Peck, M.K. & Aarts, G.** 2004. Rapid population decline in Red Knots: fitness consequences of decreased refuelling rates and late arrival in Delaware Bay. Proc. R. Soc. Lond. B. 271: 875–882.
20. **USFWS** 2007. Status of the Red Knot (*Calidris canutus rufa*) in the western hemisphere. US Fish and Wildlife Service, Pleasantville, New Jersey.
21. **Van Gils, J.A., Piersma, T., Dekinga, A., Spaans, B. & Kraan, C.** 2006. Shellfish-dredging pushes a flexible avian top predator out of a protected marine ecosystem. PLoS Biology 4:2399-2404 (e376).
22. **Piersma, T.** 2006. Migration in the balance: tight ecological margins and the changing fortunes of shorebird populations. In: Waterbirds around the world. Eds G.C. Boere, C.A. Galbraith & D.A. Stroud. The Stationery Office, Edinburgh, UK. p. 74-80.
23. **Zalles, J.I. & Bildstein, K.L. (eds)** 2000. Raptor Watch: A global directory of raptor migration sites. BirdLife International, Cambridge, UK and Hawk Mountain Sanctuary, Kempton, PA, USA. (BirdLife Conservation Series No. 9).
24. **Stroud, D.A., Baker, A., Blanco, D.E., Davidson, N.C., Delany, S., Ganter, B., Gill, R., González, P., Haanstra, L., Morrison, R.I.G., Piersma, T., Scott, D.A., Thorup, O.,West, R.,Wilson, J. & Zöckler, C. (on behalf of the International Wader Study Group)** 2006. The conservation and population status of the world's waders at the turn of the millennium. In: Waterbirds around the world. Eds G.C. Boere, C.A. Galbraith & D.A. Stroud. The Stationery Office, Edinburgh, UK. p. 643-648.

25. **Banks, R. C.** 1979. Human-related mortality of birds in the United States. U. S. Fish Wildlife Service. Spec. Sci. Report 215: 1–16.

26. **USFWS** 2002. Migratory bird mortality. US Fish and Wildlife Service, Arlington, Virginia. (Avian mortality fact sheet: http://birds.FWS.gov/mortality-fact-sheet.pdf).

27. **De Lucas, M., Janss, G.F.E. & Ferrer, M.** 2007. Birds and wind farms. Quercus, Madrid.

28. **Kirby, J., Davidson, N., Giles, N., Owen, M. & Spray, C.** 2004. Waterbirds and Wetland Recreation Handbook: a review of issues and management practice. Wildfowl and Wetlands Trust, Slimbridge, U.K.

29. **Zöckler, C. & Lysenko, I.** 2000. Waterbirds on the edge. WCMC Biodiversity Series no. 11. UNEP-World Conservation Monitoring Centre, Cambridge, U.K.

30. **Newton, I.** 2008. The Migration Ecology of Birds. Academic Press, London, UK. 976 pp.

31. **Goriup, P. & Tucker, G.** 2007. Assessment of the merits of a CMS instrument covering migratory raptors in Africa and Eurasia. Department for Environment, Food and Rural Affairs, Bristol, U.K.

32. **Bairlein, F. & Hüppop, O.** 2004. Migratory fuelling and global climate change. Adv. Ecol. Res. 35:33–47.

33. **Butler, R.W.** 2000. Stormy seas for some North American songbirds: are declines related to severe storms during migration? Auk 117:518–522.

34. **Huntley, B., Green, R.E., Collingham, Y.C. and Willis, G.** 2007. A climatic atlas of European breeding birds. Durham University, RSPB, and Lynx Edicions Barcelona.

35. **Robinson, R.A., Learmouth, J.A., Hutson, A.M., MacLeod, C.D., Sparks, T.H., Leech, D.I., Pierce, G.J., Rehfische, M.M. and Crick, H.Q.P.** 2005. Climate change and migratory species. British Trust for Ornithology, Thetford, U.K.

36. **Zwarts, L., Bijlsma, R., Wymenga, E. & van der Kamp, J.** (in press). Living on the edge. Effects of variations in environmental conditions in the Sahel on population sizes of migratory birds from Europe wintering there. KNNV Uitgeverij, Zeist, The Netherlands.

37. **Loske, K.-H.** 1989. Zur Brutbiologie der Rauchschwalbe (*Hirundo rustica*) in Mittelwestfalen. Vogelwelt 110: 59-82.

38. **Collar, N.J., Long, A.J., Robles Gil, P. & Rojo J.** 2008. Birds and People. Bonds in a Timeless Journey. CEMEX-Agrupación Sierra Madre-BirdLife International, Mexico City, Mexico. 360 pp.

