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CLIMATE CHANGE AND MIGRATORY SPECIES

(Prepared by the CMS Secretariat)

I. Climate change: a serious challenge for migratory species

1. The process of animal migration is intricately tied to climatic conditions. Climatic factors often drive nomadic behaviour directly, but also indirectly through interactions with food availability and breeding opportunity. The direction and timing of the mass migration of wildebeest in the Serengeti, for example, is directly related to rainfall and the resultant growth of vegetation. Many songbirds take advantage of the mild spring and summer to nest and feed on insects in Europe, but as it gets colder in winter they migrate to southern climes such as the African Sahara.

2. There is considerable evidence to suggest that because of this strong dependence on climatic conditions many populations of migratory species will be severely affected by climate change. Already it is evident from range shifts and other changes in species ecology that a considerable number of wild animals are responding to climate change[1]. Migratory species are opportunists and have over thousands of years adapted to arriving at the "right place" at the "right time" to maximise the use of seasonally available resources. Due to climate change these places and timings have often shifted, and already entire habitats are changing in their species composition. Ecological and socio-economic changes linked to climate change are numerous and highly complex – the critical question remains whether migratory species can adapt at sufficient speed and which factors influence this process.

3. Migratory species are highly mobile and have adapted to considerable climatic variation in the past, such as the saiga antelope (*Saiga tatarica*), which successfully adapted to past ice ages and still roams the Eurasian steppes today. However, projected climatic changes are more substantial and at least one order of magnitude faster than those of the last 10 million or more years. During the last century alone climate-induced changes have taken place faster than many migratory species could optimally adapt to.

4. The fact that the timing of animal presence and food availability, for example, is less well correlated than it used to be and would be optimal, as has been observed for several Trans-Saharan migrant birds, provides some indication of how only small changes can have considerable knock-on effects. The collective evidence of the impact of climate change on

[1] This briefing paper does not aim to review or summarise the interaction between biodiversity and climate change, this has been done elsewhere (e.g. Lovejoy & Hannah 2005); policy implications are being discussed through various biodiversity and climate change expert groups (e.g. CBD, Bern Convention).

migratory birds is particularly overwhelming to date, including examples such as wading birds in the UK whose wintering sites have consistently moved in a northerly and north-easterly direction. Furthermore, migrant birds have increasingly been observed to arrive late. Such late arrival is likely to have negative effects on animal condition, breeding success and survival rate.

5. Good data is also available to show that entire ranges of migratory birds and insects have shifted in response to climatic factors; interestingly not only in a northerly direction. Another source of evidence has originated from studies of species composition of individual habitats. Such studies indicate together with numerous anecdotal sightings that the ranges of many CMS appendix species such as marine turtles or Mongolian gazelle are now expanding in poleward or other directions into new countries outside of the historical range. Predictive modelling for species such as the Great Bustard (*Otis tarda*) listed on CMS Appendix I confirms such shifts in biota, as well as significant changes in species abundance. While some species are already adapting autonomously to climatic changes, it is predicted that the adaptive capacity[2] of many migratory species will be exceeded in the 21st Century.

6. Marine migratory species are also increasingly affected by climate change. Narwhals (*Monodon monoceros*), listed on CMS Appendix II, are vulnerable to ice entrapments, which are linked to climatic conditions. Anecdotal evidence suggests that due to Arctic warming the frequency of ice entrapments has increased, which is threatening narwhal populations on a global scale.

7. It is noteworthy that migratory species can be at a considerable advantage in adapting to climate change compared to species with a limited dispersal range due to the fact that they are highly mobile, and under the CMS definition cross at least one national border on their annual journeys. Sometimes the opportunistic behaviour of migratory species makes them inherently vulnerable, not least to anthropogenic factors. Numerous factors such as habitat degradation, fragmentation, barriers to migration and overexploitation have already lead to small population sizes and biases in other life history parameters such as sex ratios in many migratory populations. As a result such populations of migratory species have a much reduced adaptive capacity and can be extremely vulnerable, not least to climate change.

