A BIRD'S EYE VIEW ON FLYWAYS

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

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Bird migration is a miracle that should be celebrated – not on one day alone, but every day.

By Dr. Marco Lambertini, Chief Executive, BirdLife International

Barnacle Goose (Branta leucopsis) © Tim Faasen

FOREWORDS

The conservation of birds constitutes a significant proportion of the CMS Family's work with two legally binding agreements and eight Memoranda of Understanding dealing with avian species. One of the Agreements is the African-Eurasian Migratory Waterbird Agreement (AEWA), which is close to my heart as I served as its first Executive Secretary. Stretching from North America, Europe, Africa and the Middle East, it was the first such Agreement to be concluded and has had a pioneering role in developing the flyway approach to conservation. The other, the Agreement on the Conservation of Albatrosses and Petrels (ACAP), is best measured by the vastness of the southern oceans where the magnificent birds it seeks to protect roam.

Experience shows that the best approach to conservation is to take into account entire ecosystems rather than just individual species in isolation. This is particularly true of migratory birds, whose survival can depend on a few specialized, remote and vulnerable sites providing shelter or food in the right quantities at the right time. The slightest disruption to the often delicate balance can be devastating.

UNEP/CMS, with over thirty years' experience in international cooperation and transboundary conservation efforts, has an important role to play in bringing together scientific knowledge and the political will to take effective action.

The core business of CMS is to bring countries of the world together to agree common objectives, policies and priorities to safeguard the survival of endangered migratory species, i.e. those animals whose migratory behaviour means that a number of countries have a responsibility to act. Wishing to build on the successful development of AEWA, the governments that form CMS together with their partners in civil society have spent much of the past three years elaborating a strategy to ensure that not only waterbirds of the African-Eurasian region benefit from coordinated action but also other groups of species – from the tiniest songbirds to magnificent raptors – in all regions of the world are similarly protected.

The astonishing journeys that birds make span countries, continents, oceans and deserts and are made more arduous through human interventions. Migratory birds are an indispensible part of the ecosystems in which they live and are a source of joy, fascination and inspiration. Since 2006 they have also been the focus of more positive human activities through the celebration each May of "World Migratory Bird Day" (WMBD). Organized by CMS and AEWA, this initiative encourages people to teach or learn more about the phenomenon of migration and the importance of bird species worldwide. The campaign was initiated to counter the negative (and misinformed) publicity following the outbreak of avian influenza. WMBD has evolved into a platform providing positive messages for bird conservation and in 2012 the number of participating countries and events organized broke all previous records.

Over the last fifteen years, I have seen AEWA develop from an idea into a successful international agreement. It played an instrumental role in the ambitious GEF-funded project – Wings over Wetlands (WOW) – with a lasting legacy in the Critical Site Network Tool, an online resource drawing on the databases of a number of organizations as an aid to site managers, national authorities and decision-makers. AEWA's experience can serve as a model for similar initiatives in other global flyways. While I trust that they will learn from our mistakes, I hope too that they will be able to emulate AEWA's many successes.

Bert Lenten,
Officer in Charge
of the UNEP Convention on Migratory Species

Migratory birds are the most visible group of migratory species worldwide. Everybody in their daily life has seen birds coming and going with the seasons. Migratory birds can flock together in large numbers providing a spectacular view to enjoy. However, they can also be the subject of not always sustainable mass taking. With the increased environmental changes and reduction in the world´s natural habitats affecting migratory species throughout their lives – in breeding and non-breeding areas and at stopover places – the need for more international cooperation has become apparent. Various initiatives, 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 to protect of all species of wild animals, including migratory ones.

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. All this has provided much better insight into flyways in general, as well as into individual species. The 2004 Edinburgh Conference on 'Waterbirds around the World' put the need for the flyway approach strongly in people's minds: activities at one place in the flyway can affect the whole system. Instruments such as the North American Migratory Birds Conservation Act, and projects funded by the GEF such as the one on Siberian Crane and Wings Over Wetlands, have combined 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 globally. What remains 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

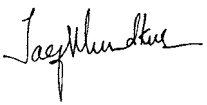
Witnessing the amazing dance of the Baikal Teal swirling around, several hundred thousand strong against the setting sun over the Chunam reservoir on the west coast of Korea, is a truly special memory for me. However, in the face of extensive changes in the landscape across the East Asian flyway, I am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

Faced with increased habitat loss and major global challenges affecting their survival, such as climate change and rising sea levels, many migratory species are in decline. Increased industrialization and agriculture have resulted in the damming and canalization of rivers, the degradation and pollution of natural wetlands, the reclamation of massive intertidal flats and other significant changes in land use. Finding ways to conserve these species and their habitats depends on taking tough decisions in order to achieve sustainable land use methods – those balancing human needs with those of nature,

This timely publication provides a valuable guide to the wonders of bird migration, featuring the many challenges that these birds face and, more 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 achieve our goals more effectively by working together to conserve these birds and their habitats.

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



Taej Mundkur
Programme Manager – Flyways
Wetlands International

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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 / CMS

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; city dwellers, who hear the calling of geese overhead, herdsmen, whose animals are followed by wagtails and harriers that feed on flushed insects; fishermen on every sea, whose boats are accompanied 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, should they no longer arrive?

It is assumed – but it is by no means certain – that these migratory birds will return each year. Many of them make long voyages in search of food and a place to breed. Voyages are very risky, often rife with natural dangers and man-made threats, e.g. the increasing impacts of climate change. Populations of many migratory birds have been proven to be falling all over the world. 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 could be altered adversely. If we want our migratory birds to keep returning each year, in numbers sufficient to allow them to survive into the future, all links must be strong. Together we must protect these birds along their entire range, in other words, their 'Flyway'.

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

Common Shelduck (Tadorna tadorna), Europe © Tim Faasen

Albatrosses and petrels, Antarctica © Tim Dodman

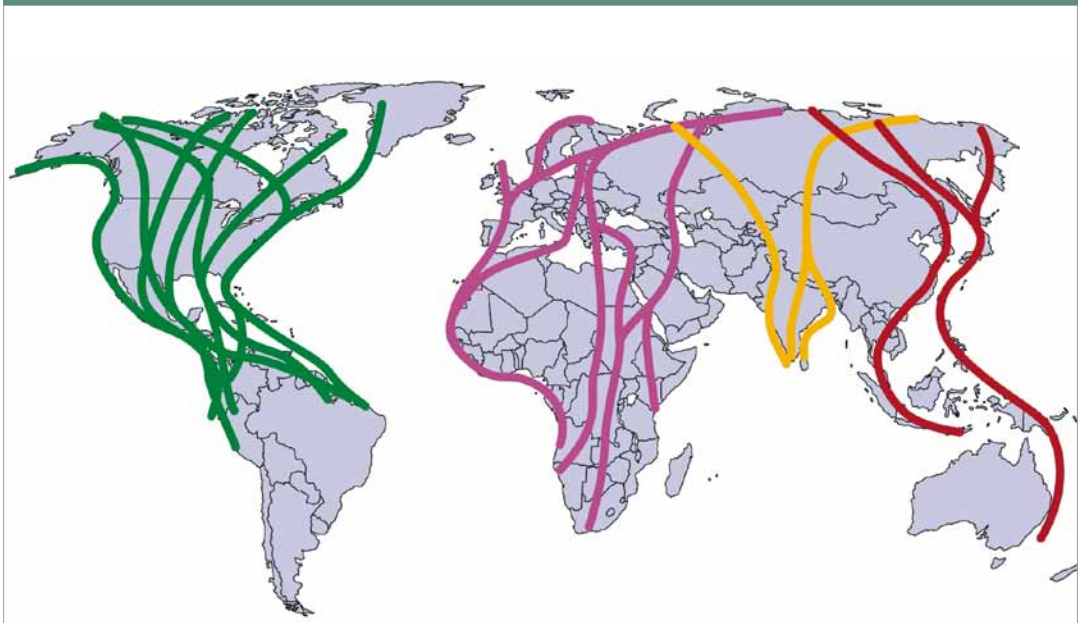
Hooded Warbler (Wilsonia citrina), South America © Adrián Azpiroz

It is the joint responsibility of governments around the world to acknowledge 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 the habitats they frequent on their journeys – in the case of birds along their flyways. Hence a key role lies in flyway conservation.

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

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]

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 breed and, for a number of waterbirds, a place to moult all their flight feathers at once, without running a great risk of being preyed upon when flightless.

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

Since the last Ice Age, migratory birds evolved over millennia to fly long distances in order to make use of different habitats and the seasonally abundant resources within various climates. Despite this high adaptability, their vulnerability increases as they depend not just on one, but all the habitats they occupy.

A general picture of bird migration world-wide is depicted in the introduction (Fig. 1, p. 9). 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.

The best known migrations link breeding grounds to non-breeding areas and take place on an annual cycle – an activity which probably originated as a strategy by birds of southern latitudes to occupy harsher, northern climates – regions with high seasonality. The migration patterns, therefore, tend to be orientated from North to South. This is, however, not an absolute rule, and some birds, for instance in Eurasia, travel a distinct East-West course.

In the semi-arid zones of the northern and southern hemisphere exists a well-defined rainy season. Many bird species breed in these areas when food is abundant before returning 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 are forced to leave and only come back for the next breeding season. They travel to lower latitudes, to equatorial regions or even on to higher latitudes in the opposite hemisphere.

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

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

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

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

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

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

Still, other resources such as locusts are rich one year and poor another. And associated with these changes, bird abundances vary.

Lastly, in arid areas, precipitation and the life it brings show no regular pattern. Therefore, many birds in arid areas also show irregular movements. They move close to where it has recently rained to profit from the seeds, insects and other food to be found there, and often to breed. And when this 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.

Gradual historical climate change has altered the patterns of food availability to birds in various parts of the world. In future, rapid climate change may require new adaptations in bird migration systems, but there is growing concern that not all species may have the requirements for this.

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, critical to their survival. However, many other migratory birds, such as North American songbirds, tend to rely on a secondary habitat and do not have stable migration routes. This means that it is not possible to designate specific regions that need protection, but that suitable habitats have to be made available throughout their entire range.

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

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

2.2 The ability to migrate – a well organized journey

Bird migration is a highly complex phenomenon, both in its spatial and temporal organization. The spectacular mass migrations of large soaring birds led early observers to adopt the concept of migration routes. The birds fly by day using updrafts, which force them to pass through narrow corridors, essentially to avoid sea expanses. However, it is now known that this is not typical, and that migration patterns are highly species-specific.