39. **Raine, A.F.** 2007. The international impact of hunting and trapping in the Maltese Islands. BirdLife Malta (internal report).

40. **Porter, R.F.** 2005. Soaring bird migration in the Middle East and North East Africa: the bottleneck sites. BirdLife International, Cambridge, U.K.

41. **Biber, J.-P. & Salathé, T.** 1991. Threats to migratory birds. In: Conserving migratory birds. Ed. T. Salathé. International Council for Bird Preservation Technical Publication no. 12. Cambridge, U.K.

42. **BirdLife International** 2004a. Birds in Europe: population estimates, trends and conservation status. BirdLife International, Cambridge, U.K.

43. **Boere, G.C. & Stroud, D.A.** 2006. The flyway concept: what it is and what it isn't. In: Waterbirds Around the World. Eds G.C. Boere, C.A. Galbraith & D.A. Stroud. The Stationery Office, Edinburgh, UK. p. 40-47.

44. **Ramsar Bureau** 1999. Strategic Framework and guidelines for the future development of the List of Wetlands of International Importance of the Convention on Wetlands (Ramsar, Iran, 1971). Gland, Switzerland. http://www.ramsar.org/key_guide_list2006_e.htm

45. **Dixon, C.** 1895. The Migration of British Birds; including their postglacial emigrations as traced by the application of a new law of dispersal. Chapman and Hall Ltd., London.

46. **US Department of the Interior** 1959. The Waterfowl Councils. A Conservation Partnership. US Fish & Wildlife Service Circular 78, US Department of the Interior. Available at http://centralflyway.org/pdf/Circular78_Pictures.pdf.

47. **Schmidt, P.R.** 2006. North American flyway management: a century of experience in the United States. In: Waterbirds Around the World. Eds G.C. Boere, C.A. Galbraith & D.A. Stroud. The Stationery Office, Edinburgh, UK. p. 60-62.

48. **Kuijken, E. 2006.** A short history of waterbird conservation. In: Waterbirds around the world. Eds G.C. Boere, C.A. Galbraith & D.A. Stroud. The Stationery Office, Edinburgh, UK. p. 52-59.

49. **Stroud, D., Boere, G.C., Galbraith, C.A. & Thompson, D.** 2006. Waterbird conservation in a new millennium – where from and where to? In: Waterbirds around the world. Eds G.C. Boere, C.A. Galbraith & D.A. Stroud. The Stationery Office, Edinburgh, UK. p. 29-39.

50. **Isakov, Y.A.** 1967. MAR Project and conservation of waterfowl breeding in the USSR. In: Proceedings of the Second European Meeting on Wildfowl Conservation, Noordwijk aan Zee, The Netherlands, 9-14 May 1966. Ed. Z. Salverda. Ministry of Cultural Affairs, Recreation and Social Welfare, The Netherlands. p. 125-138.

51. **Isakov, Y.A. (ed.)** 1970. International Regional Meeting on Conservation of Wildfowl Resources (Europe, Western Asia, Northern and Tropical Africa), Leningrad, USSR, 25-30 September 1968. Proceedings. Moscow. 424 pp.

52. **Matthews, G.V.T.** 1993. The Ramsar Convention on Wetlands: Its History and Development. Ramsar Convention Bureau, Gland, Switzerland. Available at http://www.ramsar.org/lib/lib_history.htm

53. **Boere, G.C.** unpublished. The African Eurasian Migratory Waterbird Agreement: a review of its history, background, development and implementation. AEWA Secretariat, Bonn.

54. **Matthews, G.V.T. & Isakov. Y.A. (eds)** 1981. Proceedings of the IWRB Symposium on the Mapping of Waterfowl Distributions, Migrations and Habitats. Alushta, Crimea, USSR, 16-22 November 1976. USSR, Ministry of Agriculture and Academy of Sciences. Moscow. 353 pp.

55. **Wohl, K.** 2006. The Arctic – origin of flyways. In: Waterbirds around the world. Eds G.C. Boere, C.A. Galbraith & D.A. Stroud. The Stationery Office, Edinburgh, UK. p. 120-123.

56. **Mundkur, T.** 2006. Successes and challenges of promoting conservation of migratory waterbirds and wetlands in the Asia-Pacific region: nine years of a regional strategy. Waterbirds around the world. Eds. G.C. Boere, C.A. Galbraith & D.A. Stroud. The Stationery Office, Edinburgh, UK. pp. 81-87. Available at http://www.jncc.gov.uk/PDF/pub07_waterbirds_part2.2.5.pdf

57. **Fransson, T. & Petterson, J.** 2001. Swedish Bird Ringing Atlas. Vol. 1. Naturhistoriska riksmuseet & Svriges ornitologiska Förening. Stockholm. 189 pp.

