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CONVENTION ON MIGRATORY SPECIES

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CLIMATE CHANGE AND MIGRATORY SPECIES

(Prepared by the COP-Appointed Councillor for Climate Change)

Summary:

This document reports on progress to implement Resolution 12.21(Rev.COP14) and Decisions 14.211–14.215. It proposes an amendment to Annex 2 *Decision Framework* of Resolution 12.21(Rev.COP14) as well as the deletion of Decisions 14.211–14.215 and the adoption of new draft Decisions.

The draft amendments to the Resolution and draft Decisions would support the achievement of Target 3.4 of the Samarkand Strategic Plan for Migratory Species 2024–2032.

CLIMATE CHANGE AND MIGRATORY SPECIES

Background

1. COP14 consolidated all previous Resolutions and Recommendations on climate change since COP5 and adopted amendments to Resolution 12.21 (Rev.COP14) *Climate Change and Migratory Species*. These included an update to the Resolution text and to its Annex 1, *Advice to Parties and other stakeholders on priority actions to address the issues migratory species face as a result of climate change,* and the adoption of a *Decision Framework to provide guidance to Parties on the implementation of paragraph 9 of Resolution 12.21(Rev.COP14)* as Annex 2 to the Resolution.

2. COP14 also adopted Decisions 14.211–14.215 *Climate Change and Migratory Species*:

14.214 Directed to the Scientific Council

The Scientific Council is requested, subject to the availability of external resources, to:

a) re-establish its Climate Change Working Group for the next triennium and develop Terms of Reference for the Working Group according to the rules of procedure of the Scientific Council;

b) identify those migratory species that, on balance, are likely to be negatively impacted by climate change, especially those that are likely to need human-mediated interventions, such as translocations, to moderate the impact of climate change;

c) identify species that have a high probability of changing their migration routes as a result of climate change and the connectivity options available to them;

d) identify further case studies of the role of migratory species in maintaining and enhancing climate change mitigation and adaptation (and other related ecosystem services) and develop resources for Parties to promote greater understanding of the provision of ecosystem services by migratory species;

e) propose measures to help facilitate migratory species' range changes;

f) provide advice on possible interventions, including nature-based solutions and/or ecosystem-based approaches, in relation to conserving migratory species habitats, including maintaining or enhancing connectivity and ecosystem integrity;

g) provide advice on how work under CMS on climate change could interact with implementation of the Kunming-Montreal Global Biodiversity Framework, including, but not limited to, area-based conservation measures, connectivity and restoration, the Paris Agreement adopted under the UNFCCC;

h) develop an interpretation of the term "barrier", so that there is consistency in the obligation to remove barriers to migratory species;

i) convene an international in-person workshop on migratory species and climate change to facilitate implementation of the actions above, and provide support to Party implementation of Resolution 12.21 (Rev.COP14); and

j) report to the Conference of the Parties at its 15th meeting on the progress in implementing this Decision.

14.215 Directed to the Secretariat and the COP-appointed Councillor for Climate Change

The Secretariat and the COP-appointed Councillor for Climate Change, subject to the availability of external resources, should:

a) engage with other MEAs, including in particular the UN Framework Convention on Climate Change, the Convention on Biological Diversity, the International Whaling Commission (IWC), Ramsar Convention, the United Nations Convention to Combat Desertification the

Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services Intergovernmental Panel on Climate Change, at relevant meetings, to provide information about the impact of climate change on migratory species, and the ways in which the conservation of migratory species can enhance nature-based solutions and/or ecosystem-based approaches so that they can be part of the solution to climate change adaptation and mitigation, leading to win-win results;

b) *promote knowledge exchange between relevant authorities about the impacts of climate change on migratory species including changes in Range State status that may occur, and the benefits of conservation of migratory species for enhancing climate change mitigation and adaptation;*

c) *propose revisions to the National Report format for consideration by the Standing Committee at its 56th and/or 57th Meeting;*

d) *support the Scientific Council in convening an international in-person workshop on migratory species and climate change; and*

e) *report to the Sessional Committee of the Scientific Council at its meetings before COP15, and to the Conference of Parties at its 15th meeting, on the progress in implementing this Decision.*

3. This document reports on actions undertaken by the Scientific Council (Decision 14.214), and the Secretariat and the COP-appointed Councillor for Climate Change (Decision 14.215), ahead of COP15. Annex 3 provides an overview on an Expert Workshop on Migratory Species and Climate Change, held in February 2025.

