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AEWA Conservation Guidelines No. 12

Guidelines on measures needed to help waterbirds to adapt to climate change

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BTO

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

AEWA Conservation Guidelines No. 12

Guidelines on the measures needed to help waterbirds adapt to climate change

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CONTENTS

Rationale

Article II of the African-Eurasian Waterbird Agreement includes the following:

> *"Parties shall take co-ordinated measures to maintain migratory waterbird species in a favourable conservation status or to restore them to such a status."*

Article III of the African-Eurasian Waterbird Agreement also includes the following:

> *"Parties shall investigate problems that are posed or are likely to be posed by human activities and endeavour to implement remedial measures, including habitat rehabilitation and restoration, and compensatory measures for loss of habitat."*

Although neither clause makes explicit reference to climate change, both suggest that remedial measures are needed to combat adverse effects, including climate change, on waterbirds. Additionally many of the States within the Agreement Area have made commitments under their domestic legislation and other international conventions that strengthen their intention to maintain biodiversity in the face of climate change.

A review of domestic legislation is beyond the scope of these guidelines. The main international instruments that urge Parties to protect threatened species include the Convention on Biological Diversity (Rio de Janeiro, Brazil, 1992), the Convention on Wetlands (Ramsar, Iran, 1971), the Convention on Migratory Species (Bonn, Germany, 1979) and the EC Council Directive on the conservation of wild birds (79/409/EEC).

Contracting Parties to the Convention on Biological Diversity are committed, under Article 8, to take action to:

> *"(f) Rehabilitate and restore degraded ecosystems and promote the recovery of threatened species,* inter alia, *through the development and implementation of plans or other management strategies;*
>
> *(k) Develop or maintain necessary legislation and/or other regulatory provisions for the protection of threatened species and populations;*
>
> *(l) Where a significant adverse effect on biological diversity has been determined pursuant to Article 7, regulate or manage the relevant processes and categories of activities…"*

Contracting Parties to the Convention on Wetlands are committed

under Article 1 to:

> *(1) consider its international responsibilities for the conservation, management and wise use of migratory stocks of waterfowl."*

under Article 3 to:

> *(1) formulate and implement their planning so as to promote the conservation of the wetlands included in the List, and as far as possible the wise use of wetlands in their territory.*

and under Article 4 to:

> *(1) promote the conservation of wetlands and waterfowl by establishing nature reserves on wetlands, whether they are included in the List or not, and provide adequately for their wardening.*

and

> *(4) endeavour through management to increase waterfowl populations on appropriate wetlands.*

EU member States are committed under Article 2 of Council Directive 79/409 EEC on the conservation of wild birds to:

> *"take the requisite measures to maintain the population of the species referred to in Article 1 at a level which corresponds in particular to ecological, scientific and cultural requirements."*

Although none of these Conventions makes explicit reference to climate change, all suggest that remedial measures are needed to combat adverse effects, including climate change, on waterbirds or other biodiversity. Although Council Directive 79/409 ECC refers to the conservation of birds within member states of the European Union, these countries account for almost a third of those contracted to AEWA and host a high number of the species listed on Annex II of the Agreement.

Step chart

In the development of measures to help waterbirds adapt to climate change, each country should take the following steps:

Step 1: Identify Parties to be involved in implementing species-based, site-based, regional, national and international measures to help waterbirds adapt to climate change.

Step 2: Identify species and populations most at risk from climate change and identify priority measures (for a potential list of species and measures see text).

Step 3: Prepare priority list of key sites most at risk from climate change and identify priority measures (for a potential list of sites and measures see text).

Step 4: Prepare priority list of key regional, national and international measures for helping waterbirds adapt to climate change (for a potential list see text).

Step 5: Implement climate change adaptation management measures.

Introduction

It is now unequivocal that our climate is warming. Observations of increases in air and ocean temperatures, widespread melting of snow and ice and rising global average 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 anthropogenic greenhouse gas concentrations. Discernible human influences now extend to other aspects of climate, including sea-level rise, temperature extremes and wind patterns. Climate change is considered to be the greatest environmental challenge facing the world today.

Climate change is likely to affect all ecosystems, but wetlands are particularly vulnerable. They host a very high biological diversity, providing the water and primary productivity upon which countless species of plants and animals depend for survival. Waterbirds are the most widely used tool to identify, designate and justify the protection of important wetlands. Their sensitivity to environmental change, the relative ease with which they can be counted and their tendency to congregate at key locations make them effective proxies for aspects of wider biodiversity.

Because of delays and feed-backs in the global climate system, even if greenhouse gas emissions were to be reduced substantially, significant warming would still occur. Thus, although mitigation is the only long-term solution to climate change, adaptation measures are needed to help waterbirds cope with the climate change that will inevitably occur.

