UNEP/AEWA Secretariat
UN Campus
Hermann-Ehlers-Str. 10
53113 Bonn
Germany
Tel.: +49 (0)228 815 2413
Fax: +49 (0)228 815 2450
aewa@unep.de
http://www.unep-aewa.org

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MIGRATORY WATERBIRDS AND CLIMATE CHANGE

Effects within the African-Eurasian Flyways

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MIGRATORY WATERBIRDS AND CLIMATE CHANGE

Effects within the African-Eurasian Flyways

Ilya M.D. Maclean
Mark M. Rehfisch
Robert A. Robinson

British Trust for Ornithology,
The Nunnery, Thetford, IP24 2PU,
United Kingdom

Simon Delany

Wetlands International, PO Box 471,
6700 AL Wageningen, The Netherlands

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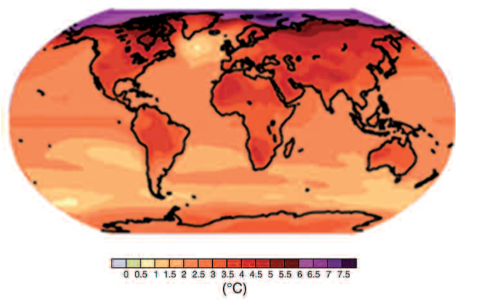
Photo on the cover page: Little Egrets (*Egretta garzetta*), © Sergey Dereliev

Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA)



Predicted global temperature increase.
Source: IPCC1

Map of the AEWA region

CLIMATE CHANGE AND WATERBIRDS WITHIN THE AEWA REGION

CLIMATE CHANGE

It is now unequivocal that our climate is warming. Increases in global temperatures, widespread melting of snow and ice and rising sea levels all point directly to a warmer planet.

There is overwhelming evidence that humans are contributing to global warming. Most of the observed increase in temperatures since the mid-20th century is very likely to be due to the observed increase in greenhouse gas concentrations[1].

Climate change is likely to affect all ecosystems, but wetlands are particularly vulnerable. Not only are they the world's most threatened ecosystem[2] but their sensitivity to changes in water level make them especially susceptible to changes in precipitation or evapo-transpiration.

WETLANDS AND WATERBIRDS

Wetlands are defined as permanent or temporary areas of marsh, fen, peatland or water, whether natural or artificial, with water that is static or flowing, fresh, brackish or salt, including areas of marine water where the depth does not exceed six metres at low tide.

Many waterbirds migrate between different areas to exploit seasonally available food supplies. During their migrations, these waterbirds cross political boundaries that have no inherent meaning for the birds, but have dramatic influences on their annual survival chances, because of differences between countries in conservation and hunting policies.

The African-Eurasian Migratory Waterbird Agreement (AEWA) ensures that coordinated and concerted actions are taken throughout the migration system of waterbirds to which it applies. The African-Eurasian flyway covers 118 countries from Europe, Central Asia and parts of Canada to the Middle East and Africa.

CLIMATE CHANGE IMPACTS ON WATERBIRDS

BREEDING RANGE SHIFTS

It is well known that species´ ranges depend on temperature. Many species have undergone significant shifts in their breeding range in a poleward direction.

In the UK, between the periods of two Breeding Bird Atlases (1968-1972 and 1989-1991), bird species (including some waterbird species) extended their breeding ranges northwards by an average of 18.9 km, a trend attributed to warming temperatures[3].

Some species have undergone much more dramatic shifts. Little Egrets were first recorded breeding in the UK in 1996. By 2003, there were over 242 pairs in southern England and by 2008 over 800, as far north as the Mersey Estuary[4].

WINTERING RANGE SHIFTS

Many species have also undergone substantial shifts in their over-wintering distributions. In Europe, shifts have generally been in a north-easterly direction as winter isotherms are aligned north-west to south-east.

In both the UK and North-West Europe, the distributions of most common species of wader overwintering on estuaries have shifted eastwards or northwards. As a result, some waders no longer occur in internationally important numbers on protected areas that were designated because of their international importance[5,6].

Shifts in wintering range reflect reduced migratory behaviour[7]. A number of wader species may be travelling shorter distances between summer and winter than previously and many species that traditionally wintered south of the Sahara, are increasing in number in the Mediterranean (see Box 1 on page 4).

Data on species range shifts in sub-Saharan Africa are extremely sparse so changes in distribution here are unknown.

Little Egret (*Egretta garzetta*)
© Sergey Dereliev

CHANGES IN THE TIMING OF BIOLOGICAL EVENTS

Many species are changing the timing of significant events in their life-cycle in response to changes in climate.