8. Furthermore, policy strategies need to address the fact that species may not be threatened by climate change in the short-term, but very much so in the long-term, or *vice versa*. For example, migratory species such as CMS Appendix I Black-necked cranes (*Grus nigricollis*) may even benefit from the positive effects of milder winters at their high-altitude breeding grounds in Central Asia, but in the long-term if glaciers melt away, the consequences for the species could be detrimental.

9. This paper aims to highlight in conjunction with another study (Inf.Doc. 9.22) that species-specific conservation approaches are required to address the individualistic responses of migratory species to climate change. Functional networks of habitats are required encompassing full regional variation to allow migratory species to adapt as well as possible. International policy action is urgently required to address the challenges and opportunities that climate change poses for the conservation of migratory species. Such action is not to be delayed by the uncertainty involved in assessing the impact of climate change on biodiversity, but must be carried out by a strong international network based on sound science.

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[2] Adaptive capacity is the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences (Appendix I IPCC, 2007).

II Context

10. The International Panel on Climate Change (IPCC) suggests that warming of the climate is unequivocal, on the basis of a rise in air and ocean temperatures, widespread melting of snow and icecaps, rising average global sea level and changing patterns of extreme climatic events (IPCC 2007). Global average temperatures have risen by 0.79°C from 1906-2005 (IPCC 2007). For the coming two decades a temperature increase of 0.2°C is predicted for a range of scenarios (IPCC Special Report on Emissions Scenarios 2000).

11. It has been estimated that even if greenhouse gas emissions would remain constant at 2005 levels, a threshold has been reached whereby a rise in global temperature of 2.4°C and the associated loss of biodiversity, deglaciation and other adverse consequences to nature are unavoidable (Ramanathan & Feng 2008). The rise of temperature is likely to be higher than average on land, particularly in already continental climatic regions, and at high altitudes in the northern hemisphere.

12. A further negative effect of the observed rise in CO_2 concentration in the atmosphere is the change in ocean chemistry, including the acidification of seawater. Since pre-industrial times until the 1990s, ocean acidity has increased by approximately 30% (corresponding to a 0.1 decrease along the pH scale; Doney 2006) and is already affecting the physiology of krill, which many migratory cetaceans are critically dependent upon for food. Changing acidification of oceans poses a risk to the maintenance of coral reefs, which provide vital habitat for migratory species such as marine turtles.

13. New data is increasingly becoming available that is of direct relevance to CMS. IUCN recently assessed the susceptibility to climate change of entire groups of species including all bird species (Foden et al. 2008). Together with BirdLife, using an analysis of biological traits, the report found that 35% of the 9,856 bird species assessed are considered as susceptible to climate change, including entire families covered by CMS and its instrument such as the Agreement on the Conservation of Albatrosses and Petrels (ACAP). A similar work will be replicated for mammals under IUCN; an analysis restricted to migratory species could be undertaken and inform CMS decisions.

III CMS climate change achievements and indicator research

14. During the last triennium CMS has actively raised awareness of the additional threat that migratory species face through global warming and other climatic changes. Resolution 8.13 from 2005 provides the mandate for this work. Several publications on climate change and migratory species have been produced since 2005, such as the popular brochure on "Climate Change and Migratory Species – Impacts of a Changing Environment on Wild Animals" which was published in 2006. The foundation was provided by a technical report on "Climate Change and Migratory Species", produced by the British Trust for Ornithology (BTO) and commissioned by the UK Department for Environment, Food and Rural Affairs (DEFRA), which was published in August 2005.

15. In 2008 a further research report on "Indicators of the impact of Climate Change on Migratory Species" has been commissioned by DEFRA from the BTO, which will be tabled at CMS COP9 (Inf.Doc. 9.22). The report proposes 18 species listed on CMS Appendices to be used as regional indicators for groups of migratory species. Research is planned to practically test one of the proposed indicators, Trans-Saharan migratory birds, and to assess

whether this indicator would already be functioning today. Further work will also target the assumptions underlying this work, specifically whether the population dynamics of entire groups of species are sufficiently correlated in their climatic response to be used as a proxy.