There are several approaches to helping waterbirds adapt to climate change. Site and species-based approaches should consider that the resources available for helping waterbirds to adapt to climate change are finite and priority measures are therefore needed. However, waterbirds migrate between different areas to capitalise on seasonally available resources. During their migrations, these waterbirds move from site to site and cross political boundaries between nations; boundaries that have no inherent meaning for the birds, but which have a dramatic influence on their annual life-cycles and their individual survival chances. Thus, in addition to measures that are specific to a particular area, broad-scale regional, national and international instruments for helping waterbirds cope with climate change are needed.

Whilst such measures and instruments need to work within existing policy frameworks, their varying spatial (and temporal) scales are such that they are unlikely to sit conveniently within the remit of one group of policy-makers. It may be that several policy groups and stakeholders such as farmers, fishers, hunters and conservation NGOs need to be engaged to ensure the effective implementation of suggested actions.

It should be noted that there is an inverse relationship between the geographical scope of a particular measure and the level of detail needed to describe the measure, whilst retaining policy-relevance. Thus, it should be noted that these guidelines give greater detail for those measures that are specific to particular sites or small regions. In this paper, the five major steps needed to help waterbirds adapt to climate change are presented.

Step 1: Identify Parties to be involved in implementing species-based, site-based, regional, national and international measures to help waterbirds adapt to climate change

Whether or not it is worthwhile attempting to implement within-country measures to help waterbirds adapt to climate change will depend on capacity and priorities with respect to other AEWA activities and obligations.

The initiative for implementing measures to help waterbirds adapt to climate change is the taken by the national AEWA focal point, usually a person or ministry responsible for nature conservation or wildlife management. This person should appoint a project coordinator, who need not be a government employee, but could come from an institution, university, consultancy or NGO dealing with conservation or climate change issues, provided he or she can obtain sufficient financial and logistical government support to fulfil his or her task.

The AEWA focal point and project coordinator within each country should investigate funding options within the government and elsewhere, and identify other team members to form a project team. The team within each country should prioritise species and populations most at risk from climate change, identify sites most at risk from climate change and identify additional priority measures at a regional and national level. The team will also be responsible for assessing the feasibility of proposed measures and for drafting adaptation management plans. Where possible, these should complement, rather than contradict existing policy frameworks. These teams should maintain contact with the AEWA secretariat for coordination and with the AEWA Technical Committee for technical advice.

To aid international initiatives, there should be regular discussion between AEWA focal points and project coordinators in different countries. Together, a list of priority international measures and potential funding sources for these should be identified. Where possible these should complement, rather than contradict existing policy frameworks and conventions.

The project team should identify stakeholders relevant to the implementation of priority measures to help waterbirds adapt to climate change. These may include government policy makers, NGO workers, land owners, or grassroots stakeholders such as farmers, fishers and hunters. The project team should be responsible for liaising with stakeholders, ensuring that decisions are made in a participatory and transparent manner and ensuring that plans are carried out with care, sensitivity and open-mindedness to all points of view.

Step 2: Identify species and populations most at risk from climate change and identify priority measures

Species particularly vulnerable to climate change

The impacts of climate change on migratory waterbirds within the AEWA region were reviewed by Maclean *et al.* (2008). Based on factors considered to place a species at risk from climate change: small population size, small range size, fragmented population, specialised diet and use of a vulnerable habitat, the following species listed on Annex 2 of the Agreement were classified as being particularly at risk:

- Cape Gannet *Morus capensis*
- Crowned Cormorant *Phalacrocorax coronatus*
- Bank Cormorant *Phalacrocorax neglectus*
- Slaty Egret *Egretta vinaceigula*
- Northern Bald Ibis *Geronticus eremita*
- White-winged Flufftail *Sarothrura ayresi*
- Madagascar Pratincole *Glareola ocularis*
- Slender-billed Curlew *Numenius tenuirostris*
- Damara Tern *Sterna balaenarum*

Populations particularly vulnerable to climate change

As with species, the impacts of climate change on migratory waterbird populations (as listed on Table 1 of the Agreement) within the AEWA region were reviewed by Maclean *et al.* (2008). Based on the same factors considered to place a species at risk from climate change, the following populations were classified as being particularly at risk:

- White Stork *Ciconia ciconia* - Southern Africa population
- Northern Bald Ibis *Geronticus eremita* - South-west Asia & South Asia (win) population
- Northern Bald Ibis *Geronticus eremita* – Morocco population
- Sacred Ibis *Threskiornis aethiopicus aethiopicus* - Iraq & Iran population
- Cape Teal *Anas capensis* - Lake Chad basin population
- White-headed Duck *Oxyura leucocephala* - Algeria & Tunisia population
- Siberian Crane *Grus leucogeranus* - Iran (win) population
- Common Crane *Grus grus* - Turkey & Georgia (bre) population
- Demoiselle Crane *Grus virgo* - Turkey (bre) population
- Demoiselle Crane *Grus virgo* - Black Sea (Ukraine) / North-east Africa population
- White-winged Flufftail *Sarothrura ayresi* - Ethiopia & Southern Africa population
- Chestnut-banded Plover *Charadrius pallidus venustus* - Eastern Africa population
- Slender-billed Curlew *Numenius tenuirostris* - Central Siberia / Mediterranean & SW Asia population

Suggested adaptation measures for species particularly vulnerable to climate change

A list of possible adaptation measures together with some background information on the ecology and risk to climate change for each species is given in Box 1.

Box 1

Species	Ecology and risks from climate change	Possible adaptation
Cape Gannet *Morus capensis*	Primarily confined to Africa, breeding on just six offshore Islands in South Africa and Namibia. Very specialised diet, comprising mainly of pilchards, maasbankers and anchovies. Threatened by climate change because of specialised diet, small number of locations at which it occurs and preferred foraging habitat. Limited opportunity to move poleward in response to warming due to lack of land, posing a major problem for this species if its food cannot survive warmer temperatures.	Identification of potential new nesting sites in southern Ocean. Provision of artificial nesting platforms. Supplementary feeding. Reduction of other threats such as commercial fishing.
Crowned Cormorant *Phalacrocorax coronatus*	Restricted to the west coast of southern Africa, breeding at 48 localities. Diet generally slow-moving benthic fish, particularly clinids, pipefish and sole. Threatened by climate change because of limited opportunity to move poleward in response to warming if its food species cannot survive warmer temperatures.	Identification of potential new nesting sites in southern Ocean. Provision of artificial nesting platforms. Supplementary feeding. Reduction of other threats such as commercial fishing.
Bank Cormorant *Phalacrocorax neglectus*	Endemic to southern Africa, breeding at 45 localities. High site-fidelity. Specialised diet comprising mainly fish, crustaceans and cephalopods especially Pelagic Goby and Cape Rock Lobster. Depends heavily on kelp beds. Threatened by climate change because of limited opportunity to move poleward in response to warming if its food species or kelp beds cannot survive warmer temperatures.	Identification of potential new nesting sites in southern Ocean. Provision of artificial nesting platforms. Supplementary feeding. Reduction of other threats such as commercial fishing.
Slaty Egret *Egretta vinaceigula*	Endemic to southern Africa: restricted and fragmented distribution in marshes and seasonal wetlands. Diet comprises mainly small fish. Also dragonflies and snails. Threatened by climate change because of small population size, limited range and vulnerability of its preferred habitat (shallow flood plains and seasonal wetlands), which make it particularly vulnerable to the drier temperatures predicted for southern Africa.	Management of water-level and key sites through e.g. small-scale temporary dams and restrictions on water abstraction. Reduction of other threats such as fishing.
Northern Bald Ibis	Currently thought to be confined to Souss-Massa National Park in Morocco, a heavily managed colony in Turkey and a recently discovered colony in Syria,	Maintain current intensive management of breeding colonies,

Species	Ecology and risks from climate change	Possible adaptation
Geronticus eremita	which migrates to Ethiopia. Historically preferred breeding habitat was cliff ledges, caves and coastal boulders on steep slopes. Food and feeding habitat is varied. Threatened by climate change due to very small population size and range. Reliant on coastal fog in Morocco.	including the prevention of nest predation to buffer against effects of climate change.
White-winged Flufftail *Sarothrura ayresi*	One population in Ethiopian highlands (in the breeding season only) and the other in South Africa (observed in the non-breeding season only) – bird may migrate between these two locations. Breeding and feeding habits very poorly known. Primarily threatened by climate change due to small range and population size and because preferred habitat may be vulnerable to rainfall change.	Protection and appropriate management of key breeding sites, particularly management of water-levels by small-scale temporary dams and control of water-abstraction. Reduction of other threats such as agricultural intensification.
Madagascar Pratincole *Glareola ocularis*	Breeds in Madagascar in a variety of habitats (rocky river islets, saltmarsh, rocky shores and short grassland) and migrates predominantly to East Africa during austral winter, often congregating at a small number of key sites. River mouths and lakes are important wintering sites. Preferred food is insects, mainly hymenopterans, neuropterans and beetles. Threatened by climate change due to small population, restricted range and by sea-level rise and rainfall variability at wintering grounds	Appropriate management of water-levels at key inland sites, by restrictions on water abstraction and small-scale temporary dams. Provision of artificial roosting islands at river mouths. Restrictions on flood-defence works at key sites, which may result in coastal-squeeze.
Slender-billed Curlew *Numenius tenuirostris*	This species is probably extinct, although there are unsubstantiated reports of this species being seen in Bulgaria and Ukraine. Breeding known only from one location on northern forest-steppe / taiga margin. Wintered on coastal lagoons in Morocco. If not extinct, then threatened by climate change due to extremely small population size and susceptibility of wintering lagoons to rainfall and sea-level changes.	Adaptation measures not relevant until true status of this species has been established.
Damara Tern *Sterna balaenarum*	Breeding confined to coastal Namibia and South Africa, with north-westward dispersion as far as Côte d'Ivoire during non-breeding season. Favours inshore bays, estuaries, creeks, harbours, lagoons and salt-pans Feeding habitats poorly known, but thought to feed on small fish, squid and crustaceans. Threatened by climate change due to specialised diet and limited opportunity for poleward movement in response to warming. High site-fidelity and favoured breeding locations make this species vulnerable to sea-level rise.	Identification of potential new nesting sites in southern Ocean. Provision of artificial nest-sites in areas threatened by sea-level rise. Supplementary feeding. Reduction of other threats such as commercial fishing.