Passerines, especially insectivorous birds, largely migrate by night on a very broad front, crossing sea expanses and deserts, while other species, e.g. finches and larks, migrate for a few hours just before and after sunrise – all needing relatively closely spaced staging points to rest and feed. On the other hand, shorebirds tend to migrate long distances between more or less fixed staging points, thus passing over large stretches of land, but rarely being seen. On the whole, different bird species have different migration behaviours and strategies. In certain species, migration behaviour differs between populations or even individuals of the same population (Fig. 2). The key is to arrive at the breeding grounds, in good time and 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 the various migration routes, birds take their food sources from different regions of the world. Therefore, the nutrition available for both migratory and non-migratory species is sustained.

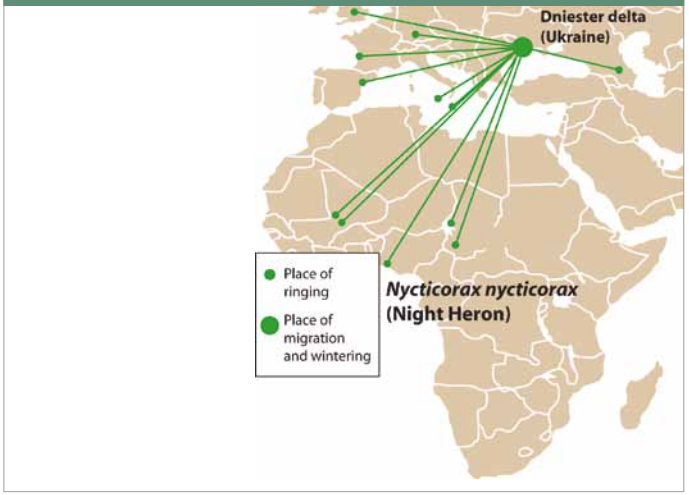
Fuelling up for the flight

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.

Some migratory birds can even double their weight prior to migration. On the other hand, certain species, such as the Bar-tailed Godwit *Limosa lapponica*, go so far as to reduce the size of their intestines, 'dead weight' on a long trip during which they do not eat[2].

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

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



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

A bird's weight, its flight efficiency (influenced by e.g. wing shape and size) and how much fuel it can store pre-migration, determine 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. 15), with several songbirds covering 1,000 km. Even the Ruby-throated Hummingbird *Archilochus colubris*, weighing less than 5 grams, can store enough fuel to fly from

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

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

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 deteriorate during their flight, the birds struggle or even 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 becomes clear that if the food source of any migratory bird, or if its entire refuelling station disappeared, the affected bird population would be in trouble (see also section 2.3).

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

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, to the specific patch of forest where they were born, or to the same garden in South America where they spent the non-breeding season the previous year. Furthermore, 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 conditions they fly, they will usually find their way to their destination. Birds have an internal daily and yearly clock. Some can detect polarized 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, e.g. sound generated by air movement around mountains or at marine coasts, or even by smell, using a 'scent map' in their memories.

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 maximize the benefit they derive from prevailing winds (migrants have been measured to fly as high as 6,700 metres).

If they wait too long for good winds, 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. Birds in great need while crossing oceans may even use ships or oil platforms to land on. Bad weather can cause individual birds, especially immature ones, to turn up in places where the species does not normally occur. A good example of this is the Azores Islands in the Atlantic Ocean, where many vagrants from both the Ne- and the Palearctic are found.

One long flight or a number of short ones

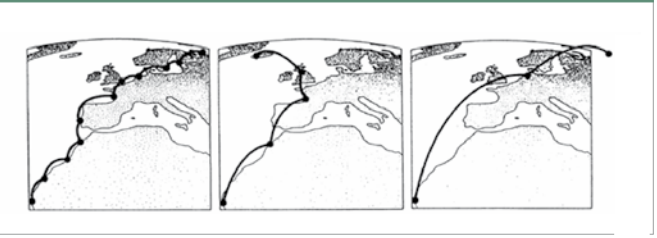
Birds that travel long distances are able to apply different strategies depending on energy reserves and refuelling possibilities along the way. For the majority of species, flights across water offer neither refuelling nor resting possibilities, whereas flights across deserts give only limited opportunities for foraging.

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 numerous places. During migration over less extreme regions these songbirds apparently progress up 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 stop-over sites every year – both on the way to and from their breeding areas. However, because they mostly migrate over a broad front, with only a few key habitats along their migration routes, conditions along their flyways can become worse without anyone really noticing.

At the other end of the spectrum are species that depend on a network of very few key refuelling sites. 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 can be more than 11,000 km apart (Fig. 4).

For variation in migration strategy see also Fig. 3, 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].

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]

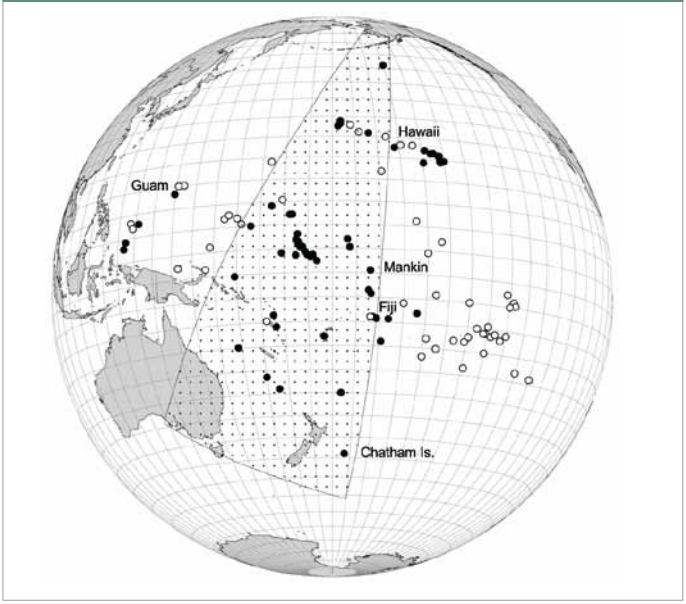
A distinction should be made between the number of sites essential for individual birds and the requirements of entire populations. It is at the population level that conservation measures should be applied: the belief that it is acceptable to lose certain stop-over sites, because other sites can take 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 the flyways.

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. Birds that soar include storks, pelicans, albatrosses, petrels, terns 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 where they run from north to south, e.g. the Andes.

Certain flyways are constricted where the land narrows, e.g. the Central American Isthmus and the Malaysian Peninsula.

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]

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, and off the southwest coast of Sri Lanka (Bridled Terns *Onychoprion anaethetus*)[5]. If they cannot avoid crossing water, land 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.

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. 16) but when facing mountains and deserts fly around them 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 bird concentrations may be found at more favourable spots, such as islands in seas and oases in deserts. 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 metres.

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 in the Americas, and the Bar-tailed Godwit in the Pacific (see Fig. 4). In the Eurasian-African system the Curlew Sandpiper *Calidris ferruginea* is a clear example (Fig. 6, p. 16). For such species, conservation of the birds and their habitats is required along both the outward and inward flyways.

Soaring Turkey Vulture (Cathartes aura) © Lee Karney / USFWS

Direction of migration

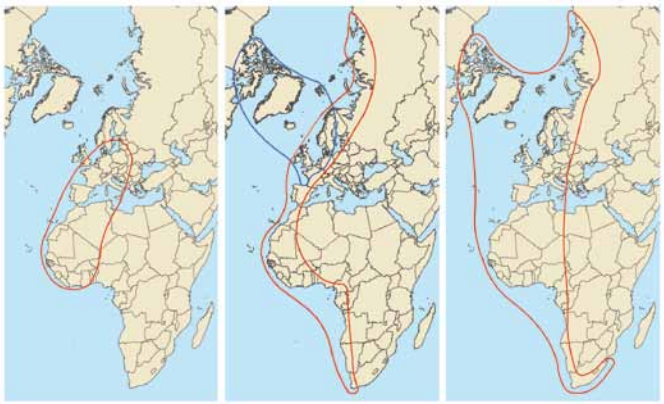
Bird migration is, by and large, thought of as movement along a south-north axis. However, as discussed already, this is not always the case.

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

Some species show a considerable east-west and vice versa 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 *Vanellus vanellus*[8] breed in Russia and winter in Western Europe; and Ruff *Philomachus pugnax*, which breeds in Siberia and spends the non-breeding season in West Africa (Fig. 7). An important example of a

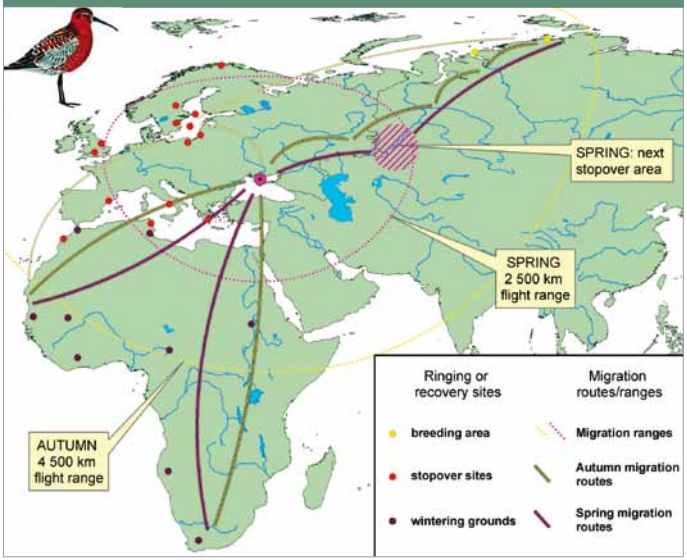
Greenland White-fronted Geese (Anser albifrons flavirostris) flying to staging areas in western Iceland. Recent research, including the use of satellite telemetry, has given a clearer understanding of the energetic implications of the lengthy two-stage migration undertaken by these geese. © Chris Wilson,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

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 over-wintering 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 season (wintering, migration and breeding) and scheme of migration routes and estimated flight ranges

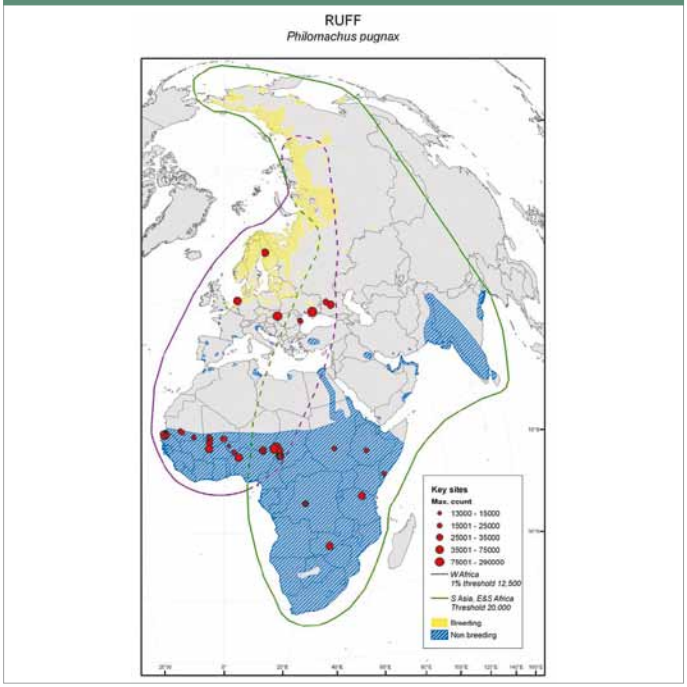


© Sergei V. Khomenko, p. 566 in [i]

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 these areas migrate to spend the non-breeding season in sub-Saharan Africa. The population that breeds in Canada and Greenland crosses 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 fly to Africa.

