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EXECUTIVE SUMMARY
CLIMATE CHANGE VULNERABILITY OF MIGRATORY SPECIES
SPECIES ASSESSMENTS
Preliminary Review

A Project Report for the CMS 16th Scientific Council Meeting

(Produced by Aylin McNamara, Zoological Society of London)

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Executive Summary

"The scientific evidence is now overwhelming: climate change presents very serious global risks, and it demands an urgent global response."
Stern Review, 2006

We can no longer afford to delay our response to the threat of climate change. IPCC predictions are clear and observed impacts are already affecting species and ecosystems. Indications of the scale of threat to biodiversity and urgency for a swift and effective global response are demonstrated by the imminent collapse of species interactions and even entire ecosystems. The first major ecosystems likely to collapse as a direct result of exponential increases in atmospheric CO_2 from anthropogenic activities are coral reefs, due to combined impacts of climate change and ocean acidification. If atmospheric CO_2 is not brought back down to safe levels it is unlikely to be the last, with major impacts predicted for many species both migratory and non migratory.

There is still time to avoid the worst impacts of climate change, if strong action is taken now

Biodiversity underpins a major mechanism by which we can build resilience into global systems, assisting adaptation to climate change whilst also providing vital carbon sinks and stores to aid mitigation. This is increasingly being acknowledged within the texts of the United Nations Framework Convention on Climate Change (UNFCCC) and negotiations are now laying down plans for 'Reducing Emissions from Deforestation and Forest Degradation' as well as 'Ecosystem Adaptation'. Climate change models are also becoming more sophisticated as appreciation and understanding grows of the interlinkages between ecosystem dynamics and climate dynamics, as well as the destabilising influence ecosystem degradation has on climate systems and the potential for feedback loops that escalate the impacts felt on both systems. Alongside this is an increased awareness that urgent action must be taken to address climate change impacts on biodiversity. This is being picked up at an international level with a growing number of decisions ratified within treaties, including the Convention on Biodiversity, the Ramsar Convention on Wetlands and the Convention on Migratory Species.

International cooperation is essential if actions are to be most effective

The Convention on Migratory Species (CMS) provides an unparalleled opportunity to develop strategies at the international level and foster cooperation between countries to tackle the impacts of climate change on specific species. As climatic changes become more apparent, and the rate of change potentially increases, habitats and species ranges will shift significantly, often crossing national borders in the process. The current protected area network may not match critical sites in future as it does today Development of an international framework through which countries can cooperate to protect species is an essential step under such dynamic and changing conditions and one in which CMS and its multiple agreements can play a key role.

Numerous challenges lie ahead for migratory species

Without mitigation the IPCC predicts that temperatures will be 3.4°C warmer by the end of the century. However, more recently the UK Met Office has indicated that temperatures are likely to increase by more than 5.5°C within the same time period. Mitigation efforts will be able to reduce this level of warming if action is taken immediately. However even with mid range scenarios of warming migratory species will still have to contend with some major challenges.

Some of the most immediate threats caused by increased temperatures to migratory species will be the loss of vital habitat as sea ice and tundra permafrost melts, as well as the collapse of food webs in the oceans linked to changing zooplankton abundance. Species exhibiting temperature dependent sex determination, including all reptile species listed on Appendix I, are likely to be impacted by increased feminisation of populations. Changes in precipitation will impact migratory species, for example, through a reduction of wetland habitats required for breeding and feeding and the reduction of grazing habitats for terrestrial mammals. Increased variation in rainfall will also affect the breeding success of species. Extreme weather events will become more frequent with migratory species identified as vulnerable to extremes in temperature, increases in storm frequency and intensity and extremes in precipitation causing flooding and drought. Sea level rise will have a major impact on many migratory species reducing availability of nesting sites and low lying coastal habitats. Ocean acidification will have wide ranging consequences for species, impacting on food webs, most prominently in Arctic Regions, as well as accelerating the loss of vital coral habitats. Changes in ocean circulations will change food distribution and abundance patterns, making predictable migrations difficult for many species dependent on these currents for blooms of prey or dependent on them for as a mechanism to aid migration.

In response to these changes biomes will shift, potentially lengthening the migrations necessary for species to reach optimal feeding and breeding locations. Phenological shifts will have implications of potential mis-match between species migration and optimal food abundance. Where certain biomes are unable to shift to track climatic changes, for example due to geographical barriers, migratory species will be impacted as suitable habitat is lost. Existing anthropogenic threats will further exacerbate the challenges faced by migratory species under changing climate regimes. These will act synergistically with climate change impacts, reducing their populations resilience to cope with such changes and most importantly reducing their ability to adapt.