When drawing up the final list of proposed adaptation measures for particularly vulnerable species, the project team should investigate the feasibility of the possible adaptation measures by consulting with the stakeholders identified in Step 1. The project team should also be responsible for devising additional or alternative adaptation measures in consultation with these stakeholders.

Suggested adaptation measures for populations particularly vulnerable to climate change

A list of possible adaptation measures together with a bit of background information on the ecology and risk to climate change for each population is given in Box 2.

Box 2

Population	Ecology and risk from climate change	Possible adaptation measures
White Stork *Ciconia ciconia* - Southern Africa population	This population is confined to the Cape Province of South Africa, especially on agricultural land of the Ruens, where it breeds sporadically and occurs alongside other White Stork populations during the non-breeding season. Diet is varied and includes mice, small reptiles, amphibia, fish and large insects. Climate change-associated threats are due to lower rainfall affecting food availability, water abstraction and by climate-induced agricultural changes.	Appropriate management of water-levels at key inland sites by restrictions on water abstraction and small-scale temporary dams. Maintenance of appropriate agricultural practices and limitations on intensification.
Northern Bald Ibis *Geronticus eremita* - South-west Asia & South Asia (winter) population	See species ecology and risk from climate change.	See species adaptation measures.
Northern Bald Ibis *Geronticus eremita* – Morocco population	See species ecology and risk from climate change.	See species adaptation measures.
Sacred Ibis *Threskiornis aethiopicus aethiopicus* - Iraq & Iran population	This population is confined to the wetlands of southern Iraq and Iran just north of the Persian Gulf. It has a varied diet, which includes small mammals and reptiles, amphibia, fish, large insects and bird eggs. Climate change associated threats are due to lower rainfall affecting food availability, water abstraction and by climate-induced agricultural changes.	Appropriate management of water-levels at key inland sites by restrictions on water abstraction and small-scale temporary dams. Maintenance of appropriate agricultural practices and limitations on intensification. Reduction of other threats notably wetland drainage.

Population	Ecology and risk from climate change	Possible adaptation measures
Cape Teal *Anas capensis* - Lake Chad basin population	This population is mainly confined to Lake Chad, but it may also occur in North-east Nigeria. Elsewhere, this species' diet comprises mainly insects with small numbers of other invertebrates, tadpoles and plant material. Very little is known about this population, but much can be inferred by the status of Lake Chad itself, which has fluctuated considerably as a result of cyclical drought and flooding. It is now considerably smaller than previously despite high rainfall as increased water abstraction and over-grazing has resulted in desertification. This teal population is highly threatened by climate change because of the vulnerability of Lake Chad to drier conditions.	Appropriate management of water-levels at key pools within the Lake Chad by restrictions on water abstraction and small-scale temporary dams. Maintenance of appropriate agricultural practices and limitations on livestock levels.
White-headed Duck *Oxyura leucocephala* - Algeria & Tunisia population	This population is resident at a few sites in Tunisia and Algeria, notably at Lake Tonga and Lake Tunis. The diet of other populations of this species comprises mainly plant matter, but also fish, frogs, worms, molluscs and crustaceans. This population is likely to be severely threatened by future drier conditions in the Mediterranean basin, as indicated by the species' vulnerability to drought elsewhere.	Appropriate management of water-levels at key inland sites by restrictions on water abstraction and small-scale temporary dams. Reduction of other threats, notably wetland drainage, eutrophication and inter-breeding with Ruddy Ducks (*Oxyura jamaicensis*).
Siberian Crane *Grus leucogeranus* - Iran (winter) population	This population breeds in the Tyumen District of Russia and winters in Fereidoon Kenar and Esbaran in Iran. Their favoured nesting habitats are bogs, marshes, and other wetland types of the taiga/tundra transition zone, preferring wide expanses of shallow fresh water with good visibility, a characteristic also required in winter. On the breeding grounds they eat cranberries, rodents, fish and insects, but on migration and on the wintering grounds, they excavate roots and tubers. Primarily threatened by climate change due to small range and population size, but also threatened by warming of breeding habitats and by changes in rainfall on wintering grounds.	Appropriate management of water-levels at key wintering sites by restrictions on water abstraction and small-scale temporary dams. Removal of trees at favoured breeding locations.