Implementation of Decision 14.214(i): Expert Workshop on Migratory Species and Climate Change

4. An Expert Workshop on Migratory Species and Climate Change took place between 11 and 13 February 2025 in Edinburgh, United Kingdom of Great Britain and Northern Ireland. The Government of the United Kingdom and the UK Joint Nature Conservation Committee (JNCC) provided financial and in-kind support for the meeting and to facilitate attendance by CMS Party representatives and international experts. The Expert Workshop brought together over 80 experts from across the world, representing 13 Parties to CMS and 53 academic and policy organizations, to discuss issues identified in Decision 14.214 b)-h).

5. The Expert Workshop Report highlights important new findings from research and collaborative efforts on climate change and migratory species that should be considered by CMS, and identifies priorities to be taken forward by the Convention. The summary of the findings of the Expert Workshop is contained in Annex 4; document UNEP/CMS/COP15/Inf.28.12a contains the full report.

Implementation of Decision 14.214(a): re-establishing the Climate Change Working Group

6. The Working Group on Climate Change (hereafter referred to as the Working Group) was re-established and Terms of Reference agreed at the 7th meeting of the Sessional Committee of the Scientific Council. The Working Group met twice during the intersessional period: as part of the Expert Workshop meeting in February 2025, and online in June 2025.

7. The Working Group discussed the implementation of actions related to Decision 14.214 and future priorities. A summary of the findings of the online meeting of the Working Group is contained in Annex 4.

Implementation of Decision 14.214(b): identification of migratory species negatively impacted by climate change

8. JNCC produced a review of possible approaches to addressing Decision 14.214 b), available as UNEP/CMS/COP15/Inf.28.12b. The review assesses methodologies for four different types of vulnerability assessments, makes recommendations on how to phase implementation of the Decision, and provides a set of options to inform the prioritization of species most urgently in need of conservation action.

9. The Working Group considered the review and agreed a phased approach to the implementation of the Decision would be useful: 1) identify those migratory species most likely to be impacted by climate change; and 2) identify those migratory species most in need of intervention. The Group also agreed that a matrix approach could be used to identify species, with priority given to Appendix I species, and that more detailed case studies could be developed in the next triennium.

Implementation of Decision 14.214(c): identification of migratory species that have a high probability of changing their migration routes

10. The Expert Workshop discussed measures to manage migratory routes and range changes. Comprehensive modelling and analysis are required to identify potential range shifts, and consequently limited progress was made to implement this Decision due to capacity constraints. It was agreed that the work should be prioritized for the next intersessional period and would require the procurement of technical expertise.

Implementation of Decision 14.214(d): case studies demonstrating the role of migratory species in climate change mitigation and adaptation

11. With support from JNCC, the Working Group produced a set of case studies on the role of migratory species in supporting climate change mitigation and adaptation (UNEP/CMS/COP15/Inf.28.12c). These cover a range of taxa and complement the case studies included in Part 3 of the Climate Change and Migratory Species Report. The case studies cover the following topics:

    - Marine turtle feeding behaviours
    - Monarch butterflies and other invertebrates aid in alpine meadow health
    - Eurasian lynx as a keystone predator supporting forest ecosystem services
    - Dugong grazing aids seagrass carbon capture and resilience
    - Bats foraging techniques enhance forest ecosystem services and aid in plant survival
    - Geese grazing patterns can support the resilience and mitigation potential of tidal marshes
    - Elephants, ecosystem services and conservation

Implementation of Decision 14.214(e): measures to facilitate migratory species' range changes

12. The report on implementation of Decision 14.72(b) (summary in Annex 2 of document UNEP/CMS/COP15/Doc.25.4.1, and full report in document UNEP/CMS/COP15/Inf.25.4.1b) provides Parties with a set of recommendations to mitigate the impacts of climate change on cetacean species, including actions that support range shifts in response to climate change. These recommendations therefore also contribute to the implementation of Decision 14.214(e) in relation to cetacean species.