Many albatross and petrel species that breed in southern latitudes ride the westerlies over the Southern Ocean, circumnavigating the Antarctic region in an eastward direction. Many of these flyways have been discovered with modern techniques such as geo-locators, small data loggers on the leg of a bird (e.g. an albatross) that record night-day changes, among other parameters.

Figure 7: Ruff migration map



© Wetlands International 2009, [ii]

The ability to fly is not always necessary for migration

So far in this chapter 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, are unable to fly. They travel long distances on land in their search for food and water. Their movements are often nomadic and show no regular pattern. However, in parts of the Sahel, Ostriches tend to walk north during the rains and south in dry periods. In Western Australia, Emus walk towards the coastal areas in the south for the winter rains there, and to inland areas further north for summer monsoonal rains.[9]

Antarctic penguin species swim northward at the onset of the cold season, away from the pack ice. To breed, some swim south again, while others 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 the Antarctic summer months of January/February, 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. Others migrate at night, most likely to reduce heat stress as well.

Nocturnal migration definitely reduces predation by birds of prey. Others, such as many waders, use a different tactic. By frequenting saline shallows during the non-breeding season, they take advantage of the availability of food in large quantities; furthermore, they may also do so to avoid the parasites that are prevalent in fresh water areas[10].

2.3. Migration and its dangers

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

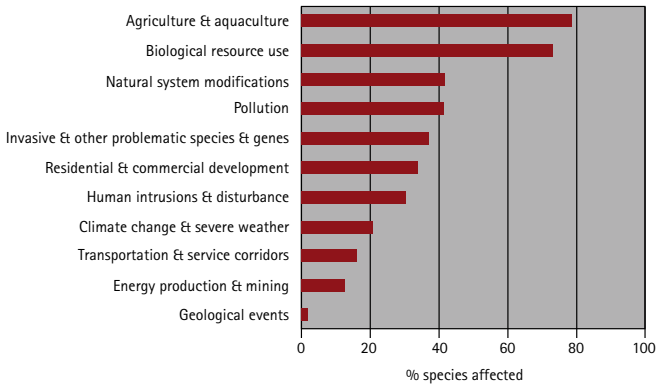
Foremost among them are agriculture and aquaculture, affecting nearly 80 per cent of migratory birds, and the use of biological resources (i.e. logging, collection of fire wood and construction etc.) affecting more than 70 per cent [11], based on [12].

A change in agricultural land use does not only include clearing, but also land use intensification [14, 15, 16], landscape fragmentation [17], and overgrazing. It is, in part, related to the increase of human population. In Burkina Faso for example, the large decrease in natural vegetation in just 25 years is undoubtedly related to the simultaneous doubling of the local population (approximately 3 per cent annual growth rate) [18].

Land use changes with negative effects on migratory birds are taking place in breeding areas, in non-breeding areas, and in stop-over areas. Even though the general impact of changes in these three types of area will differ between species, effects at stop-over sites should 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 *Limulus polyphemus* eggs in Delaware Bay, a result of 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. [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 (affecting 40 per cent of species, Fig. 8) encompasses for instance the construction of dams and drainage of wetlands. In the People's 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

China and the Republic of Korea, 37 per cent and 43 per cent, respectively, of inter-tidal wetlands have disappeared due to land reclamation; 80 per cent 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 the 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 the year 2000, numbers of such structures had increased roughly fourfold. Consequently, an estimated 4–5 million birds per year are killed, affecting 350 migratory species, in particular, long-distance migrants that fly at night[26].

The toll of **obstacles**, e.g. modern wind turbines, on migratory birds does not seem very large as yet, and has been estimated to kill 33,000 birds per year in the USA[26]. However, wind farms sited across narrow migration routes of soaring birds, or near wetlands occupied by many birds, can cause relatively large losses[27]. Effects do not merely concern direct mortality (figures are probably underestimated due to the number 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 consideration of the 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 and electrocution, especially for larger migratory birds (e.g. Great Bustards *Otis tarda*) and birds that often perch on pylons, such as raptors and storks. Careful location and design modifications can help to reduce these problems.

Habitat change and migratory threats are further intensified due to **climate change**, with at least 20 per cent of migratory bird species being affected. This impact is expected to increase dra-

Pelican killed by wind turbines © Mihail Iliev

White Storks (Ciconia ciconia) killed by collision © Mohammed Shobrak

matically over the next decade, not least in Arctic regions[29] and includes:

- 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

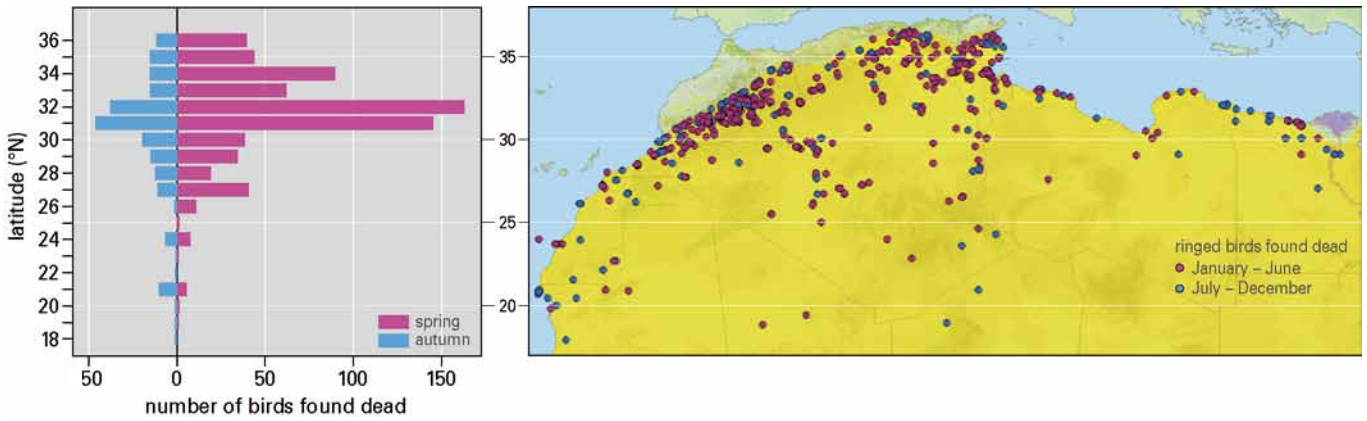
([14, 30-35]; see also 4.1, on birds as indicators of climate change)

More songbirds die while crossing the Sahara than in the six months they spend in the sub-Saharan regions. 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 six months before the annual migration. It has been found that 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 having to cross 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 leocogeranus* in West and Central Asia. After the establishment of reserves and/or reduced hunting, populations of waterbirds have increased in Western Europe. The same can be said for 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, but more specifically in rural areas (see

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)



text box, p. 54). Once again, the Trans-Saharan songbirds mentioned earlier suffer another hit. In total, some 10 million hunters are involved, an estimated 60,000 tonnes of lead are discharged into the environment, and approximately one half to one billion migratory birds are killed each year. The estimated four million birds killed annually in the Mediterranean island state of Malta alone, 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 are considered to be poor. 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.

The killing of threatened species at migration bottleneck sites is likely to have negative effects on population sizes[23, 31, 39,40]. Therefore, it is important to include sustainable hunting in a systems approach to the integrated management of migratory birds along their entire flyway.

Pollution is considered to be a major threat too, with 40 per cent of species affected (see Fig. 8, p. 18), so are parasites and diseases, especially at breeding colonies and other sites where (water) birds congregate, e.g. avian botulism and avian influenza[11]. Particularly managing the risk of avian influenza is important in relation to migratory birds given its potential threat 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 per cent of all migratory raptors worldwide are considered threatened by habitat loss; 31 per cent by direct persecution; and 21 per cent by environmental contaminants. Significantly, 30 per cent are threatened by at least two of these factors and 8 per cent by all three factors. Long distance migratory raptors are considered particularly vulnerable.[23]

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

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

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; and 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 which obtain all or most of their food from the water. Flyways help to give worldwide conservation of migratory birds an effective and efficient structure.

3.1 The flyway concept – its definition, history and role in the 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".

Boere and Stroud[42] 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 these species complete their annual cycle. It includes the areas where the birds breed, main non-breeding locations, migration stop-over sites, as well as moulting and post-breeding expansion areas.

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 is never the entire land or sea surface over which flyover takes place, but rather an archipelago or network of sites (see 3.2). 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.

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 recognized: Atlantic, Mississippi, Central and Pacific (Fig. 10). In the period 1947-1952, a Council and Technical Committee were established for each flyway.[45, 46]

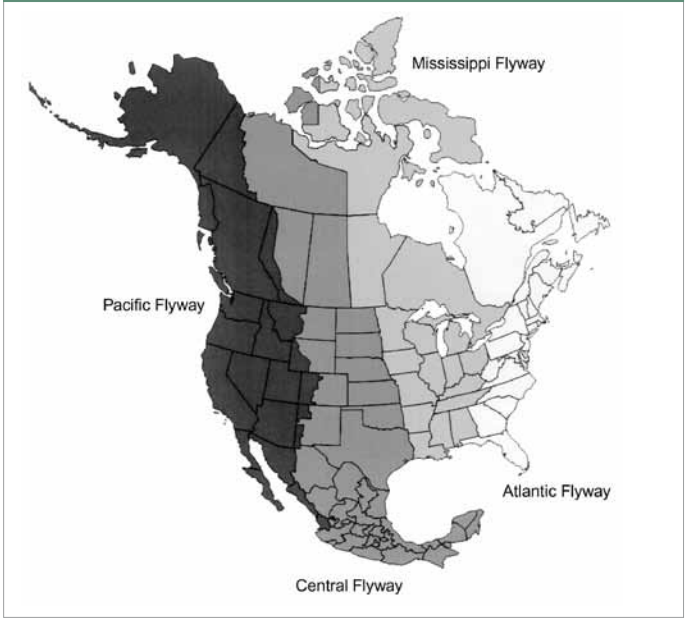
In Eurasia and North Africa, a sustained programme of international co-operation for waterbird conservation commenced after the Second World War[47, 48]. The first flyway maps for waterbirds in western Eurasia were published by the International Waterfowl Research Bureau (IWRB, now part of Wetlands International) and the USSR Academy of Sciences[49, 50] (Fig. 11). The Russian ornithologist Isakov recognized four major flyways for ducks, swans and geese in the Western Eurasian region. The maps of the main 'geographical populations' of these birds were published in the context of discussions on an international legal instrument for the conservation of wetlands and migratory waterfowl. The discussions resulted in the establishment of the Ramsar Convention in 1971[51, 52].