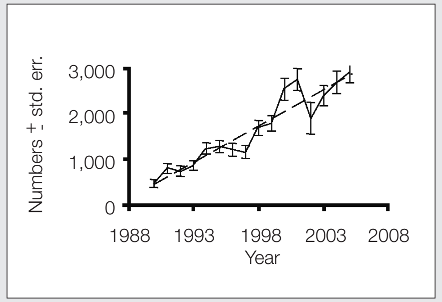
Studies on the spring arrival of migratory birds in the UK suggest that up to 72% of species are arriving earlier than 30 years ago, some up to two weeks earlier[9]. Similar advances in arrival dates have occurred throughout Europe. For example, the spring arrival dates of the first White Stork at many sites across Spain has advanced by about 40 days since the mid-1940s[10].

Departure dates from breeding grounds tend to show less consistent trends, possibly due to the opposing effects of earlier completion of breeding versus milder autumn temperatures which means food may be available for longer.

Breeding has also advanced. Data suggest that the laying dates of bird species advanced, on average, by nine days between 1976 and 1996 and were related to either spring temperature or spring rainfall or both[11,12].

BOX 1. WADERS WINTERING NORTH OF THE SAHARA

Increasing numbers of migratory waterbirds are opting to capitalise on milder conditions in Europe. For example, the Greenshank, normally a long-distant migrant to Africa, is over-wintering in the Mediterranean in increasing numbers.



Source: Wetlands International (in press)[8]

The number of Greenshank overwintering in the West Mediterrnean has increased substantially·
© Mike Weston

CLIMATE CHANGE IMPACTS ON WATERBIRDS

MISTIMING OF BIOLOGICAL EVENTS

There is evidence from a whole range of species suggesting that shifts in the timing of biological events has resulted in mistiming with respect to the availability of resources.

Migratory waterbirds can respond to changing climate by changing the timing of significant events in their life-cycle such as breeding. However, the resources on which they depend, also respond to climate, but often at a different rate. For example, both Pintail and Golden Plover have advanced the timing of their breeding at a different rate to the food on which their young are fed, resulting in higher juvenile mortality (see Box 2).

Similar mismatches can occur with weather. Recent advances in the timing of breeding of White Storks in Spain in response to warmer temperatures has exposed chicks to more rain, as rainfall tends to be higher earlier in the year leading to higher mortality[13].

The extent to which migratory waterbirds can evolve sufficiently in response to climate to avoid making ecological mistakes is unclear.

BOX 2. MISTIMING IN HATCHING OF GOLDEN PLOVER CHICKS

The survival of Golden Plover chicks is critically dependent on the availability of tipulid larvae on which they feed.

Golden Plover first-laying dates are negatively correlated with both March and April temperature, whereas tipulid emergence is negatively correlated with May temperatures.

Historical data suggest that tipulid emergence has advanced by less than the laying-date of Golden Plover, possibly leading to chick starvation[14].

Golden Plover (*Pluvialis apricaria*)
© Nigel Clark

The nests of species such as Damara Tern are likely to be vulnerable to sea-level rise © Pete Morris

Populations of Purple Heron in Western Europe are particularly vulnerable to Sahel drought © Rob Martin

SEA-LEVEL RISE

Rising sea-levels may flood the nests of birds breeding in low-lying coastal areas. It will also cause habitat loss, particularly where landward re-alignment of coastal habitats is restricted by coastal defences.

Waterbirds that are site-faithful and nest in low-lying areas such as shingle ridges, are likely to be most at risk from nest flooding. This includes terns, Ringed and Kentish Plovers and Audouin's Gull.

Coastal habitats prone to erosion, such as mangroves and saltmarsh are also at risk from sea-level rise. These habitats are particularly important as they export organic material and thus form the base of estuarine foodwebs.

Sea-level rise may also change the characteristics of coastal habitats. Estuaries are likely to become wider and sandier, which will adversely affect some small species of waders that favour muddy sediments[15].

CHANGES IN RAINFALL

Waterbirds are particularly vulnerable to changes in rainfall because of their dependence on wetland habitats.

The most vulnerable species to changes in rainfall are those that occur predominantly in southern Africa or Mediterranean regions, the two regions that are predicted to get considerably drier.

Waterbirds, in common with many other species are particularly sensitive to changes in rainfall in the Sahel region of Africa. This area, being just south of the dry expanses of the Sahara desert represents a crucial stop-over or wintering area.

For example, the number of breeding pairs of Purple Heron in the Netherlands is closely linked to Sahel rainfall as is the annual survival of White Storks in Western Europe[16,17].