Implementation of Decision 14.214(f): interventions to conserve migratory species' habitats

13. JNCC developed a Decision Framework to provide guidance to Parties on the implementation of Resolution 12.21 (Rev.COP14), which was adopted at COP14: Resolution 12.21 (Rev.COP14) Annex 2. The Decision Framework provides guidance on which actions are most likely to be appropriate to support migratory species adaptation to climate change.

14. Further work was carried out by JNCC in this intersessional period to test the Decision Framework on different CMS-listed species and provide recommendations to improve its relevance to all CMS species groups. This work was presented at the Working Group session during the Expert Workshop. The Working Group agreed that further work was required to improve the applicability of the Decision Framework to aquatic environments.

15. The Working Group produced a revised version of the Decision Framework, including further information on the strategies and core conditions required for their implementation (Annex 1). The Group recommends updating Resolution 12.21(Rev.COP14) Annex 2 to account for these changes.

Implementation of Decision 14.214(g): contribution to implementation of the Kunming-Montreal Global Biodiversity framework

16. A session was dedicated to discussing this topic at the Expert Workshop and full details of the discussion can be found in the Workshop Report. The Expert Workshop made a series of recommendations, which are summarized in the summary of its findings in Annex 3.

Implementation of Decision 14.214(h): development and interpretation of the term "barrier"

17. With input from the Expert Workshop and the Working Group, JNCC produced a report on the interpretation of the term "barrier" in the context of migratory species conservation (see the summary of the report in Annex 5 and the full text in document CMS/UNEP/COP15/Inf.28.12d). The report covers physical, ecological, environmental, social and regulatory factors that may disrupt or inhibit migratory pathways. It aims to provide conceptual clarity and consistency regarding the obligations of Parties to remove or mitigate barriers impeding the free movement of migratory species between critical habitats necessary for their life cycles.

18. The Working Group recommends the report is used as a guidance tool for Parties, the Scientific Council and other relevant stakeholders in identifying, categorizing and prioritizing work to remove or ameliorate barriers to migration. Furthermore, it provides a foundational framework to inform the development and implementation of mitigation measures and to promote standardized policy approaches across regions and species.

Implementation of Decision 14.215 directed to the Secretariat and the COP-appointed Councillor for Climate Change

19. In support of the implementation of this Decision, the Secretariats of the UN Convention on Biological Diversity (CBD) and UN Framework Convention on Climate Change (UNFCCC) attended the Expert Workshop and provided presentations on the potential synergies and areas for collaboration between these conventions and CMS. There was also a dedicated session on cetaceans delivered by the International Whaling Commission (IWC), covering the relationship to CMS work, climate change impacts on cetaceans and their prey, and climate change effects on cetacean habitats.

20. The Secretariats of the CBD, UNFCCC, UN Convention to Combat Desertification (UNCCD) and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) were also invited to the online meeting of the Working Group in June to provide an overview of links with and between these Conventions and Frameworks, and contributed to discussions on ways to improve synergies with CMS in the future.

21. Knowledge exchange was facilitated through presentations and discussions at the Expert Workshop in Edinburgh, including through the joint session with the IWC on cetaceans and climate change; presentations on the impacts of climate change on migratory species, covering different taxa and regions; and presentations on nature-based solutions to address the impacts of climate change. See the Expert Workshop Report and links to presentations on the meeting webpage for details.

22. It was not possible to make progress towards implementing Decision 14.215(c), which calls for revisions to the National Report format. This is due to the procedure which was set up by the Standing Committee to establish actions and indicators for the Samarkand Strategic Plan for Migratory Species (Resolution 14.1), in particular Target 3.4., which would lead towards a revision of the National Report format, and which had not been completed by the time of writing this document.