IWRB refined the flyway concept, organizing a specific symposium in 1976 on the mapping of waterfowl distributions and habitats in Europe[53]. The other continents were added later.

It should be noted that flyways illustrated on different map projections can appear quite dissimilar to each other, and the use of various 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. 13, p. 33). [54]

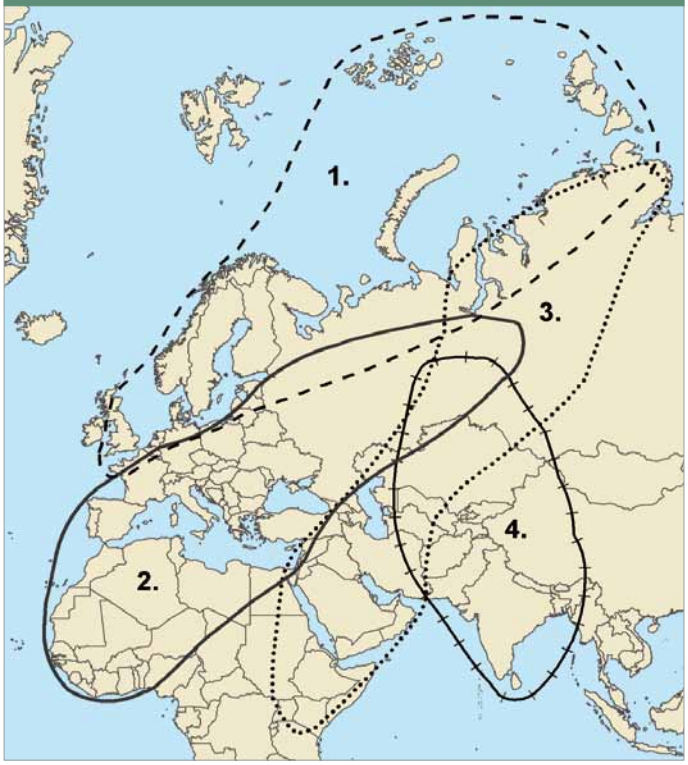
The Ramsar Conference held at Heiligenhafen, Germany, in 1974 called for 'increased cooperation on a regional and "flyway" basis'. The Strategic Framework of Ramsar grouped the migrations of shorebirds/waders into eight broad flyways (Fig. 12 p. 24). At the 1997 CMS Conference of the Parties, the flyway 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 Migratory Waterbird Agreement (AEWA), focussing on waterbirds and their flyways in this region, 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] (Fig. 13, p. 33)

Figure 10: The waterfowl flyways of North America



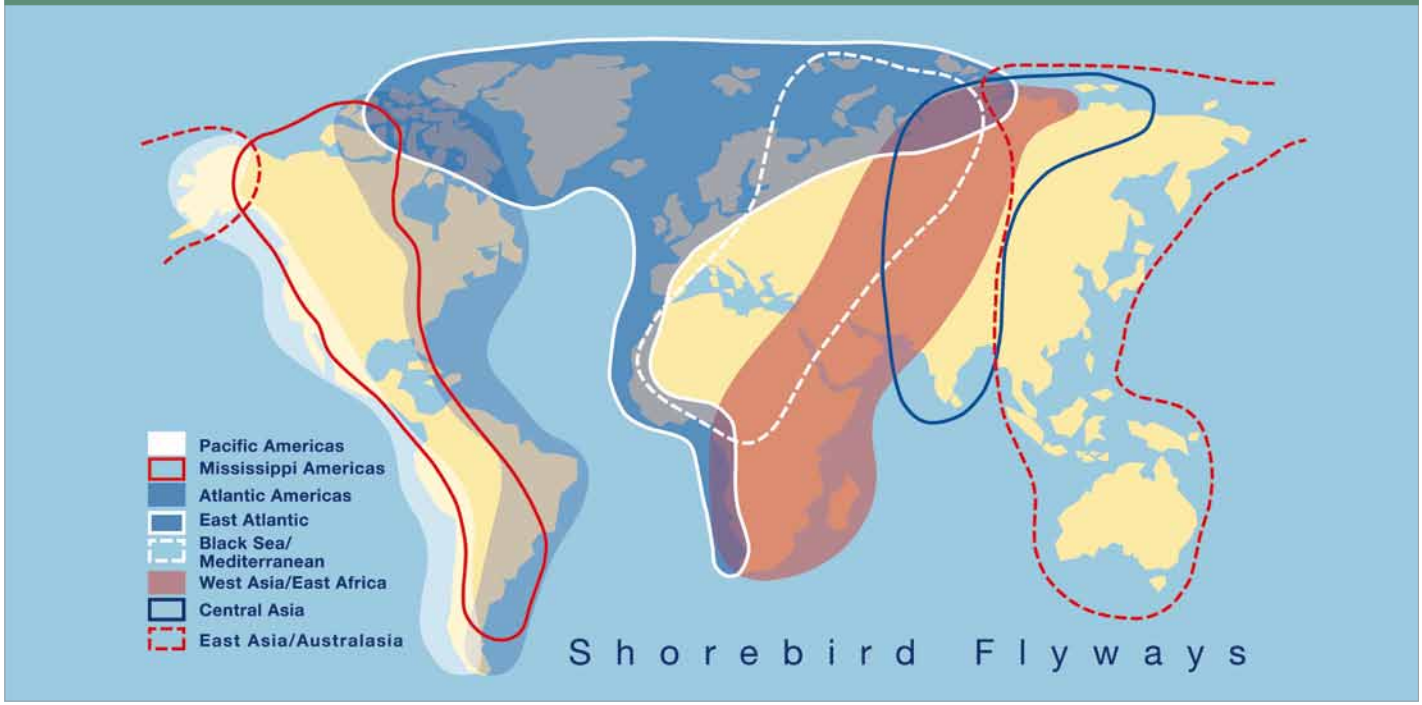
© Blohm, Sharp, Padding, Kokel, Richkus, p. 201 in [i]

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]

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

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 and 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 (see Fig.11,

p. 23)[43]. In Central and Eastern Eurasia, the Central Asian Flyway (which includes Isakov's Siberian/India population and extends to the West, North and East), and the East Asian Flyway (which reaches southward to the Greater Sunda Islands), have been identified.

From the point of view of shorebird research, management and conservation, eight flyways have been proposed by the International Wader Study Group[42]. 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 their extension to the southern end of South America, the combination of the Central and Mississippi flyways, and the extension of the Pacific Flyway further into the Ocean (Fig. 12).

The reason for the flyway approach to conservation is to facilitate political cooperation on 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].

To make limited resources more effective practical projects usually focus on a single species, a type of habitat, a specific site (e.g. Wings over Wetlands text box, p. 26) or a particular threat (see section 3.3 Memoranda of Understanding (MoUs)), adding to the overall conservation of the flyway.

Protection of individual species

There are a number of MoUs and Action Plans focusing on single species, known as Single Species Action Plans. Details can be found, for example, on the websites of the Convention of Migratory Species (CMS), the Western Hemisphere Shorebird Reserve Network (WHSRN), AEWA, BirdLife Europe, BirdLife Africa, BirdLife Pacific, Wetlands International, the Hong Kong Bird-watching Society, and ArcCona Ecological Consulting. See also text boxes on WHSRN p. 41, Spoon-billed Sandpiper *Eurynorhynchus pygmeus* (East and South-East Asia), p. 28, and Eurasian Spoonbill *Platalea leucorodia* (Europe, Asia and Africa), p. 29.

Site networks and site conservation

Conservation of migratory species that depend on a network of sites along their flyways strongly benefits from the proper management of the entire region. Wetlands International therefore produces a series of Flyway Atlases, which identify key congregation sites of individual bird species, families or even wider taxonomic groups (see text boxes on WHMSI, WHSRN and the Wetlands International's Flyway Atlas Series, pp. 40-42). This provides the background of site conservation. Various initiatives have been established worldwide to promote such conservation efforts: WHSRN and WHMSI in the Americas; the East Asian - Australasian Flyway Site Network; and the West/Central Asian Site Network for Siberian Cranes and other waterbirds (WCASN). The listing of sites on the networks gives them international recognition, and provides a framework for training and research activities and a focus for public awareness and education. Authorities are encouraged to prepare plans for the listed sites. In the African-Eurasian Flyway region, the WOW project and the WCASN identify and manage networks of critically important sites (see text boxes, p. 26-27).

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 separate 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. 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[55]. These networks have now been brought together under the East Asian-Australasian Flyway Site Network under the framework of the East Asian-Australasian Flyway Partnership (section 3.4 and text boxes on EAAFP, p. 43, and WHMSI, p. 40).

Protection of habitats

A number of initiatives target habitat-oriented rather than species-oriented conservation actions, such as AEWA (section 3.3) and the Ramsar Convention (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 3.3). See also text boxes on shade-grown coffee (p. 30) and Hawk Mountain Sanctuary (p. 50).

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

© Wings Over Wetlands

Common Tern (Sterna hirundo), © Tim Faasen

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

The project supported field projects in 11 important wetland areas in 12 countries (see above). These projects focused on a number of wetland-related conservation issues including: community mobilization, management planning, ecotourism, field research, wetland restoration, control of invasive species, transboundary management, education and alternative livelihoods.

A training and capacity development framework was elaborated in consultation with a wide range of partners across the region. This focused 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 was developed by the WOW technical team and provided 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. The Critical Sites Network (CSN) Tool unifies the conservation efforts of countries along the entire Flyway by providing decision-makers and conservation organizations with the improved data access needed for timely and focused wetland and waterbird conservation.

Wings Over Wetlands was a joint effort between Wetlands International (hosting the project's coordination unit in the Netherlands) and BirdLife International and was further 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) was engaged to support project implementation. There was close coordination with the UNEP/AEWA Secretariat, the Ramsar Convention on Wetlands, UNEP-WCMC and with many local partners along the African-Eurasian flyways.