Population	Ecology and risk from climate change	Possible adaptation measures
Common Crane *Grus grus* – Turkey & Georgia (breeding) population	This population breeds at one site in Georgia and on the Central Plateau of Eastern Turkey. The wintering grounds are not known with certainty. The population favours seasonally flooded or marshy plains and wetlands. Other populations of this species feed on a variety of plant material and some animal prey. Climate change is a threat to this population because of its size and range. The habitat with which it associates is likely to be vulnerable to changes in rainfall.	Appropriate management of water-levels at key breeding sites by restrictions on water abstraction and small-scale temporary dams. Reduction in high-intensity agriculture in favoured feeding locations. Reduction of other threats such as wetland drainage.
Demoiselle Crane *Grus virgo* - Turkey (breeding) population	This population breeds in Eastern Anatolia in Turkey, but its wintering grounds are not known with certainty. Little is known about the precise habitat and food requirements of this population. Elsewhere this species requires ready access to drinking water and frequents a wide range of habitats from shrubby steppe to coarse grassland interspersed with salt flats. It feeds on a variety of plant material and some animal prey. Threatened by climate change because of its small population and because its habitat is sensitive to changes in rainfall regimes directly, and indirectly because of changes in agriculture.	Appropriate management of water-levels at key breeding sites by restrictions on water abstraction and small-scale temporary dams. Reduction in high-intensity agriculture in favoured feeding locations. Reduction of other threats such as wetland drainage and disturbance.
Demoiselle Crane *Grus virgo* - Black Sea (Ukraine) / North-east Africa population	This population breeds in the Black Sea & Ukraine area and formally wintered in sub-Saharan Africa from Lake Chad to Ethiopia, but now mainly at Gezira in Sudan. This population frequents a fairly broad range of habitats from shrubby steppe to grassland and cultivations, especially for feeding, although nesting is usually in undisturbed habitat. Threatened by climate change because of small population and because its habitat is sensitive to changes in rainfall regimes directly, and indirectly because of changes in agriculture.	Appropriate management of water-levels at key breeding and wintering sites by restrictions on water abstraction and small-scale temporary dams. Reduction in high-intensity agriculture in favoured feeding locations. Reduction of other threats such as wetland drainage and disturbance.
White-winged Flufftail *Sarothrura ayresi* - Ethiopia & Southern Africa population	See species ecology and risk from climate change.	See species adaptation measures.

Population	Ecology and risk from climate change	Possible adaptation measures
White-winged Flufftail *Sarothrura ayresi* - Ethiopia & Southern Africa population	See species ecology and risk from climate change.	See species adaptation measures.
Chestnut-banded Plover *Charadrius pallidus venustus* - Eastern Africa population	This population is confined to a handful of sites in East Africa and is concentrated at just three sites: Lake Natron, Lake Manyara and Lake Magadi. The population is predominantly resident, but undergoes local movements in response to drying-up of breeding habitat. The species tends to feed along the waters edge on a variety of insect and crustacean species. All three of its most favoured lakes are similar in that they are highly-alkaline and saline and fluctuate greatly in water-level in response to rainfall. Consequently changing rainfall potentially causes a major threat to this species.	Appropriate management of water-levels by management of the wider catchement area of each of the three key sites. Reduction of other threats such as the construction of the soda ash plant and hydro-electric dam at Lake Natron.
Slender-billed Curlew *Numenius tenuirostris* - Central Siberia / Mediterranean & SW Asia population	See species ecology and risk from climate change.	See species adaptation measures.

When drawing up the final list of proposed adaptation measures for particularly vulnerable populations, the project team should investigate the feasibility of the possible adaptation measures by consulting with the stakeholders identified in Step 1. The project team should also be responsible for devising additional or alternative adaptation measures in consultation with these stakeholders. The final document containing the proposed adaptation measures should be circulated to the AEWA Technical Committee for additional input.

Step 3: Prepare priority list of key sites most at risk from climate change and identify priority adaptation measures

The project team in each country should be responsible for identifying key sites at risk from climate change and identifying measures to help waterbirds adapt to climate change at these sites.