58. **Bakken, V., Runde, O. & Tjørve, E.** 2003. Norsk ringmerkingsatlas. Vol. 1. Stavanger Museum, Stavanger.

59. **Wernham, C., Toms, M., Marchant, J., Clark, J., Siriwardena, G. & Baillie, S. (eds)** 2002. The Migration Atlas: movements of the birds of Britain and Ireland. T. & A.D. Poyser, London.

60. **Zink, G.** 1973-1985. Der Zug europäischer Singvögel: ein Atlas der Wiederfunde beringter Vögel. Vol. 1 (1973), vol. 2 (1975), vol. 3 (1981) and vol. 4 (1985). Vogelwarte Radolfzell, Moggingen, Germany.

61. **FAO** 2005. Map of H5N1 outbreak in 2005 and major flyways of migratory birds. ftp://ftp.fao.org/docrep/fao/010/a0115e/a0115e04.pdf

62. **Normile, D.** 2006. Are wild birds to blame? Science 310:426-428.

63. **Olsen, B., Munster, V.J., Wallenstein, A., Waldenström, J., Osterhaus, A.D.M.E. & Fouchier, R.A.M.** 2006. Global patterns of Influenza A virus in wild birds. Science 312:384-388. Available at www.sciencemag.org/cgi/reprint/312/5772/384.pdf

64. **Pfeiffer, D.U., Brown, I., Fouchier, R.A.M., Gaidet, N., Guberti, V., Harder, T., Langston, R., Soares Magalhaes, R.J., Martin V., Sharp, J.M., Stärk, K., Stroud, D.A., Szeweyk, B., Veen, J. & Waldenström, J.** 2006. Scientific report on migratory birds and their possible role in the spread of highly pathogenic avian influenza. 155 pp. + 20 pp. figures. (Annex to: Migratory birds and their possible role in the spread of highly pathogenic avian influenza. The European Food Safety Authority Journal 357:1-46). Available at www.efsa.eu.int/science/ahaw/ahaw_opinions/1484_en.html

65. www.grauwekiekendief.nl

66. http://en.wikipedia.org/wiki/Guano

67. **Zwarts, L. & Wymenga, E.,** Altenburg & Wymenga Ecological consultants, pers comm. 2001.

68. **Carson, Rachel.** Silent Spring (Boston: Houghton Mifflin, 1962), Mariner Books, 2002, ISBN 0-618-24906-0

69. http://www.birdlife.org/news/news/2008/04/SA_Birding_Routes.html

70. **USDept of Interior, Fish and Wildlife Service and US Dept of Commerce**, US Census Bureau 2002. 2001 National Survey of Fishing, Hunting and Wildlife-Associated Recreation. www.census.gov/prod/2002pubs/FHW01.pdf

71. **Pullis La Rouche, G.** 2006. Birding in the United States. A demographic and economic analysis. In: Waterbirds Around the World. Eds. G.C. Boere, C.A. Galbraith & D.A. Stroud. The Stationery Office, Edinburgh, UK. p. 841-846.

72. **BirdLife International** 2008. The Sustainable Hunting Project. Building Capacity for the Sustainable Hunting of Migratory Birds in Mediterranean Third Countries. Report to the European Commission on LIFE Third Countries Project LIFE 04/TCY/INT/000054. http://www.birdlife.org/action/change/sustainable_hunting/index.html

73. **Malawi Government** 2001. Lake Chilwa Wetland State Manage-

ment Plan. Environmental Affairs Department, Ministry of Natural Resources and Environmental Affairs.

74. www.rspb.org

75. http://en.wildatheart.org.tw/archives/a_brief_history_of_greyfaced_buzzard_conservation_in_taiwan.html

76. **Hardin, G.** 1968. „The Tragedy of the Commons". Science, Vol. 162, No. 3859 (December 13, 1968):1243-1248.

77. **Hauksson, S.B.** pers comm. In: Kanstrup, N. 2006. Sustainable harvest of waterbirds. A global review. In: Waterbirds around the World. Eds G.C. Boere, C.A. Galbraith & D.A. Stroud. The Stationery Office, Edinburgh, UK. p. 98-106.

78. **BirdLife International** 2008a. The BirdLife Checklist of the birds of the world with conservation status and taxonomic sources. Version 1. Available at www.birdlife.org/datazone/species/downloads/BirdLife_Checklist_Version_1.xls.

79. **Delany, S. & Scott, D.** 2006. Waterbird Population Estimates. Fourth Edition. Wetlands International, Wageningen, The Netherlands.