Siberian Crane Wetland Project

www.scwp.info

In 2003 the International Crane Foundation, in collaboration with the governments of China, the Islamic Republic of Iran, Kazakhstan and the Russian Federation, launched the UNEP/GEF Siberian Crane Wetland Project (SCWP). The six-year project focused on a network of 16 globally important wetlands in Eurasia which are of critical importance for migratory waterbirds and other wetland biodiversity. The SCWP was carried out by UNEP, as Implementing Agency of the Global Environment Facility grant, in cooperation with CMS. The SCWP activities were implemented at three levels:

© International Crane Foundation

© Ji Weitao

At the project site level, activities aimed to reduce external threats and ensure necessary water flows to maintain the ecological health of wetlands. Activities included 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 promoted sustainable livelihoods for local communities.

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

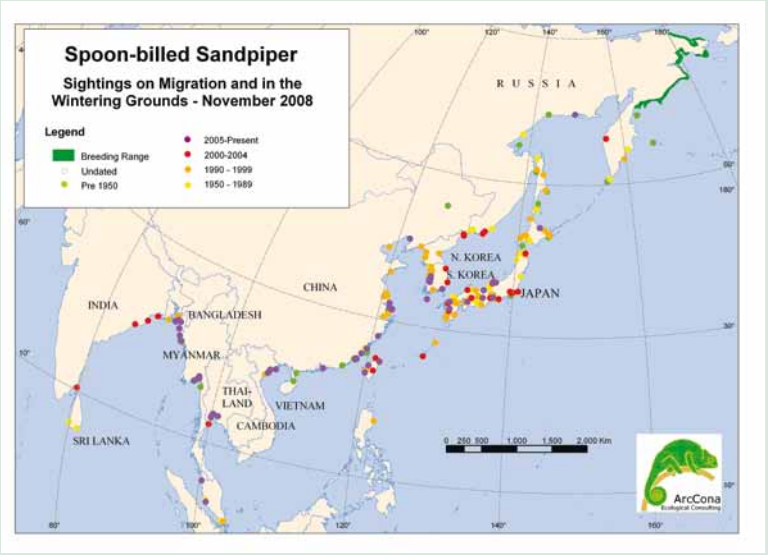
At the international level, the focus was on flyway conservation – the network of wetland sites along the entire migratory pathways of the cranes. To achieve this, the SCWP promoted cooperation among the four countries and other Siberian Crane Range States, enhancing interaction among sites and engaging communities in the management of the wetlands along the West/Central and East Asian flyways for migratory waterbirds (www.sibeflyway.org/). Conservation actions within these flyways were coordinated with other initiatives for migratory waterbirds and closely integrated with the Conservation Plans created through the CMS MoU (see section 3.3).

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 was up-listed to 'critically endangered' by IUCN. 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

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, as well as on its staging and non-breeding grounds in Vietnam, Thailand, Myanmar and Bangladesh. In addition to acknowledged threats such as pollution and climate change, the hunting and trapping of sandpipers in Russia, China, Vietnam, Myanmar and Bangladesh are serious and on-going perils. Furthermore, egg and feather collection, human disturbance and subtle changes in the habitat due to climate change are known hazards on the breeding grounds specifically.

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, proposed or undertaken, on intertidal mudflats of importance along the flyway, 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 together with required conservation activities.

Continued research is required to further define the wintering areas and understand the needs of the species while on migration. This includes continuous monitoring to establish an understanding of the population status and development, and to evaluate the success of conservation activities. International and regional cooperation and coordination are essential for the survival of this migratory bird and its habitats across the entire migration range. CMS and regional flyway partnership agreements, such as the East Asian - Australasian Flyway Partnership (EAAFP), p. 43, can provide powerful instruments to ensure consistent conservation efforts across flyways.

Eurasian Spoonbill *Platalea leucorodia*

• AEWA International Single Species Action Plan

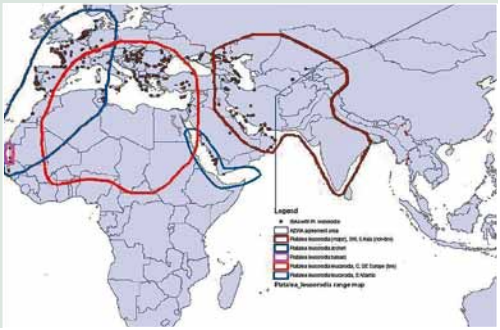
www.unep-aewa.org/meetings/en/mop/mop4_docs/meeting_docs_pdf/mop4_30_ssap_spoonbill.pdf

The Eurasian Spoonbill has a distribution from the East Atlantic to India and China.

Eurasian Spoonbill, courtesy of Wings Over Wetlands

The balsaci subspecies is the most vulnerable, with a sharp decline in numbers in the breeding population, 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.

P.l. archeri is not protected in four Range States; 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 Range State governments 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. The Action Plan was prepared by the International Spoonbill Working Group, an informal group hosted by Eurosite and was adopted at AEWA MOP4. 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.



Management of threats

If a threat is considerable and easily identifiable, it can and should also be tackled in its own right. A case in point is the often unsustainable by-catch of seabirds during long-line and trawl-fishing operations. These types of fishing in their original form are considered the most severe threat to albatrosses. It was a major reason to found ACAP, the Agreement on the Conservation of Albatrosses and Petrels (section 3.3). Significant progress has been made in the reduction of by-catch of albatrosses and several other species of sea birds by large-scale fisheries. See the text boxes on by-catch reduction (p. 31), WHMSI (p. 40), and on hunting of migratory birds in the Mediterranean region (p. 54).

Incentives for local people and capacity building

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 raising awareness. 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 (see text box p. 32).

Key points to consider using the flyway approach

The complexity of the migration strategies and systems of individual bird species was noted above. Simplifying all the world's bird migration systems into a very limited number of flyways of necessity results in 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 by implementing the flyway concept.

First of all, by looking at the distribution of the five major flyways for waterbirds one can be misled into believing that all birds migrate along a north-south axis. As mentioned in chapter 2, a

number of species show movement along an east-west axis. Furthermore, circumpolar movements over the Southern Ocean and altitudinal movements do not appear in such composite maps.

Maps of generalized flyway systems further conceal a considerable inter-species variation in individual migration systems. Chapter 2 describes how the broad front migration exhibited by many passerines differs from the more channelled migration shown by many waterbirds and raptors. 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, 56-59]

Such limitations should not detract from the application of the flyway concept. However, when these limitations 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. The global map of wader flyways has thus been widely reproduced as relating to all waterbirds and, even more erroneously, as describing the movements of all migratory birds [60-62]. 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 recognized in policy fora such as the Avian Influenza Task Force [63].

Shade-grown coffee to protect 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 at flyway bottleneck sites such as Central America and further afield in South America, in coffee-growing areas with above average rainfall. Nowadays 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 and regulation of the hydrological cycle.

However, in the 1970s, coffee bush varieties became available resistant to the sun and their cultivation increased profit per hectare. Conversion to shadeless coffee varieties meant the cutting of trees, and an increase in the use of mineral fertilizer and pesticides. Problems of soil depletion, soil erosion and increased run-off and downstream flooding were often the result, and so was a reduction of habitats for migratory birds. The decline of many migratory insectivorous birds from North America (see Migratory Bird Trends in chapter 5) is attributed in part to the conversion from shade-grown to shadeless 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 produced. 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 coffee farmers. The package often indicates which migratory birds winter in the region of production and profit from the purchase of that particular brand of coffee. Today, sales of organically grown, shade coffee represent about 1 per cent, or US$30 million, of the U.S. market for coffee beans.

Reducing the by-catch of albatrosses in longline fisheries

- **www.savethealbatross.net/**
- **www.acap.aq**

- Albatross Task Force, BirdLife International partners
- Seabird By-catch Working Group, 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, putting them in real danger of extinction. All 22 species of albatross in the world 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 (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. This is because

- They only breed once they are fully mature – this can take as long as 12 years.
- They only produce one chick at a time, with some species only breeding 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 albatroses 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 raising awareness about the decline of albatross numbers.

© Samantha Petersen, WWF South Africa

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

By-catch © Peter Ryan, WWF South Africa

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

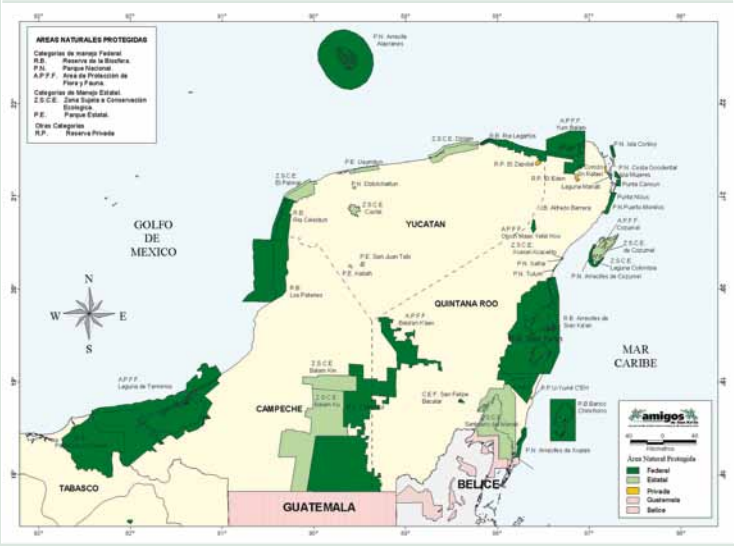
- streamer (bird scaring) lines for pelagic systems
- underwater bait-setting capsules and bait pods
- safe lead weights for pelagic longline gear
- natural deterrents such as shark liver oil
- blue-dyes for camouflaging bait
- smart hook development for pelagic fisheries.

Combining migratory bird conservation with local development:

Sian Ka'an Biosphere Reserve, Quintana Roo province, Mexico *

www.siankaantours.org

As mentioned earlier there is a variety of methods to protect birds along their flyways. One with a strong developmental element is the Sian Ka'an Biosphere Reserve. Community Tours is the name under which the Maya ecotourism guides in Chunyaxché operate. Chunyaxché is situated in the Co-operative Zone of the 528,000 hectare Sian Ka'an Biosphere Reserve, on the east side of Mexico's Yucatan Peninsula. The Reserve has been recognized as a UNESCO World Heritage site and an Important Bird Area. Some 374 bird species occur there, of which 135 are migratory and 26 are (very) abundant breeders in Canada. This was reason enough 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 co-operative.



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

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 so keep prices up, all the while limiting tourists per boat and the number of boat rides. Before starting the business in 2005, the average income of the six cooperative members was approximately US$ 300 per month.