Identifying key sites at risk from climate change

In selecting sites, the following guidelines should be used:

(1) the site should be important for waterbirds. The identification of such sites should rely primarily on the Ramsar Sites List (http://www.ramsar.org/key_sitelist.htm). Additional information from BirdLife International's inventory of Important Bird Areas (http://www.birdlife.org/datazone/sites/) and Natura 2000 sites inventory (http://ec.europa.eu/environment/nature/natura2000/sites_birds/index_en.htm) should be consulted if necessary.

and

(2) the site should be threatened by climate change because of any of the following:

(a) it is an important breeding, stop-over or wintering site for any of the species and populations identified as being particularly threatened by climate change (as listed in Step 2);
(b) it is located at the poleward edge of any land mass and is an important breeding, stop-over or wintering site for species or populations of waterbird listed on Annex 2 and Table 1 of the Agreement with a restricted range at the poleward edge of that land-masses;
(c) it is located at high altitude relative to the surrounding area and is an important breeding, stop-over or wintering site for species or populations of waterbird listed on Annex 2 and Table 1 of the Agreement with a restricted range confined primarily to that mountain range;
(d) it is very vulnerable to sea-level rise and inundation by the sea would have a direct or indirect detrimental effect on waterbirds associated with the site;
(e) it is very vulnerable to changes in water-level and such changes are expected as a result of changes in rainfall and evaporation and would have a detrimental direct or indirect effect on waterbirds associated with the site; and
(f) it is very vulnerable to changes in human land-use and such changes are expected because of climate change and would have a detrimental direct or indirect effect on waterbirds associated with the site.

Identifying measures to help waterbirds adapt to climate change at these sites

In general, the project team should consult widely with the stakeholders identified during step 1, prior to drawing-up the definitive list of adaptation measures for particular sites and each measure should be tailored to each specific site. However, to provide guidance for this definitive list, and to ensure project teams in different countries adopt broadly similar approaches, the following is provided as guidance:

(1) Where a site is located at the poleward edge of a land mass, it is important to consider the relative merits of on-site adaptation measures versus the merits of taking a broader-scale approach whereby other sites located in better future climate space are developed as conservation sites instead. In most instances there is limited scope for developing other sites where waterbirds are confined to the poleward edge of landmasses, however scope

for management within the existing site is often also limited. In some instances there may be potential to influence micro-climate by altering vegetation structure. In most instances, best-practise would be to reduce non-climate related threats to the site and implement initiatives which improve the quality of the site generally, as this will buffer species populations against the effects of climate change. Relevant stakeholders should be consulted to determine the feasibility of proposed adaptation actions.

(2) Where a site is located at high altitude relative to the surrounding area, again it is important to consider the relative merits of on-site adaptation measures versus the merits of taking a broader-scale approach whereby other sites located in better future climate space are developed as conservation sites instead. In most instances there is limited scope for developing other sites where waterbirds are confined to high altitude relative to the surrounding area, however scope for site-management is also limited. Again, in some instances there may be potential to influence micro-climate by altering vegetation structure. Again, in most instances, best-practice would be to reduce non-climate related threats to the site and implement initiatives which improve the quality of the site generally, as this will buffer species populations against the effects of climate change. Translocation of individuals should also be considered where areas with suitable climate are a considerable distance from current remnant populations. Relevant stakeholders should be consulted to determine the feasibility of proposed adaptation actions.

(3) Where a site is particularly vulnerable to sea-level rise, measures to maintain inundation at appropriate levels should be considered. In some instances it may be appropriate to prevent inundation by constructing sea-defences. However, in so doing, care should be taken to avoid freshwater or brackish areas becoming hyper-saline during periods of high evaporation. In some instances, controlled inundation may be necessary. Where practical, managed re-alignment should also be considered. Translocation individuals should also be considered where areas with suitable future climate change are a considerable distance from current remnant populations. Relevant stakeholders should be consulted to determine the feasibility of proposed adaptation actions.

(4) Where a site is particularly vulnerable to changes in water-level, it may be appropriate to manipulate water-levels by small-scale temporary damming to maintain high water-levels or improved drainage to reduce water-levels. Management of the wider catchment area should also be considered, particularly where increased water-abstraction is likely during periods of lower rainfall. When drawing-up lists of proposed actions at such sites, it is important to engage with relevant stakeholders to discuss the practicalities of proposed measures. Translocation individuals should also be considered where areas with suitable future climate change are a considerable distance from current remnant populations. Relevant stakeholders should be consulted to determine the feasibility of proposed adaptation actions.

(5) Where a site is particularly vulnerable to climate change-induced changes in human land-use, the nature and extent of these changes needs to be considered prior to drawing-up adaptation measures. Translocation individuals should also be considered where areas with suitable future climate change are a considerable distance from current remnant populations. Relevant stakeholders should be engaged to determine the nature and extent of changes and should be consulted to determine the feasibility of proposed adaptation actions.