The increased threats identified within this study to migratory species from climate change should act to clarify and highlight the urgency for immediate mitigation action to prevent such levels of increased pressures on species survival. Although climate change is inevitable to a certain degree, due to committed levels of warming from historical emissions, the more that emission levels can be reduced in the future the less severe climate change will be in terms of peak temperature and the slower the rate of change. This is a vitally important factor for species survival. If the rate of change and peak temperatures can be reduced, the more chance species have to adapt to these changes. Migratory species, which are highly mobile in nature and therefore potentially able to disperse to track changes, offer great opportunities for conservation success if adaptation can be facilitated.

Identifying and developing effective conservation measures is vital

To enable identification and development of effective conservation measures CMS urgently requires a standardised process by which species can be prioritised for further action. This study has piloted a methodology to grade migratory species on their vulnerability to climate change that allows for identification of main limiting factors for species resilience and ability to adapt to climate change. Conservation measures will be most effective if they focus efforts on main limiting factors to species survival. However, in light of the increasing urgency for CMS to review the large number of migratory species, both listed within its appendices and those currently not listed, a phased methodological approach has been recommended and details of potential steps forward outlined. This will allow CMS to take full advantage of both a low level review that can cover more species, identifying those of *concern* and *likely concern* for further attention, whilst also providing a foundation for higher levels of review that will output gradings of vulnerability for selected species. A standardised approach is required throughout every phase that will increase beneficial outputs for CMS and reduce inefficiencies.

Changing methodologies from one year to the next will limit the ability for comparative reviews to be made. A standardised phased approach will also allow for an iterative process of reviews and long term monitoring of research findings that could immediately identify species requiring elevation to a status of concern for further attention, making policy more responsive to the latest information. Currently species-level climate change information is often very limited and data deficient. However, this is an expanding field of research and even within the last 2 years the level of information has grown rapidly, highlighting the potential importance of a mechanism through which relevant information can be rapidly incorporated by CMS. Key research gaps can also be highlighted with a lower level review and communicated to the scientific community, facilitating wider engagement.

Case study assessments of CMS Appendix I species have revealed a high level of vulnerability for many species

Previous studies have suggested that migratory species are particularly sensitive to climatic disturbances and corresponding impacts. Their vulnerability stems from the large investments they make to migrate to high quality habitats, often timing their arrival to coincide with the optimum abundance of resources at their destination. With this in mind, and considering the urgent need for CMS to identify species with high vulnerability for further policy attention, species within CMS Appendix I were prioritised for review that showed indications of being the most biologically migrant species, including those with long distance or cyclic migration patterns. The results of 45 case study species are presented within this report and full assessments have been made available to further inform potential next steps. 44 Appendix I species and one example species from Appendix II, the Narwhal, have been graded against ranges of high, medium or low vulnerability. All species studied exhibited either high or medium vulnerabilities to climate change. No species studied were found to have a low vulnerability to climate change.

Each species has been evaluated on the basis of in-depth literature reviews and, where possible, expert opinion and graded against 4 main factors to identify their overall vulnerability to climate change:

1. **Vulnerability of habitat/s:** to identify whether species will be affected by climate change impacts on key dependent habitats.
2. **Ecological flexibility:** to identify the adaptation potential and resilience of species to climate change by reviewing key life history traits and characteristics. These include species degree of specialisation and ability to disperse to new suitable ranges as well as the degree to which climate change will impact on reproductive success and important environmental triggers or phenological cues.
3. **Species interactions:** to identify whether species will be affected by climate change due to impacts on predator, prey, competitor species as well as impacts on key mutualistic and symbiotic relationships.
4. **Synergistic threat processes:** to identify whether further threats, including those directly anthropogenic driven as well as diseases and invasive species, will reduce species ability to adapt and reduce their resilience to climate change impacts alongside any potential interactions between these threat processes and climate change.

Recommendations have been made for any future studies to use a phased methodological approach, as outlined in this report, to increase outputs at each stage for policy use and allow for a standardised review of remaining migratory species. Main case study results are outlined below:

REPTILES

- 7 out of the total 8 reptile species listed on CMS Appendix I have been included in case study assessments

- All species of reptiles included in this study have been identified as having a HIGH VULNERABILITY to climate change

  Green Turtle, Hawksbill Turtle, Kemp's Ridley Turtle, Gharial, Loggerhead Turtle, Olive Ridley, Leatherback Turtle

MAMMALS

- 16 species (42%) out of the total 38 species of mammals on CMS Appendix I have been included in case study assessments