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. They have also received funding from the World Heritage Site Fund to build a Bird Monitoring Centre where students and researchers can stay while carrying out their bird studies with members of the cooperative. Furthermore, all the guides in the community have received training in English. 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 organization (USA) and UNEP. All funding and activities were carried out by Amigos de Sian Ka'an A.C.

** references: a, b*

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: 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).

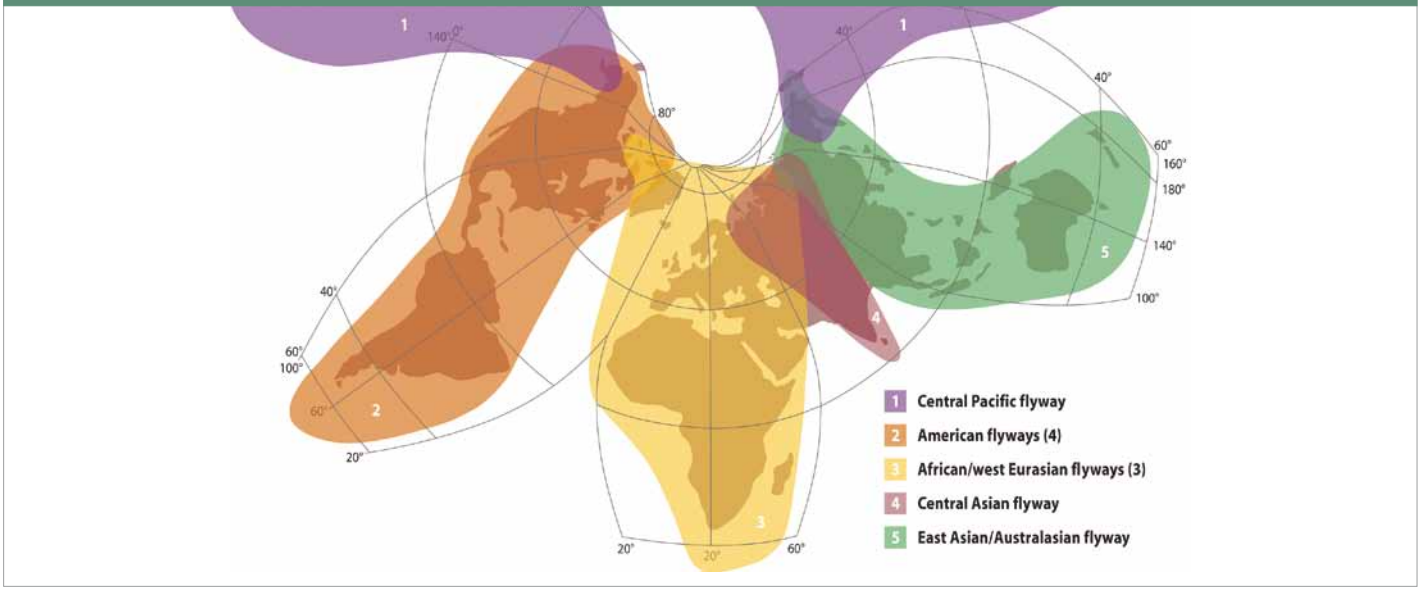
2. The **Central Asian Flyway (CAF)** area: Central Siberia, Mongolia, the Central Asian Republics, Iran and Afghanistan, the Gulf States and Oman, the Indian subcontinent and the Maldives (Fig. 13).

3. The **East Asian Australasian Flyway (EAAF)** area: 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. 13).

4. The **Americas** area: North, Central and South America, the Caribbean, the four traditional North American flyways (Pacific, Central, Mississippi and Atlantic), and the area over which a number of South American initiatives are in progress (Fig. 13).

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, recognized by many shorebird research-

Figure 13: The five international migratory waterbird flyways originating in the Arctic



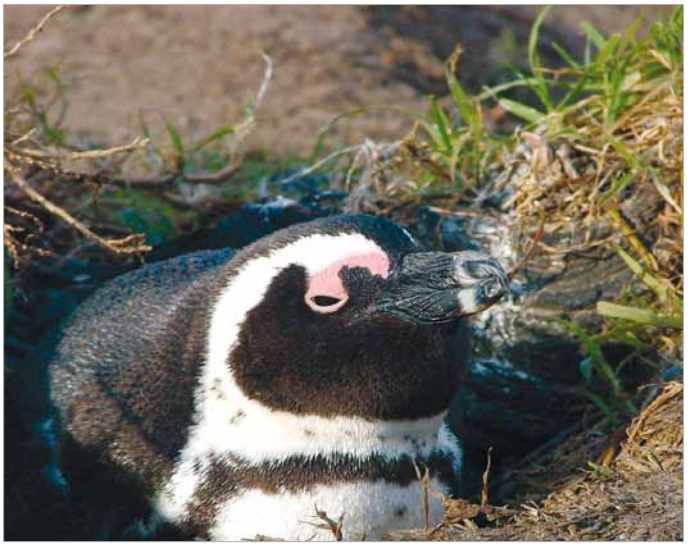
© Kenton D. Wohl, p. 120 in [i]

ers, 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 emphasizing (Fig. 13, p. 33).

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 stretch across 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. 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, provides a framework for the basis for future CMS policy on flyways, and contributes to work on the future shape of CMS. See Resolution 9.2 under the COP pages of the CMS website.

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. 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/).



African Penguin (Spheniscus demersus), South Africa © Tim Dodman

Surfbird (Aphriza virgata) © Adrián Azpiroz

Black-browed Albatross chick © Samantha Petersen / WWF South Africa

Siberian Crane © Irina Gavrilova / Oka Crane Breeding Center

Agreement on the Conservation of Albatrosses and Petrels (ACAP): This CMS agreement 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. (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 its flyways and secondly, to habitat deterioration in its non-breeding/wintering grounds. Although the hunting 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 reestablish numbers, to protect and manage their habitats and enhance co-operation among the Range States and other concerned agencies (see text box on the Siberian Crane Wetland Project, p. 27.)

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 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.

www.cms.int/species/sb_curlew/sbc_bkrd.htm

Great Bustard (*Otis tarda*) MoU: The Great Bustard MoU entered into force on 1 June 2001 after the signature of the fifth Range State. It covers the residual Middle-European populations of the species which numbers less than 45,000 individuals worldwide and whose habitat spans individual pockets of Eurasian grassland. Modern agricultural practice has caused the bird's rapid decline in much of Central and Eastern Europe. The remaining populations are 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 raising public awareness. 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.

www.cms.int/species/otis_tarda/otis_tarda_bkrd.htm

Aquatic Warbler (*Acrocephalus paludicola*) MoU: This MoU concluded in Minsk, Belarus, under CMS auspices on 30 April 2003 aims to safeguard this small waterbird. Its population is estimated to have declined sharply by 40 per cent over the last ten years. Its dependence on specialized and vulnerable habitat means it has become globally threatened, as its habitats have suffered from constant decline. This fall 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 summarizes 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 throughout its range and to promote the expansion of the breeding population to other suitable areas.

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.

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.

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

Migratory Birds of Prey in Africa and Eurasia MoU: 40 states have signed this MoU since its concluding negotiation meeting in Abu Dhabi, the United Arab Emirates, on 22 October 2008. 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 and 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.

www.cms.int/species/raptors/index.htm

Saker Falcon (Falco cherrug) © Qatari / Wikipedia

High Andean Flamingos and their Habitats MoU: The populations of the two species of High 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". The MoU aims at improving the conservation status of the species and their habitats. It was concluded among the Range States (Argentina, Bolivia, Chile and Peru) during COP9 on 4 December 2008.

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 in section 3.4. It takes the existence of established or proposed regional agreements fully into account 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 organizations using the flyway approach

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

Conventions, Instruments & Organizations	Objectives	Website
Flyway approaches covering more than one flyway area		
Convention on Wetlands of International Importance: the Ramsar Convention	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 organization 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	The Treaty Act initially 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
Western Hemisphere Shorebird Reserve Network (WHSRN)	Conservation strategy launched by scientists in 1986 to protect key habitats throughout the Americas in order to sustain healthy populations of shorebirds (see text box p. 41 for more details).	www.whsrn.org/
Partners in Flight	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/
The Western Hemisphere Migratory Species Initiative	Founded in 2003 in Chile, it aims to contribute significantly to the conservation of the migratory species of the Western Hemisphere (see text box p. 40 for details).	www.whmsi.net
Waterbird Conservation for the Americas	Launched in 1998 with a focus on colonial birds in North America, since expanded to emphasize most wetland and marine birds throughout the Americas. This voluntary partnership has as its vision that the distribution, diversity, and abundance of populations and habitats of breeding, migratory, and non-breeding waterbirds are sustained or restored throughout the lands and waters of the Americas.	www.waterbirdconservation.org

Table 1 (cont.)

Conventions & Organizations	Objectives	Website
Flyway approaches in the Central Asian flyway area		
The Central Asian Flyway (CAF) process	CAF extends between the Arctic Ocean, 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 p. 43 for details).	www.eaaflyway.net/
Other examples of instruments, programmes and organizations 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 that 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 Paléarctique 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	Organizations 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/

The Western Hemisphere Migratory Species Initiative

- **www.whmsi.net**

Countries of the Western Hemisphere are parties to international conventions, treaties and accords committed to the conservation of migratory species. The Western Hemisphere Migratory Species Initiative (WHMSI) assists countries in fulfilling this commitment. The mission of WHMSI is to promote cooperation and communication among States, international initiatives and civil society.

At the Fourth WHMSI Meeting in December 2010, participants analyzed which components of a framework were necessary to enhance collaboration among migratory bird initiatives in the Americas. The following recommendations were the results:

- Collaboration by supporting countries through capacity building on tackling key threats, including: habitat loss, urbanization, water quality, lack of awareness, under-resourced agencies, disease and climate change
- Initiatives to inform governments and donors seeking "green" reputations on common stories
- A forum to further discuss common issues, including follow-up planning, education awareness, "twinning" of sites linked by shared species, policy development for sustainable land management, readiness and ecosystem services, and identification of important areas that might be outside of Protected Areas.
- WHMSI as a catalyst to encourage further research, strengthen NGO capacity and identify information gaps.
- WHMSI tools (whmsi.net, Pathway) could distribute information and request additional input. Particularly successful initiatives should be highlighted.
- Bringing partners' efforts together, as well as engaging decision-makers and resource users, in order to develop constituencies for migratory species conservation

Draining a wetland © USFWS

Eagle release during Migratory Bird Day 2005
© Ronald Laubenstein / USFWS

These recommendations have been well received by dedicated organizations including the Waterbird Conservation Council and the BirdLife Partners in the Americas, who are now collaborating on a directory of individuals working in flyways and migratory birds in the Americas, as well as in aquatic birds in general.