POPULATION IMPACTS

Although it has been widely demonstrated that climate change has already had major impacts on waterbirds, the implications for population numbers are less well understood.

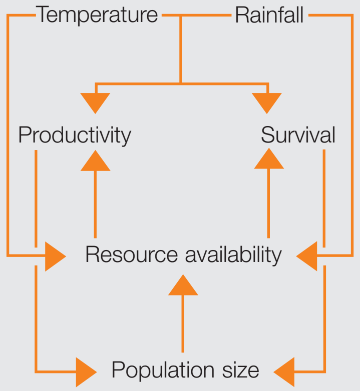
Understanding the impacts of climate change on a population requires an understanding of how such impacts affect the survival and productivity of individuals.

Extreme temperatures and rainfall tend to lower the survival and productivity of waterbirds. Cold temperatures and high rainfall can cause chick mortality, whereas high temperatures and low rainfall can cause heat strain or wetlands to dry up.

It is much harder to predict the effects of climate change on populations. Climate change can affect species directly or indirectly by affecting the availability of resources. However there are complex interactions between resource availability and population size (see Box 3).

BOX 3. UNDERSTANDING POPULATION-LEVEL IMPACTS OF CLIMATE CHANGE

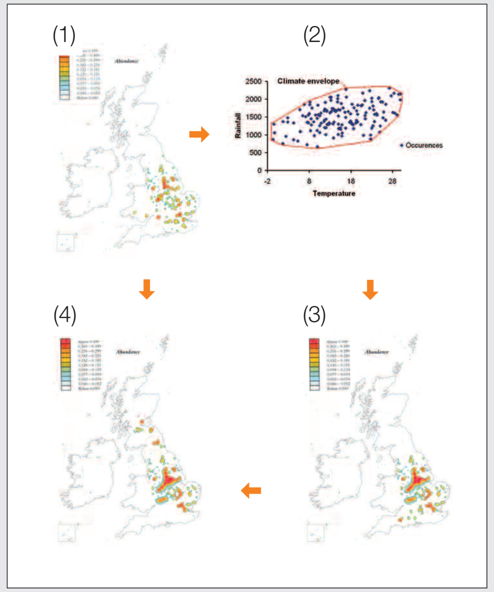
Flow chart of interaction between climate change, demography, resource availability and population size. These interactions make it difficult to predict the impacts of climate change on populations.



PREDICTING FUTURE IMPACTS ON WATERBIRDS

BOX 4. PREDICTING FUTURE DISTRIBUTION AS CLIMATE CHANGES

Observed distribution of e.g. Little Ringed Plover (1) are translated into limits of climate variables suitable for each species, the climate envelope (2, red line), which allows current potential range to be modelled (3) and future range predicted (4).



FUTURE IMPACTS

Observed impacts of climate change on waterbirds are expected to continue and increase. Due to uncertainties in climate forecasts and species interactions, future impacts cannot be quantified precisely.

There is uncertainty in the extent of future changes, because of complexities in modelling climate and the unknown magnitude of future mitigation measures. Such uncertainties are compounded by expected changes in land-use, which are also likely to have a major impact on waterbirds directly.

The most widely used method of forecasting future impacts of climate change on birds is the “climate-envelope” approach, whereby the current climatic extremities of a species’ range are quantified and future ranges predicted by assuming such relationships will be similar in the future[18].

Relationships between climate and species are likely to change as conditions alter, so the method requires further testing by examining whether historic predictions match current ranges.

SPECIES SENSITIVE TO CLIMATE CHANGE

SPECIES SENSITIVITY

Migratory waterbirds are vulnerable to climate change. They are especially sensitive to changes in water levels and can be affected by climate change during migration and on their breeding or wintering grounds.

Species with small populations and ranges, fragmented distributions, with specialist food requirements or that occur in vulnerable habitats are likely to be most affected by climate change.

These parameters have been quantified for all species listed on Annex 2 of the Agreement. The most vulnerable species to climate change are listed in Box 5.

Slaty Egret (*Egretta vinaceigula*)
© Grant Reed, Letaka Safaris

BOX 5. SPECIES PARTICULARLY VULNERABLE TO CLIMATE CHANGE

The species listed in the table (right) are particularly vulnerable (score > 17) to climate change based on their small population size & range, high degree of fragmentation, association with vulnerable habitats and specialist diet[19].