23. The Secretariat supported the organization of, and participated in, the Expert Workshop and the Working Group meetings.

Discussion and analysis

24. A considerable amount of work has been undertaken since COP14 with outcomes available in the following documents:

- UNEP/CMS/COP15/Inf.28.12a Report of the Expert Workshop on Migratory Species and Climate Change.
- UNEP/CMS/COP15/Inf.28.12b Report on climate change vulnerability assessment methodologies
- UNEP/CMS/COP15/Inf.28.12c Case studies on the ecosystem services migratory species support related to climate change mitigation and adaptation
- UNEP/CMS/COP15/Inf.28.12d Report on the interpretation of the term “barrier” in the context of migratory species conservation
- CMS/COP15/Inf.25.4.1b Report on the Impacts of Climate Change on Cetacean Welfare and Conservation

25. While important progress has been made on implementing the COP14 Decisions, additional work is needed to identify actions to enhance the resilience of migratory species to climate change and to ensure their conservation across entire migratory routes.

26. Further research and evidence gathering are needed to address taxonomic and regional knowledge gaps in species’ movement patterns. Efforts to utilize new technologies and scientific methods provide valuable tools to facilitate this. Furthermore, efforts to undertake horizon scanning exercises are also needed to identify future threats and opportunities, as well as the species and habitats most vulnerable to climate change. This will aid the prioritization of limited resources and inform early-warning systems and response protocols.

27. To advance these issues, draft Decisions 15.CC a)-d) propose that the Scientific Council re-establishes its Working Group on Climate Change and Migratory Species after COP15, undertakes a horizon scan of potential impacts of climate change on migratory species, organizes a workshop to continue examination of the issues related to migratory species conservation, and develops case studies to showcase how migratory species have adapted to barriers to migration.

28. More actions are needed to communicate the urgency and immediacy of climate change impacts to different stakeholders, including the general public, policymakers and the business sector. Case studies and key messages that demonstrate both the impacts of climate change on migratory species and the ecosystem services they provide should be tailored to different audiences and made widely available. Draft Decision 15.AA invites Parties to identify case studies evidencing successful cases of migratory species adaptation to climate change.

29. Recognizing and including Indigenous Peoples and Local Communities (IPLCs) and youth in efforts to support migratory species adaptation to climate change will be crucial to ensure actions are inclusive, just and long-lasting. Proactive outreach, such as community workshops, and the provision of grants to support attendance at meetings, can facilitate this. Creative methods, such as infographics, workshops and storytelling, should be utilized to engage diverse audiences and secure long-term funding.

30. It is essential that CMS further engages in work on climate change, both within the Convention itself through its Scientific Council, and also by forging stronger relationships with other frameworks concerned with climate change, both to promote synergies and to minimize unintended trade-offs, demonstrating how migratory species are both affected by climate change and can be part of the solution. Efforts are also needed to integrate actions at the local and global levels to ensure policy and practice coherence.

31. Draft Decision 15,CC e)-i) request the Scientific Council to engage in partnership with organizations and other stakeholders and promote knowledge exchange and collaboration, including contribution to the IPBES Nexus Assessment.

Recommended actions

32. The Conference of the Parties is recommended to:

    a) adopt the draft amendments to Resolution 12.21(Rev.COP14) contained in Annex 1 of this document;

    b) adopt the draft Decisions contained in Annex 2 of this document;

    c) take note of the findings of the Expert Workshop and of the Working Group meeting contained in Annexes 3 and 4, respectively; and

    d) delete Decisions 14.211-14.215.

ANNEX 1

PROPOSED AMENDMENTS TO RESOLUTION 12.21 (Rev.COP14)

CLIMATE CHANGE AND MIGRATORY SPECIES

Adopted by the Conference of the Parties at its 12th Meeting (Manila, October 2017);
Revised by the Conference of the Parties at its 14th meeting (Samarkand, February 2024).

The proposed revision only applies to Annex 2 of Resolution 12.21 (Rev.COP14). Proposed new text is underlined. Text to be deleted is ~~crossed out~~.