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 is a conservation strategy launched in 1986. 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 recognized, 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:

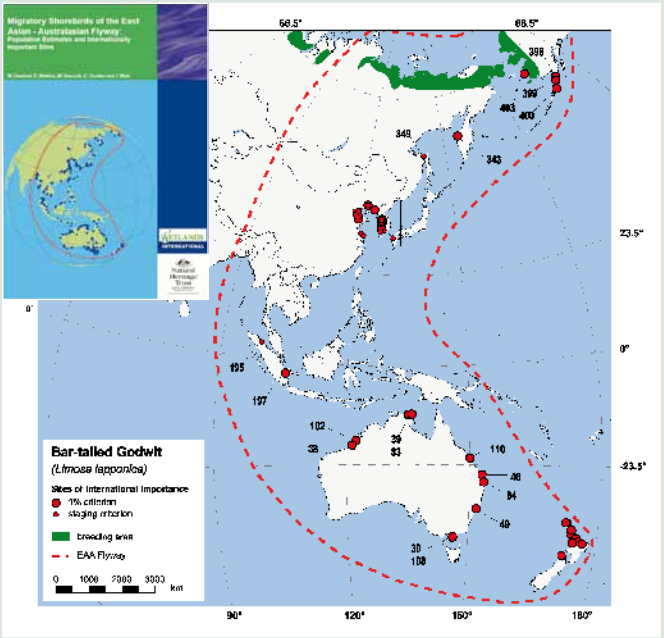
- Build a strong system of international sites used by shorebirds throughout their flyways.
- Develop science and management tools that expand the scope and pace of habitat conservation at each site within the Network.
- Secure local, national and international recognition for sites, raising new public 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 a 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 AEWA Secretariat. 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 the Atlas of Wader Populations in Africa and Western Eurasia was completed in 2008[c,d,e,f]. Plans for future atlases include volumes covering all the other waterbird populations encompassed in AEWA and other major flyways.

A majority of waterbird populations congregate 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 kilometres apart, and waterbirds undertake some of the longest and most spectacular migrations to reach their destination. Wetlands International's flyway atlases identify key sites used by congregations of each population. A key site is defined as a site at which 1 per cent or more of a population regularly occurs. The sites identified 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 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 poor information, where field skills, general education and awareness on waterbird are certainly needed. Data limitations indicate where more information is required, e.g. for species, habitats and regions that are poorly surveyed.



© Wetlands International 2008 [iii]

The mapped population boundaries and key sites for waterbird populations presented in Wetlands International's flyway atlases provide in a readily useable form information vital for the conservation of the world's waterbirds. 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 Flyway 5 in Fig. 13 p. 33). Migratory waterbirds share this flyway with 45 per cent 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 August 2012, the EAAF Partnership consists of 27 partners, including 14 national governments, 3 intergovernmental agencies, 9 international non-government organizations and 1 international business sector.

The Partnership builds on the achievements of the Asia-Pacific Migratory Waterbird Conservation Committee and Asia-Pacific Migratory Waterbird Conservation Strategies (the 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 last Implementation Strategy covered the period 2007-2011 but was revised at the EAAFP MOP6 in March 2012.

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 designated under the Flyway Site Network.

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 regions they pass through while on migration.

Insect control

Probably the most recognized ecological function of migratory birds is pest control. The value of insect-eating birds is well known to 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, Benjamin Franklin one of the "Founding Fathers" of the USA, 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 per cent 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

In the USSR, 25 million nest boxes were supplied for Common Starlings *Sturnus vulgaris* 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 *Creatophora 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 feed on millions of Senegalese Grasshoppers *Oedaleus senegalensis*. Due to their grasshopper devouring capacities, Abdim's Storks and Cattle Egrets are held in high esteem by local farmers. 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[64].

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 hybridized with and 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.

Cattle Egret (Bubulcus ibis) during migration
© Mohammed Shobrak

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.

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)[65]. The mining of the resulting layer of 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[66].

Migratory birds as indicators of pollution

A further very important, but insufficiently appreciated, 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 (see text box, p. 50) were used to show the damaging effects of DDT and other organochlorides on raptor reproduction, as well as 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 re-colonize 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 Swallows were used to monitor effects of radiation post-Chernobyl.

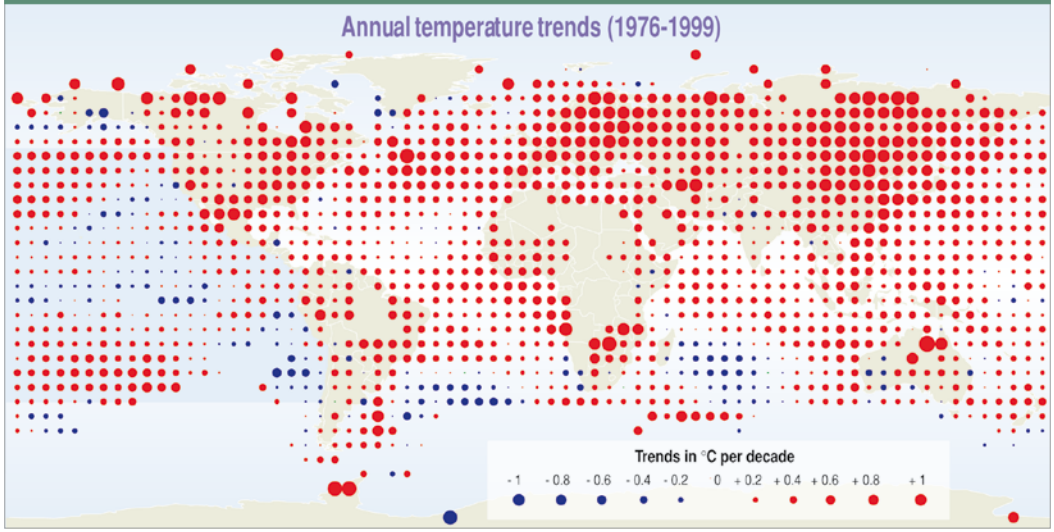
Migratory birds as indicators of land use change

The composition and number of migratory birds on a plot of land reflect the effects, changes in farming and other types of land

Oiled Cormorant © Still Pictures

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 permanently occupy the niches left open by the weakened migratory species.

Figure 14: Observed changes in global average surface temperature



© IPCC 2001, p. 90, in [i]

Migratory birds as indicators 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. At the end of the 20th century, many places, such as Canada and across Europe (from France to Russia), witnessed the arrival of migratory birds almost four days earlier every ten years from when recordings began (see relation to Fig. 14).[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 such as the Bonn and Ramsar Conventions and Agreements such as AEWA.

In Antarctica, on the contrary, Adélie Penguins *Pygoscelis adeliae* and six petrel species have been arriving at their colonies for unknown reasons nine days later at the beginning of the

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

21st century than in the early 1950s, and are laying eggs two days later. Adélie Penguins breeding on Anvers Island in the Antarctic Peninsula have declined by 70 per cent owing to retreating ice, and the Emperor Penguin in Terre Adélie declined by 50 per cent in the late 1970s in response to abnormally warm temperatures. Neither has recovered since. Populations of other long-lived, slow-breeding species such as albatrosses may not show any adverse effects yet, but may suddenly crash if there are no young birds when the older 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 Shear-waters *Puffinus griseus* 'wintering' on the California Current off the South-West coast of the USA. Interestingly, reproductive success of Elegant Terns *Sterna elegans* and Heermann's Gulls *Larus heermanni* in the Eastern Pacific could be used to envisage the outcome of fishing efforts and climatic events such as El Niño[38].

Migratory birds in December, Ghana © Tim Dodman

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

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[67]. This can be demonstrated by the work of the Ramsar Convention regarding the protection of wetlands. The initiative of the Ramsar Convention came from people concerned about the fate of waterbirds, especially migratory waterbirds. They realized that, for the well-being of those migratory birds, the well-being of their wetland habitats was essential (Table 1, p. 38).

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 of 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.

4.2 Bird-watching and tourism

Bird-watching and eco-tourism are commercially developed in many industrialized 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 bird-watching 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.

On a South African site, 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 bird-watching 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 simultaneously addresses social, economic and environmental needs, resulting in greatly increased local conservation awareness[68].

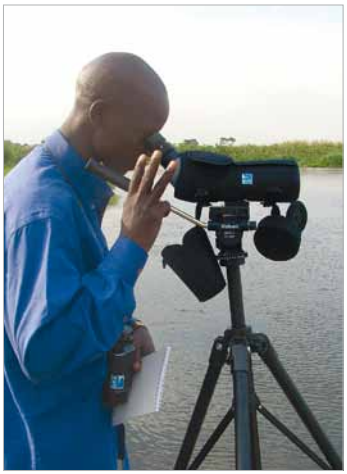
Table 2: Some annual values of bird-dependent activities, bird products and services.*

Country	Activity	Annual value (US$)	Year (approx.)
Bird-watching and tourism			
South Africa[68]	two birding routes: local travel accommodation and birding guides	6,400,000	2007
USA[69, 70]	bird-watching trips	7,400,000,000	2001
	bird-watching and related equipment	24,300,000,000	2001
USA[69, 70]	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[71]	value of birds killed only, assuming a price of $ 0.50 per bird	250,000,000	2006
Malawi[72]	waterbird hunting	215,000	1999
Nauru[65]	guano export	20,000,000	1991
Nauru[65]	guano export	640,000	2004
Iceland (estimate)	eider down collection	28,000,000	2006

** Note that reliable economic data are scarce.*

Another example is shown in the box (p. 50) 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 species near their homes. That is nearly one in five people of 16 years or older, of whom 54 per cent are female. In comparison, there are 3.0 million bird hunters, of whom just 5 per cent are female.

Black-throated Mango (Anthracothorax nigricollis), female © Veargy 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 went 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, large equipment such as boats, cars, campers).[69, 70]

At Cape May for instance, 300 km south of New York, an estimated US$ 25-30 million per year is spent by bird watchers, sustaining some 700 jobs in the process.

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 per cent, watch waterbirds, most of which are migratory.[69, 70]

Costa Rica in 1999 received US$ 1 billion from tourism, of which 41 per cent stemmed from bird-watching eco-tourists[38]. Mostly this was 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 a European Community 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.[73]

Well known sites for watching migratory birds 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 and 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:[74].

Hawk Mountain, Pennsylvania, USA 1934-2011

www.hawkmountain.org/

Located along the Appalachian Flyway in east-central Pennsylvania and founded in 1934, 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.