- 9 species of mammals studied have been identified as having a HIGH VULNERABILITY to climate change

  North Pacific Right Whale, Northern Atlantic Right Whale, West African Manatee, Bowhead Whale, Dama Gazelle, Southern Right Whale, Addax, Blue Whale, Snow Leopard

- 7 species of mammals studied have been identified as having a MEDIUM VULNERABILITY to climate change

  Cuvier's Gazelle, Sei Whale, Short-beaked Common Dolphin, Humpback Whale, Mexican Free-tailed Bat, Sperm Whale, Marine Otter

- One mammal species assessed from Appendix II and has been identified as having a HIGH VULNERABILITY to climate change

  Narwhal

FISH

- All 4 species of fish on CMS Appendix I have been included in this study and fully assessed.

- 2 species of fish assessed have been identified as having a HIGH VULNERABILITY to climate change

  Giant Catfish, Common Sturgeon

- 2 species of fish assessed have been identified as having a MEDIUM VULNERABILITY to climate change

  Basking Shark, Great White Shark

BIRDS

- 17 species (23%) out of the total 75 species of birds on CMS Appendix I have been included in case study assessments

- 10 species of birds assessed have been identified as having a HIGH VULNERABILITY to climate change

  Balearic Shearwater, Relict Gull, Short-tailed Albatross, Sociable Plover, Steller's Eider, White-naped Crane, Red-breasted Goose, Siberian Crane, Basra Reed-warbler, Bermuda Petrel

- 7 species of birds assessed have been identified as having a MEDIUM VULNERABILITY to climate change

  Aquatic Warbler, Swan Goose, Andean Flamingo, Humboldt Penguin, Pallas Fish Eagle, Puna Flamingo, White-tailed Eagle

Within CMS Appendix I the species most vulnerable to climate change impacts have been identified as the Green Turtle and the Hawksbill Turtle.

The top twelve species most vulnerable to climate change impacts (which rank 1-4) within CMS Appendix I have been identified as the Green Turtle, Hawksbill Turtle, Balearic Shearwater, Kemp's Ridley Turtle, North Pacific Right Whale, Northern Atlantic Right Whale, Relict Gull, Loggerhead Turtle, Gharial, Bowhead Whale, West African Manatee and the Short-tailed Albatross.

It is recommended that immediate action be taken to develop climate change conservation strategies for species identified as highly vulnerable to these impacts. Suggested effective responses have been outlined within the conclusions of this report.

Important results to note:

- All marine turtle species listed within CMS Appendix I are highly vulnerable to climate change due to the combined impacts of sea level rise, increased temperatures and extreme weather events alongside synergistic impacts of current anthropogenic threats.

- All plankton and krill feeding whales are highly vulnerable to climate change due to combined impacts of ocean acidification, changes in ocean circulations and polar ice melt.

- The Narwhal has been identified as one of the most highly vulnerable species, of those included in this study, to climate change. However this species is currently only listed on CMS Appendix II.

- All species studied listed by IUCN Red List as Critically Endangered are highly vulnerable to climate change

Further detailed results are outlined in the case study analysis and concluding comments sections of this report.

Some species studied will have little hope of a future if strong and immediate action is not taken to mitigate climate change

This study has identified highly vulnerable species within CMS Appendix I that will not respond to conservation measures in the long term if action is not taken to mitigate climate change. Many of these are marine species. For these species the threat of climate change is so severe and the potential for conservation to effectively increase their resilience and ability to adapt so limited that the **only** available option for their future survival is to mitigate climate change. This is not to say that other conservation measures should be stopped for these species, but that climate change mitigation needs to be acknowledged as an essential part of their long term conservation strategy. Other conservation measure will only be effective if mitigation is also achieved. These species include:

Hawksbill Turtle, Green Turtle, Balearic Shearwater, Kemp's Ridley Turtle, Narwhal, North Pacific Right Whale, Northern Atlantic Right Whale, Relict Gull, Gharial, Loggerhead Turtle, Short-tailed Albatross, Bowhead Whale, Leatherback Turtle, Southern Right Whale, Siberian Crane and Blue Whale.

Other species have not been included in this selection if they have potentially viable conservation options available to them to reduce the impacts of climate change. However it is very likely that climate change will further stretch limited conservation resources and capacities and species will not be able to have all available conservation options applied to them effectively to ensure there survival. Therefore for these species it is also vital to take a dual approach to climate change whereby proactive adaptation measures are applied to species alongside considerable and rapid emissions abatement to limit further impacts that threaten their future.

Reduction of greenhouse gas emissions is vital if we are to avoid unmanageable levels of climate change.