Revised Annex 2 to Resolution 12.21 (Rev.COP14).

DECISION FRAMEWORK TO PROVIDE GUIDANCE TO PARTIES ON IMPLEMENTATION OF PARAGRAPH 9 OF RESOLUTION 12.21 (REV. COP14)

Resolution 12.21(Rev.COP14) Paragraph 10 states:

Agrees that Article I (1) (c) (4) of the Convention, on the definition of "favourable conservation status" could be interpreted as follows in light of climate change, and invites the governing bodies of relevant CMS instruments to also approve this interpretation:

According to Article I (1) (c) (4) of the Convention, one of the conditions to be met for the conservation status of a species to be taken as "favourable" is that: "the distribution and abundance of the migratory species approach historic coverage and levels to the extent that potentially suitable ecosystems exist and to the extent consistent with wise wildlife management". While there is a continued need to undertake conservation action within the historic range of migratory species, such action will increasingly also need to be taken beyond the historic range of species in order to ensure a favourable conservation status, particularly with a view to climate-induced range shifts. Such action beyond the historic range of species is compatible with, and may be required in order to meet, the objectives and the obligations of Parties under the Convention;

The 5th and 6th meetings of the Sessional Committee of the Scientific Council considered the text above and provided the following guidance:

1. Scenarios and actions

Four scenarios are considered, which cover the different statuses of migratory species with respect to climate-induced range shifts. In the following, the term "barrier" is used to refer to any factor that inhibits migratory species from expanding their range or acts as an impediment to connectivity of their migratory route.

2. Categorizing scenarios

i. Species not present throughout suitable range

Some CMS-listed species have been so severely depleted that they only occupy a small part of the range that is climatically suitable for them, such as Addax (*Addax nasomaculatus*), or are extinct-in-the-wild, such as Scimitar-horned Oryx (*Oryx dammah*).

ii. Species range limited by natural barrier(s)

As climate change degrades habitat in one location, it may not be possible for that habitat to naturally recover in adjacent areas. Examples include the coral reef systems used by Hawksbill Turtles (*Eretmochelys imbricata*). A related issue is where breeding or nesting grounds are required to stay geographically fixed, whilst foraging grounds are pushed away by climatic change, as may be the case for Loggerhead Turtles (*Caretta caretta*) and Grey-headed Albatross (*Thalassarche chrysostoma*).

iii. Species range limited by anthropogenic barrier(s)

Where there is no natural barrier to range expansion, there may instead be a barrier resulting from human activity. This is the case at nesting sites for seabird species such as the Black-footed Albatross (*Phoebastria nigripes*), where sea-level rise on islands may push birds to nest at higher altitudes which are unsuitable due to the presence of invasive predators and human disturbance. Anthropogenic barriers may also be present at boundaries between Regional Fisheries Management Organisations (RFMOs) where a range expansion may take species into seas with different bycatch mitigation standards.

iv. Species range likely to be limited by anthropogenic barrier(s) in future

Even where there is currently capacity for species to adapt their movements in response to climate change, there may be a probability that these future habitats will undergo changes that will make them unsuitable. This is particularly an issue in the Arctic, where retreating sea ice is permitting greater navigation and therefore more industrial activity. While much of the Arctic could currently accommodate poleward shifts of species such as Bowhead Whale (*Balaena mysticetus*), by the time these range shifts occur the Arctic marine environment may be further developed and thus less accommodating than it is today. Similarly, wetlands that are currently unused by waterbirds and under consideration for development may become more in demand as stopover sites due to sea-level rise. Finally, the advance of aridification in the Sahara and changing rainfall in the Sahel could push species such as Dorcas Gazelle (*Gazella dorcas*) to compete for habitat with land increasingly needed for agriculture.

3. A framework for action

The following decision framework is influenced by approaches to ecosystem observation and management in fisheries (Link, et al., 2020); by decision science used to prioritize conservation (Xiao, et al., 2021) and by ranking of research priorities (Rushing, et al., 2020) for migrating birds. It is intended as a basis for engagement between Range States and for prioritization of actions for migratory species at risk from climate change. By combining this framework with careful analysis of scientific evidence for each species, strategies can be focused on actions that make best use of resources to protect species and their migration routes.