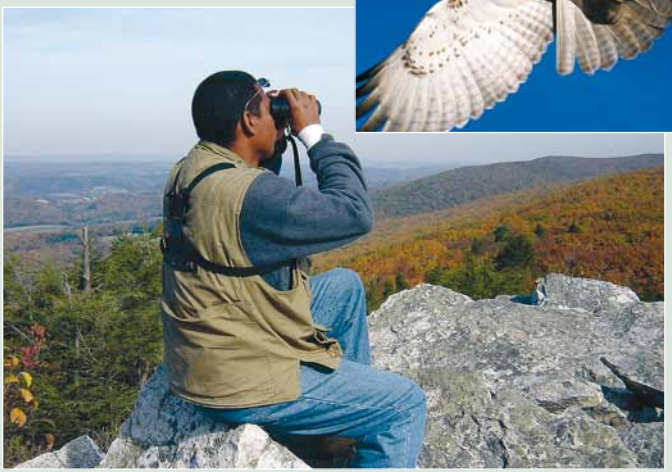
To advance the mission, a full-time staff team of 16, assisted by a 200-member volunteer corps, carries out integrated conservation programmes in education, research and monitoring, including operating a Visitor Centre, the Acopian Center for Conservation Learning, and managing the 2,600-acre sanctuary.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

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 biostatistician 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. Since half of the raptors that pass through 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 organizations, for training in its Conservation Internship Programme.

Red-tailed Hawk (Buteo jamaicensis)
© Jeff Schmoyer



Birdwatching at Hawk Mountain Sanctuary
© Hawk Mountain Sanctuary

Migratory bird events

The spectacle of bird migration has led to the organization 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 organization of the World Bird Festival in Ebeles-Saqi, in October that year. 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[71].

Another example of a festival is the Crane Celebrations organized 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.

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 an 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.

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]

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. **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 2012 alone, more than 250 events in 81 countries all over the world were registered under the umbrella of World Migratory Bird Day.

Many publicity activities are also organized 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 avian behaviour, including that of migratory birds. Many of the best fliers are migratory birds, thus technology has also 'borrowed' much from these species, 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, but controversial, economic activity. Many bird species are kept as pets for their beauty and their song. In the period 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[71]. The same can be said for other parts of the world.

Falconry

A number of migratory raptors are used to catch other birds and mammals, especially in West and Central Asia, including the Saker Falcon, 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, 71].

Osprey (Pandion haliaetus), courtesy of Wings Over Wetlands

Saker Falcon © Mohammed Shobrak

Breeding Knot (Calidris canutus) © Gerard Boere

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

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[71]. More often though 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[71]. The 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 considerable impacts these hunters had on these 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 Bustards 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 Quails *Coturnix coturnix* were killed in one day along a short stretch of Italian coastline, and almost two million were exported from Egypt in 1913.[37]

Colonization 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*, Red Knot, Wood Duck *Aix sponsa*, Wild Turkey *Meleagris gallopavo* and Whooping Crane, conservation laws, and on-the-ground conservation activities, came in time.[38] Hunting caused the decimation of Siberian Crane populations in Western and Central Asia, where only a few individuals now remain. The text box on sustainable hunting (p. 54) describes the situation today and makes suggestions how to balance bird population numbers without threatening them.

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

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

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 *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. 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.[38] 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[75]. 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.

Measures for 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 of land, and supporting a variety of groups. The interests of these groups must be considered and alternatives found 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 better protect migratory birds and to avoid further conflicts between hunters and conservationists, as has happened in the past.

In response to the above, BirdLife International, BirdLife–the Netherlands and UNDP-GEF, completed a three-year initiative (2004-2007) to tackle these issues in Morocco, Algeria, Tunisia, Egypt, Lebanon, Jordan and the Syrian Arab Republic.

Project activities included:

1. The 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

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

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

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[76]. Their total harvest of about 3,000 kg of down is about 75 per cent 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 fertilizer 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 fertilizer either directly or after processing. When the United States Congress realized in the mid-19th century how important guano was, it 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]

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

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. 48), which is also a consequence of 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[12,77]. In 2008, 11 per cent 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 the numbers of (near-) threatened species per region is given in Table 3. The low percentage of (near-) threatened migratory soaring birds in the Americas (2 per cent), and the high percentages of (near-) threatened soaring birds in the Asia-Pacific (33 per cent) and Palearctic-Africa (24 per cent) regions are remarkable. Also notable are the high percentages of (near-) threatened waterbirds in the Asia-Pacific (23 per cent) and Palearctic-Africa (16 per cent) regions.[12]

The regular population estimates and status reviews for all waterbird populations worldwide, coordinated by Wetlands International, indicate that:

- 40 per cent of waterbird populations, for which trend data are available at the global level, are decreasing,
- 34 per cent are stable,
- 17 per cent are increasing
- 4 per cent have become extinct[78].

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.[79, 80]

Breeding Bird Surveys (BBS) have been used to show that, over the period 1978-1987, 44 of 62 species (71 per cent) that breed in eastern North America and spend the non-breeding season in Central or South America, declined in abundance. Only 48 per cent (15 out of 32) resident bird species, and species that migrate within North America, did so[17]. More recent BSS analyses showed negative population trends over the period 1980-2005 for:

- 62 per cent of bird species that breed in Eastern-North America and spend the non-breeding season in Central or South America
- 65 per cent of bird species that breed in Western-North America and spend the non-breeding season in Central or South America
- 70 per cent of bird species that breed in western North America and migrate within in North America
- 86 per cent of grassland-breeding birds continent-wide[81].

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[82].

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 and waterbirds.

MIGRATORY BIRDS

In Europe, long-distance migrants are declining significantly more than short-distance migrants, irrespective of breeding habitat. Of 118 intercontinental migrating species, 48 (40 per cent) 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. 20, discussed in section 2.3.

www.cms.int/species/sb_curlew/sbc_bkrd.htm

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

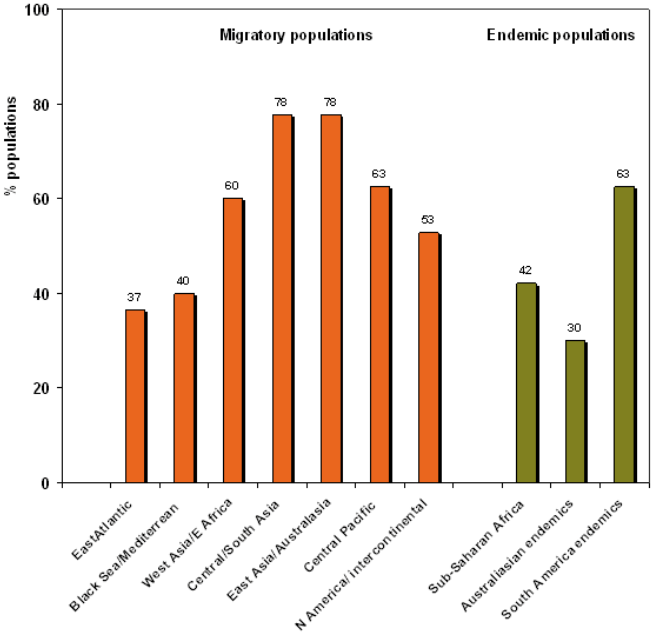
www.cms.int/species/raptors/index.htm

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 per cent in recent times) and of lowland forest loss (80 per cent), it is estimated that mangrove specialist birds must be at least Near-threatened, and lowland forest specialists Endangered[83]. In Japan, serious range contractions of breeding birds also appear to be associated with long-distance migration[84].

In Asia as a whole, 62 per cent of waterbird populations are now decreasing or have become extinct, and only 10 per cent show an increasing trend[78]. In inland eastern Australia, migratory waterbird populations have plummeted by 79 per cent over a 24-year period[85]. In Central, Southern and Eastern Asia, 17 (33 per cent) of the 51 migratory raptor species considered, currently exhibit an unfavourable conservation status[31]. See also www.cms.int/bodies/ScC/15th_scientific_council/15th_ScC_documents.htm#scc13_docs for the status of albatross and petrels.

A global summary of population trends can be found in Fig. 15.

Figure 15: 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.



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

6 CONCLUSIONS AND RECOMMENDATIONS

Monitoring: The data available on bird migration and individual populations had grown steadily within the last century. Nevertheless, there are still considerable 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, their habitat status, and the most suitable conservation strategies. To help fill these gaps, new technologies, small signalling devices for radio and satellite tracking which record geographical location data of the bird they are attached to, 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. Nevertheless, 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 (chapter 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 rather than our lack of ecological understanding are limiting action. This is why efforts must focus on all the available conservation tools from monitoring and research to interdisciplinary conservation action to juridical measures.

With regard to applied conservation in the field, a network of critical sites, not least along the world's flyways, is likely to maximize 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 habitats 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 human land use, but also more indirectly through climatic factors. The spatial and temporal migratory behaviour of many birds, such as Trans-Saharan songbirds, is 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, ideally growing from the bottom up, which will naturally help these initiatives adapt well to specific circumstances. Where the exploitation of a migratory species or the habitat of such a species is dependent upon the socio-economic conditions 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 of migratory birds and their plight certainly needs to be improved among the general public. Activities such as World Migratory Bird Day and World Bird Day, Crane Celebrations, as well as the many migratory bird festivals worldwide (see section 4.2), must continue to be developed further. Public information through schools and other educational institutions that 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, e.g. bird population size or attitudes of the local population, must be clearly measurable and linked to the project aims, and 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 spe-

cies 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[79,80]. 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 harmonization 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 co-operation through bilateral agreements between adjacent countries. However, the advantage of several multilateral 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 Migratory Waterbird Agreement, for example, illustrates how cost-effective and powerful such a multilateral agreement can be.

The development of legislation, adaptable 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, particularly in the light of climate change.

In conclusion, it is evident that migratory birds, especially long-distance migrants, will benefit considerably from conservation 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
- Provision of such conservation action to ensure that threats facing migratory birds along their flyways are minimized, including any exploitation that exceeds sustainable levels
- Habitat conservation along a critical site network along all the migration flyways, adaptable and flexible to account for future changes such as in flight patterns and habitat morphology, to maximize the adaptation potential of individual bird species
- Careful planning and adaptation of man-made physical threats such as renewable 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 into 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 minimized, 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 benefits the entire ecosystem, and that includes humans as well. Therefore, it is necessary for each Range State to not only 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.

Through such a framework, common and fair solutions for farmers whose crops have been ravaged by birds, for example, can be found. 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 sustainable conservation of these birds, which form part of the greatest animal movement on Earth.

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A BIRD'S EYE VIEW ON FLYWAYS

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

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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 declined significantly, due to a variety of threats.

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 co-operation is being organized 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 along the birds' flyways. To really catch the imagination of local people, especially in less developed countries, conservation projects should also have a human development component.

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