Preparation of document detailing adaptation measures

When drawing up the final list of proposed adaptation measures, the project team should re-circulate the proposed adaptation measures to the stakeholders identified in Stage 1 for final comment. The final document containing the proposed adaptation measures should be circulated to the AEWA Technical Committee for additional input.

Step 4: Prepare priority list of key regional, national and international measures for helping waterbirds adapt to climate change

Although adaptation measures for species and areas particularly vulnerable to climate change provide one means of helping waterbirds adapt to climate change, there is also a need to prioritise broad-scale adaptation measures that operate and should be implemented at the regional, national or international level. These include identification of suitable protected area networks, management of the wider countryside and reduction of other threats to waterbirds, which will allow their populations to be buffered against the effects of climate change.

Identification of protected area networks

If species approaching their climatic limits cannot adapt to the new climate and cannot be maintained in their present locations by management, they will only survive if they move into new areas where the climate is suitable. Thus, to facilitate species dispersal and the dispersal of resources on which they depend, a suitable network of protected areas is needed.

By and large, such a network already exists as numerous wetlands within the AEWA region have been designated as Wetlands of International Importance under the Ramsar Convention. However, the current network to some extent reflects the amount of resources available in each country available for such action, and particularly in some of the poorer countries in Africa fewer sites have been designated. The network of Ramsar sites in north-east Africa just south of the Sahara is particularly sparse. In this region, there are sites, such as the Gezira wetland system, which are very important for species populations that are particularly vulnerable to climate change. The region itself is especially important as it represents the area that species using the West Asian – East Africa Flyway reach just after making their arduous journey across arid regions.

We recommend therefore that the project team:

(a) identify a full list of sites in need of protection that host internationally important numbers of waterbirds, are particularly vulnerable to climate change, but are not currently designated as Wetlands of International Importance. The BirdLife International inventory of Important Bird Areas (http://www.birdlife.org/datazone/sites) could provide guidance for this task.
(b) Prioritise those that are most in need of protection based on (i) their importance to waterbirds, (ii) their vulnerability to climate change and (iii) the degree of threat facing these sites.
(c) Identify measures for achieving their protection by consulting stakeholders including:
    a. relevant government departments (responsible for environment, water resources, fisheries, agriculture, infrastructure *etc*.) and statutory agencies;
    b. the national coordinator of the International Waterbird Census;
    c. universities;
    d. BirdLife International Partners and representatives of other relevant NGOs;
    e. specialist institutes and hunters' organizations; and
    f. other stakeholders such as landowners, farming and fisheries representatives.

Management of the wider countryside

Although networks of protected areas provide one means of aiding species dispersal and ensuring adequate availability of habitat in areas likely to be colonized by waterbird species in the near future, a necessary complementary means of aiding species dispersal is to ensure a 'permeable landscape', especially for species that have dispersed distributions and do not normally gather in large congregations. This can only be achieved by favourable management of the wider countryside. It is beyond the remit of the project team to ensure such favourable management of the wider countryside

throughout the entire AEWA region, but there are means with which this may be improved within existing legislative frameworks. The project team within each country should thus:

(a) identify legislation and policy, including agri-environment schemes, within each country, relevant to management of the wider countryside that could be modified slightly to, or could without modification, help waterbirds adapt to climate change;
(b) identify the steps that need to be taken to ensure that helping waterbirds to adapt to climate change is given greater emphasis within these policy frameworks;
(c) consult with relevant stakeholders such as government departments responsible for environment, water resources, fisheries, agriculture, infrastructure *etc*. to assess the feasibility of enshrining waterbird adaptation measures within this policy; and
(d) draw up a guidance document documenting the priority measures and stating how these could be achieved.

There may in some instances be the opportunity to work with e.g. land-owners, local communities and other relevant stakeholders to devise means of managing the wider countryside to help waterbirds adapt to climate change. The project team should thus:

(e) identify additional measures that do not rely on existing legislative frameworks, but instead rely on engagement with relevant stakeholders such as land-owners and local communities;
(f) consult with these relevant stakeholders to assess the feasibility of such measures;
(g) prioritise the measures; and
(h) include the priority measures in the guidance document indicated in (d) above.

Minimising other impacts

In many instances the scope for introducing measures to help waterbirds adapt to climate change directly is limited and the only option available is to reduce other pressures on waterbird populations. Again, it is beyond the remit of the project team to ensure all threats to waterbirds are reduced, but again there are means by which this may be improved within existing legislative frameworks. The project team within each country should thus:

identify legislation and policy within each country, relevant to buffering populations against the impacts of climate change that could be modified slightly to, or could without modification, help waterbirds adapt to climate change;
(a) identify the steps that need to be taken to ensure that buffering waterbirds against the impacts of climate change is given greater emphasis within these policy frameworks;
(b) consult with relevant stakeholders such as government departments responsible for environment, water resources, fisheries, agriculture, infrastructure *etc*. to assess the feasibility of enshrining such measures within these policy frameworks;
(c) prioritise the measures; and
(d) draw up a guidance document documenting the priority measures and stating how these could be achieved.