16. The CMS mandate does not foresee for the UNEP/CMS Secretariat to conduct the research required for informed decision-making on migratory species policy. Hence partnerships with organisations that have relevant climate change expertise are of critical importance. A climate change specific collaboration has been initiated with organisations such as the Zoological Society of London (ZSL) in order to address the need for species-specific advice. The ZSL is working closely with the Hadley Centre for Prediction and Research of the UK Met Office, ensuring a sound scientific basis for their climate change work. As part of the ZSL-CMS collaboration, CMS listed species will be explicitly tagged as of 2009 in a ZSL online reference manual that compiles publications on climate change (www.bioclimate.org). This will be an extremely valuable resource for policy makers to obtain focussed and reviewed information on the effect of climate change on individual CMS species. Furthermore, this resource will highlight the existent gaps in our knowledge and permit the direction of research towards these gaps.

17. Part of CMS' activities addressing climate change take place not at the generic overall Convention level, but specifically functions through Agreements. Predictive models assessing potential future range shifts of species, for example, are important for national governments to be aware of in order to plan their environmental policy response. Increasingly such studies are being incorporated and where appropriated also commissioned to facilitate the effective evolution of Agreements. Most recently in November 2008, the Second Meeting of Signatories of the Great Bustard (*Otis tarda*) Memorandum of Understanding considerably benefited from a climate change modelling study showing how under certain global warming scenarios the spatial distribution of the Eurasian Great Bustard populations would shift considerably, mostly in a northerly direction, and would lead to significant changes in population size within current range states.

18. The Fourteenth meeting of the CMS Scientific Council identified the membership of a small working group charged to maintain an overview of the issues concerning climate change and migratory species. In future it will be important for this group to continue this work and, if resources were made available, to organise a meeting to consider the explicit research and policy response needs in order to address the threat that climate change poses for migratory species around the world.

19. In the light of recent studies it appears that global warming and other climatic changes will be unavoidable to some extent (Ramanathan & Feng 2008), hence CMS needs to urgently address the challenge of adaptation. A range of measures is urgently required in order to improve the resilience and adaptation potential of populations of migratory species. Due to its species-specific policy approach CMS is well placed to put in place adaptive and mitigating measures to address in a coordinated manner.

IV Future priorities for research and monitoring

20. It is evident that further research and monitoring action is urgently required to inform decision makers. Firstly, a full assessment of the changes in spatial and temporal population dynamics of migratory species linked to climate change is required. It is noteworthy that the envisaged difficulty in producing such an assessment should not halt action based on best available evidence.

21. Secondly, there is a need to understand the geographical variation of the climate change impact. The equator region, for example, may be particularly susceptible to climate change and the cooler waters of the worlds' oceans are most strongly affected by ocean acidification for chemical reasons. Such global perspectives are required in addition to the population-specific species data to coordinate international migratory species policy. A thorough and general assessment of factors affecting the susceptibility of animal species to climate change can be found elsewhere (e.g. Foden et al. 2008). The following list provides a non-conclusive number of factors that may affect the vulnerability of individual species and should be assessed in the context of migratory species and climate change during the forthcoming triennium.