The Decision Framework considers four strategies: conservation, restoration, adaptation and translocation. The framework aims, first, to define and categorize the ecological, logistical, societal, financial and policy conditions that must be met for these strategies to be viable for migratory marine species experiencing climate change–induced range shifts.

~~Four strategies are considered:~~

4. Strategy definitions, timescales and scales of action

The definitions of each of the strategies below are for the purposes of the Decision Framework only.

i. Conservation

Conservation refers to the protection and management of existing habitat within the projected future range of a species or population to prevent further decline.

Examples of conservation strategies include setting aside buffer zones inland from current coastal wetlands (Wikramanayake, et al., 2020), and the limiting of industrial expansion into the Arctic, the latter perhaps utilizing tools such as the World Wildlife Fund (WWF) ArcNet ~~12~~ 29.

ii. Restoration

Restoration refers to the active recovery or rehabilitation of degraded, damaged or destroyed habitats or populations to their former, functional or resilient states.

Examples of restoration strategies include the active removal of invasive predators from potential seabird nesting sites (Reynolds, et al., 2015) and enhanced bycatch mitigation measures across fishery boundaries to promote natural restoration (Krüger, et al., 2018).

iii. Adaptation

Adaptation refers to the process of adjusting conservation and management practices to respond to the current and anticipated impacts of climate change and other large-scale environmental changes for migratory species and their current habitats.

~~Examples of possible adaption strategies include rebuilding of coral reef systems (Rinkevich, 2014) and construction of artificial nesting sites for turtles and other coastal breeding species.~~

For example, loggerhead turtles are long-distance migratory species that return to specific beaches to nest. The sex of hatchlings is determined by sand temperature during incubation, with warmer sands associated with the production of more females. An adaptation example could be shading nests to cool sand in order to restore sex ratios.

iv. Translocation

Translocation refers to the intentional movement of individuals to establish, re-establish or reinforce a population in a suitably new or former habitat.

Examples of translocation strategies include the reintroduction of captive addax (Addax Nasomaculatus) into protected areas of north Africa (Newby, et al., 2016), and the use of light aircraft to guide Siberian crane (*Leucogeranus leucogeranus*) migration (the “Flight of Hope” project) in Russia.

Planning time frame: 2100

To ensure the long-term persistence, recovery and ecological functionality of species under climate change, it is critical that conservation, restoration, adaptation and translocation actions are designed with a forward-looking perspective. The year 2100 is widely accepted as the standard long-term time horizon in climate science, serving as the endpoint for most global and regional climate models, including those used by the Intergovernmental Panel on Climate Change (IPCC).

Using 2100 as the planning horizon provides a scientifically grounded and policy-relevant time frame for evaluating the viability and effectiveness of management interventions. Climate

projections through 2100 incorporate a range of plausible future scenarios (e.g., Shared Socioeconomic Pathways[1]), allowing decision makers to consider uncertainty and plan for a diversity of outcomes across temperature, precipitation, sea-level rise and extreme events.

Many species have long life cycles, rely on persistent habitat conditions, or are already facing cumulative pressures. Therefore, short- to mid-term planning (e.g., through 2050 or 2070) will probably underestimate the scale and duration of environmental change experienced. The 2100 benchmark ensures that actions account not only for current suitability but also future climatic stability. This is particularly important for species with migratory behaviour, specialized habitat needs or narrow environmental tolerances.

However, some decisions may warrant a different time horizon depending on the species, ecosystem or management context. The table below outlines commonly used time frames, their corresponding model coverage and intended use:

Time Horizon	**Model Coverage**
2025–2040	Near-term projections
2041–2060	Mid-century projections
2061–2100	Long-term projections

Scales of action: population, sub-population and species-level planning

Climate change does not affect all populations within a species uniformly; local conditions, adaptive capacity and exposure vary widely across a species' range. As such, conservation and management actions should be considered at multiple biological scales:

Species level: When climate threats or range shifts affect the entire species distribution or when actions (e.g., large-scale translocation or habitat corridor development) are required to ensure overall persistence.