Species	Population size score	Range size score	Fragmentation score	Habitat score	Food score	Climate vulnerability score
Cape Gannet *Morus capensis*	2.0	2.0	3.5	6.0	6.0	19.5
Crowned Cormorant *Phalacrocorax coronatus*	4.0	4.0	2.0	4.0	4.0	18.0
Bank Cormorant *Phalacrocorax neglectus*	4.0	6.0	3.0	4.0	2.0	19.0
Slaty Egret *Egretta vinaceigula*	5.0	4.0	2.0	6.0	2.0	19.0
Northern Bald Ibis *Geronticus eremita*	7.0	4.0	3.4	4.0	0.0	18.5
White-winged Flufftail *Sarothrura ayresi*	6.0	3.0	4.0	6.0	2.0	21.0
Madagascar Pratincole *Glareola ocularis*	2.0	2.0	3.5	6.0	6.0	18.5
Slender-billed Curlew *Numenius tenuirostris*	9.0	3.0	2.5	6.0	2.0	26.5
Damara Tern *Sterna balaenarum*	3.0	3.0	1.5	6.0	4.0	17.5

POPULATIONS SENSITIVE TO CLIMATE CHANGE

BOX 6. BIOGEOGRAPHIC POPULATIONS PARTICULARLY VULNERABLE TO CLIMATE CHANGE

The populations listed in the table (right) are particularly vulnerable to climate change based on their small population size & range, high degree of fragmentation, association with vulnerable habitats and specialist diet[19].

Species	Population	Climate vulnerability score
White Stork *Ciconia ciconia*	Southern Africa	24.5
Northern Bald Ibis *Geronticus eremita*	South-west Asia & South Asia (win)	27.0
Northern Bald Ibis *Geronticus eremita*	Marocco	24.0
Sacred Ibis *Threskiornis aethiopicus*	*aethiopicus* Iraq & Iran	21.0
Cape Teal *Anas capensis*	Lake Chad basin	21.5
White-headed Duck *Qxyura leucocephata*	Algeria & Tunisia	22.5
Siberian Crane *Grus leucogeranus*	Iran (win)	25.5
Common Crane *Grus grus*	Turkey & Georgia (bre)	20.0
Demoiselle Crane *Grus virgo*	Turkey (bre)	24.5
Demoiselle Crane *Grus virgo*	Black Sea (Ukraine) North-east Africa	20.0
White-winged Flufftail *Sarothrura ayresi*	Ethiopia & Eastern Africa	27.0
Chestnut-banded Plover *Charadrius pallidus*	*venustus* Eastern Africa	20.5
Slender-billed Curlew *Numenius tenuirostris*	Central Siberia Mediterranean & SW Asia	22.5

POPULATION SENSITIVITY

Biogeographic populations are of great significance in conservation legislation and are even more vulnerable to climate change than species.

One of the important criteria used to identify wetlands of international importance, is whether a wetland hosts in excess of 1% of a particular biogeographic population of a species.

If the same criteria used to identify species vulnerability to climate change are applied to the populations listed on Table 1 of the Agreement, populations generally score as more vulnerable to climate change than species (compare Box 6 with Box 5).

Although this is to be expected, given that an individual species comprises several populations and as such the populations are likely to be more range-restricted and smaller in size than the species as a whole, it serves to illustrate the importance of using a population-based approach to conserving species in the face of climate change.

HELPING BIRDS ADAPT TO CLIMATE CHANGE

ADAPTATION

Although the only long-term solution to climate change is to mitigate against it by reducing emissions, delays in the climate system are such that we are already committed to further warming. To help birds cope with such changes, measures are needed to help them adapt.

1. Site management

One of the most effective means of helping birds to adapt to climate change is management of key sites. Viable measures include manipulation of vegetation to alter micro-climate and management of water-levels, by restoring surrounding areas, undertaking small-scale temporary damming, drainage and imposing restrictions on water use.

2. Protected area networks

If species cannot adapt to climate change and cannot be maintained at their present locations, they will only survive if they move into new areas. To facilitate species dispersal a coherent network of protected areas must be established, particularly towards the colder extremities of a species' range and in areas predicted to become drier.

3. Management of the wider countryside

Although networks of protected areas provide one means of aiding species dispersal, there is also a need to manage the wider countryside in a manner that favours dispersal. This is best achieved by integrating appropriate management into existing policy frameworks such as agri-environment schemes.

4. Minimising other impacts

For some species, and in some areas the only option is to minimise other impacts. To this end, limiting wetland drainage and degradation is important as this will buffer waterbirds against prolonged periods of drought and will also ensure that species can disperse adequately as climate changes.

Cley Marshes Nature Reserve, a managed bird sanctuary along the north Norfolk coast, UK
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MIGRATORY WATERBIRDS AND CLIMATE CHANGE

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