- site-specificity to breeding and non-breeding habitats (especially to sites that will change habitat composition due to climate change)
- specialist versus generalist species (e.g. in terms of habitat or prey)
- site fidelity of migratory populations to sites that will become smaller or disappear due to climatic changes (e.g. the reduction of marine turtle nesting habitat due to changes in sea level)
- barriers to dispersal
- site restriction and limited available habitat (e.g. species on mountain tops, Arctic)
- long-distance migrants
- small populations with a lower adaptive capacity
- slow life history species with a lower adaptive capacity
- exploited and overharvested species (e.g. due to climate change and resultant resource limitations local people may depend on migratory populations more strongly for food or income)
- sex-determination process (e.g. marine turtle sex-determination is temperature dependent)
- habitat-specific dependency of a species or population on a habitat type that is likely to become rare or modified due to climate change (e.g. coral reefs, sea grass pastures, Karoo in Southern Africa)
- sensitivity of population dynamics on environmental triggers (e.g. timing of mating, hibernation, migration)

V Conclusions

22. Looking ahead it is clear that climate change will have an increasingly large impact on the status of migratory species. Developing clear strategies to assist species adapt to these impacts will be a key contribution that the Convention could make to the global conservation of biodiversity. Exactly how the Convention makes this contribution requires further thought and discussion. The organisation of a clearly focussed workshop to review these issues should be considered.

23. Climate change is already leading to shifts in species ranges and will continue to do so. As a result the range states of an individual species are likely to change, which can include a shift, an expansion or a reduction. Furthermore, the historical range of a species is unlikely to provide an optimal suitable range for numerous species due to considerable habitat and climatic modifications. The concept of historical range may be outdated. This matter needs to be discussed with scientific experts internationally since it will have implications for the flexibility of CMS instruments but may also affect other Multilateral Environmental Agreements.

24. As range states shift CMS instruments will have to adapt. Both CMS species listings and individual CMS agreements are likely to be affected. The feasibility of flexibility of species ranges in the context of climate change needs to be urgently assessed. Already individual member states are discussing the possibility of expanding individual Memorandums of Understanding; it is important that time scales of legal adaptation are sufficient to address ecological adaptation timeframes.

25. There is considerable evidence to suggest that species responses to climate change are not only individualistic, but also vary considerably by population. CMS is optimally placed to address such species-specific responses through the existent CMS Family network. Further capacity is required to develop current ongoing climate change activities and to strengthen partnerships within this field of work.

26. Current avenues for international policy intervention through CMS instruments, as well as the necessary research required to inform future decision-making, are discussed in the recommendations provided below.

VI Recommendations for CMS ongoing work on climate change and migratory species

27. It is recommended that the following matters be considered within the context of the CMS climate change mandate:

28. The following non-conclusive list of action points recommends that Parties:

- Should despite the uncertainty surrounding the impact of climate change on migratory species not delay their action and decision-making;
- Promote research to monitor migratory populations, in order to assess the impact of climate change building on the analysis of existing datasets;
- Strengthen research to determine which groups of species and populations are likely to most susceptible to climate change impacts, with particular emphasis on CMS Appendix I species;
- Focus conservation efforts on populations of CMS Appendix I species and those which are most likely to benefit from those efforts;
- Take a global view to migratory species conservation, recognising that ranges will be affected and taking international and regional collective action;
- Foster and promote global capacity building to implement conservation action on migratory species, which are threatened by climate change;
- Facilitate an increase in climate change relevant scientific capacity and advice to the Secretariat, for example via the climate change and migratory species working group;
- Support the access of the Secretariat to peer-reviewed scientific literature;
- Support strengthened collaboration of the CMS Secretariat and the working group with other bodies that have relevant capacity and expertise on climate change as it affects migratory species, such as existent IUCN groups;
- Recognise that due to climate change, ranges of migratory species will be affected to and that CMS instruments need to become more flexible to adapt to these variations of range states;
- Assess regularly the implementation of the CMS climate change and migratory species mandate;

- Support and facilitate the organisation of a workshop of the working group and relevant bodies to further the CMS mandate;

29. Secretariat-specific recommendations:

- Provide information about the procedure and implications of amending the existent range state lists for species listed on CMS Appendices and for species-specific CMS Agreements, and to post this information on the CMS webpage;
- Strengthen collaboration with organisations that already have relevant migratory species and climate change capacity, including biodiversity related bodies and existent partner organisations;
- Request the Secretariat to incorporate climate change impact dynamics and adaptation measures into species-specific Action Plans;

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