Preparation of document detailing adaptation measures

When drawing up the final list of proposed adaptation measures, the project team should re-circulate the proposed adaptation measures to the stakeholders identified in Stage 1 for final comment. The final document containing the proposed adaptation measures should be circulated to the AEWA Technical Committee for additional input.

Step 5: Implement climate change adaptation management measures

In the implementation of measures to help waterbirds adapt to climate change, it will be necessary to secure sufficient funding and to ensure, where possible, that the majority of stakeholders with a vested interested in the proposed management measures are willing to allow the measures to proceed. We suggest therefore, that prior to implementing any management measures, the project term should:

- identify sources of funding for each initiative;
- consult the AEWA Secretariat or Standing Committee as to the likely success of each funding initiative;
- consult the AEWA Secretariat or Standing Committee to identify any other sources of potential funding;
- draft proposals to secure funding;
- if funding is successful for a particular initiative, appoint a project team for each measure to ensure it is carried out; and
- if funding is successful for a particular initiative, conduct a series of workshops in which relevant stakeholders are invited to participate, so that the best plan of action can proceed.

Useful references and websites

Climate change

Austin, G.E. & Rehfisch, M.M. 2005. Shifting nonbreeding distributions of migratory fauna in relation to climate change. Global Change Biology, 11, 31-38.

Maclean, I.M.D., Austin, G.E., Rehfisch, M.M., Blew, J., Crowe, O., Delany, S., Devos, K., Deceuninck, B., Günther, K., Laursen, K., van Roomen, M. & Wahl, J. (in press) Global warming causes rapid changes in the distribution and abundance of birds in winter. Global Change Biology.

Maclean, I.M.D., Rehfisch, M.M., Delany, S. & Robinson, R.A. 2008. The Effects of Climate Change on Migratory Waterbirds within the African-Eurasian Flyway. BTO Research Report No. 486, BTO, Thetford.

Robinson, R.A., Crick, H.Q.P., Learmonth, J.A., Maclean, I.M.D., Thomas, C.D., Bairlein, F., Forchhammer, M.C., Francis, C.M., Gill, J.A., Godley, B.J., Harwood, J., Hays, G.C., Huntley, B., Hutson, A.M., Pierce, G.J., Rehfisch, M.M., Sims, D.W., Santos, M.B., Sparks, T.H., Stroud, D.A. & Visser, M.E. (in press) Travelling through a warming world: climate change and migratory species. Endangered Species Research.

Parmesan, C & Yohe, G. 2003. A globally coherent fingerprint of climate impacts across natural ecosystems. Nature, 421, 37-42.

Robinson, R.A., Learmonth, J.A., Hutson, A.M., Macleod, C.D., Sparks, T.H., Leech, D.I., Pierce, G.J., Rehfisch, M.M. & Crick, H.Q.P. 2005. Climate Change and Migratory Species. British Trust for Ornithology Research Report 414, Thetford, UK.

Wetlands and Waterbirds

Evans, MF. 1994. Important Bird Areas in the Middle East: Priority Sites for Conservation. BirdLife Conservation Series, BirdLife International, Cambridge, UK.

Fishpool, L.D.C. & Evans, M.I. 2001. Important Bird Areas in Africa and Associated Islands: priority Sites for Conservation. BirdLife Conservation Series, BirdLife International, Cambridge, UK.

Heath, M.F., Evans, M.I., Hoccom, D.G., Payne, A.J. & Peet, N.B. 2000 Important Bird Areas in Europe: Priority Sites for Conservation. BirdLife Conservation Series, BirdLife International, Cambridge, UK.

Maclean, I.M.D. & Austin, G.E. 2008. Wetland Bird Survey Alerts 2004/2005 (Release 2): Changes in numbers of wintering waterbirds in the Constituent Countries of the United Kingdom, Special Protection Areas (SPAs) and Sites of Special Scientific Interest (SSSIs). BTO Research Report No. 492, BTO, Thetford.

Websites

BirdLife International's inventory of Important Bird Areas:
http://www.birdlife.org/datazone/sites/

Defra report on climate change and migratory species:
http://www.defra.gov.uk/wildlife-countryside/resprog/findings/climatechange-migratory/

Natura 2000 sites inventory:
http://ec.europa.eu/environment/nature/natura2000/sites_birds/index_en.htm

Ramsar site list:
http://www.ramsar.org/key_sitelist.htm

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