Population level: When distinct, geographically separated populations face different climate exposures, making them unequally vulnerable to range shifts, habitat loss or genetic bottlenecks.

Sub-population level: When local adaptations, behaviours (e.g., nesting sites, breeding grounds) or ecological conditions demand site-specific strategies.

Managers must evaluate the appropriate scale for action based on ecological distinctiveness, connectivity, demographic trends and conservation value. For example, a sub-population in a climate refuge may require habitat protection, while a more exposed population may warrant assisted migration or genetic support. Multi-scale planning allows for targeted action where it is most needed, while also supporting overall species resilience.

In practice, this means that decision frameworks should include criteria to:

- Assess whether range shifts affect the entire species or only specific populations
- Determine the feasibility and ecological justification for intervening at smaller scales
- Evaluate how local actions contribute to or potentially conflict with broader species conservation goals

1 Shared Socioeconomic Pathways (SSPs) are climate change scenarios of projected socioeconomic global changes up to 2100 as defined in the IPCC Sixth Assessment Report on climate change in 2021.

5. Core conditions

i. Conservation

- Suitable habitat lies within a region that is projected to remain or become climatically suitable for the species (or population), or can be managed to retain suitability under future climate scenarios
- Viable wild populations still exist
- Species is still occupying critical parts of its natural range
- Breeding and migratory behaviour remain functional
- Threats (e.g. bycatch, pollution, habitat loss) are ongoing but manageable or abatable
- Critical habitats (breeding, feeding, stopover sites) are still intact or partially degraded
- Genetic diversity is sufficient to support natural reproduction
- There are no natural or human-made barriers preventing access to suitable habitat, or if such barriers exist, they can be removed in a logistically and cost-effective manner

ii. Restoration

- Suitable habitat lies within a region that is projected to remain or become climatically suitable for the species (or population), or can be managed/restored to retain suitability under future climate scenarios
- The current or projected habitat conditions are degraded or unsuitable for sustaining the target species or population
- Habitat degradation is reversible (e.g. through reef recovery, wetland rewetting) and manageable long-term
- Environmental conditions (e.g., water quality, vegetation) and ecological interactions (e.g., prey availability) can be restored to a functional state
- Sufficient source populations exist for natural or assisted [re]colonization
- Restoration will not result in harmful ecological imbalances (e.g., trophic cascades, disease transmission)

iii. Adaptation

- Suitable habitat within the species' natural range is currently unavailable or too limited in extent or quality to support a viable population
- Suitable habitat conditions can be actively created or modified to support species persistence under current and/or projected climate scenarios
- The actions required (e.g., water management, shading, erosion prevention) are logistically and financially feasible long-term

iv. Translocation

- The habitat is climatically suitable at the time of translocation and projected to remain suitable for meeting the behavioural and environmental needs of the species (or population) across all life stages
- Natural [re]colonization is not possible or too slow
- Threats (natural or human) at the release site are low or manageable
- Individuals can survive and reproduce at the new site without human intervention

- The species' movement or habitat use is flexible enough to allow establishment
- Risk of disease introduction at the candidate site is low
- Risk of competition or predation on other at-risk species in the candidate site is low
- Risk of hybridization with another species in the candidate site is low
- Donor populations are genetically diverse and can withstand removal of individuals
- Monitoring of both the source and translocated populations is financially feasible. Required monitoring includes assessments of genetic fitness, reproductive success, survival rates, predator-prey interactions, habitat use, and overall population health
- It is logistically and financially feasible to move a sufficient number of individuals to establish a viable, self-sustaining population in the new habitat
- There are no significant social or cultural barriers that would prevent or undermine the success of the translocation effort, and local communities and stakeholders are informed, engaged and supportive of the action.

At each stage of the decision process, other factors will have to be taken into account, such as cost (Shoo, et al., 2013) and the potential risks and benefits incurred by other species that share the habitats in question. In particular, any attempt at translocation – either for assisted colonization or recolonization – should follow the International Union for Conservation of Nature (IUCN) Guidelines for Reintroduction and Other Conservation Translocations.