80. **Butchart, S. H. M., Stattersfield, A. J., Bennun, L. A., Shutes, S. M., Akçakaya, H. R., Baillie, J. E. M., Stuart, S. N., Hilton-Taylor, C. & Mace, G. M.** 2004. Measuring global trends in the status of biodiversity: Red List Indices for birds. Public Lib. Sci. Biol. 2: 2294–2304.

81. **Butchart, S.H.M., Akçakaya, H.R., Chanson, J., Baillie, J.E.M., Collen, B., Quader, S., Turner, W.R., Amin, R., Stuart, S.N., Hilton-Taylor, C. & Mace, G.M.** 2007. Improvements to the Red List Index. Public Lib. Sci. One 2(1): e140.

82. **Sauer, J.R., Hines, J.E. & Fallon, J.** 2005. The North American Breeding Bird Survey, results and analysis 1966–2005. USGS Patuxent Wildlife Research Centre, Laurel, MD, USA.

83. **Stotz, D.F., Fitzpatrick, J.W., Parker, T.A. & Moskovits, D.K.** 1996. Neotropical birds: ecology and conservation. University of Chicago Press.

84. **Wells, D.R.** 2007. The birds of the Thai–Malay Peninsula, 2: passerines. Christopher Helm. London.

85. **Amano, T. and Yamaura, Y.** 2007. Ecological and life-history traits related to range contractions among breeding birds in Japan. Biol. Conserv. 37:271–282.

86. **Nebel, S., Porter, J.L. & Kingsford, R. T.** 2008. Long-term trends of shorebird populations in eastern Australia and impacts of freshwater extraction. Biol. Conserv. 141: 971–980.

Text Box references

a. **Barbara MacKinnon de Montes, Amigos de Sian Ka'an, and Carla Sbert**, Nature Canada, pers. comm.

b. **Nature Canada**, Amigos de Sian Ka'an & Panama Audubon Society 2007. Community-based Nature Tourism: Opportunities to Achieve the Sustainable Conservation of Important Bird Areas in Mexico and Panama. Final Report to the Canadian International Development Agency.

c. **Rappole, J.H., King, D. & Barrow, J.** 1999. Winter ecology of the endangered Golden-cheeked Warbler. The Condor 101:762-770.

d. **Welton, M., Anderson, D., Colorado, G., Pérez, S. & Medina D.** 2006. Migration habitat for cerulean warblers and other neotropical migrant songbirds in Northern Central America. US Fish and Wildlife Service.

e. **Delany, S., Scott, D.A., Dodman, T. & Stroud, D.** 2009. An Atlas of Wader Populations in Africa and Western Eurasia. Wetlands International. The Netherlands.

f. **Scott, D.A. & Rose, P.A.**1996. Atlas of Anatidae Populations in Africa and Western Eurasia. Wetlands International, The Netherlands.

g. **Miyabayashi, Y. & Mundkur, T.** 1999. Key sites of the Anatidae in the East Asian Flyway. Wetlands International, Japan.

h. **Chan, S.** 1999. Atlas of Key Sites for Cranes in the North East Asian Flyway. Wetlands International, Japan.

Image reference list

i. **Boere G.C., C.A. Galbraith & D.A. Stroud (eds.)** 2006. Waterbirds Around the World. The Stationery Office, Edinburgh, UK.

ii **Delany, S., Scott, D., Dodman, T. & Stroud, D. (eds).** 2009. An Atlas of Wader Populations in Africa and Western Eurasia. 524 pp. Wetlands International, Wageningen, The Netherlands.

iii. **Bamford, M., Watkins, D., Bancroft, W., Tischler, G. & Wahl, J.** 2008. Migratory Shorebirds of the East Asian-Australasian Flyway; Population Estimates and Internationally Important Sites. Wetlands International - Oceania. Canberra, Australia.

A BIRD'S EYE VIEW ON FLYWAYS

A brief tour by the Convention on the Conservation of Migratory Species of Wild Animals

UNEP CMS

www.cms.int

Migratory birds have a considerable economic, ecological and cultural value. If we want to continue profiting from, and enjoying, migratory birds, their ecological requirements will need to be met throughout the year, and all along their flyways. The numbers of many migratory bird species have gone down significantly, due to a variety of threats. Luckily, the flyways of different species or populations of migratory birds do not occur haphazardly: they show a certain pattern.

The recognition of major flyway systems can assist in making conservation of migratory birds more effective and more efficient, requiring cooperation among various countries. This cooperation is being organised through a number of established international treaties and agreements. Some of these treaties and agreements are 'all encompassing' on paper; But for conservation and management to be practicable the resulting on-the-ground projects generally need to be focused on species conservation, habitat protection or threat management. To really catch on with local people, especially in less well-off countries, conservation projects should also have a human development component.

ISBN 978–3–937429–99–1