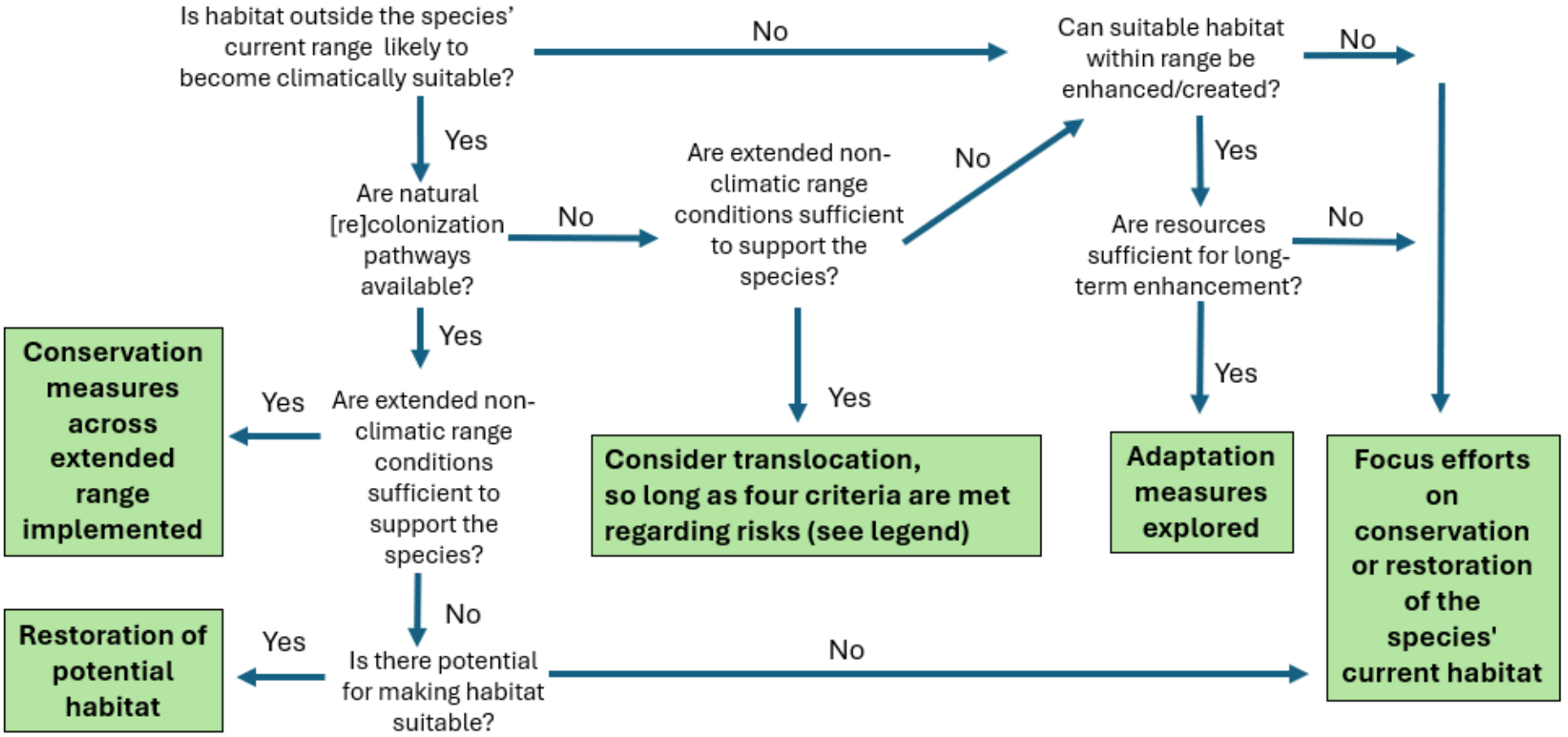

Figure 1. A Decision Support Framework to guide actions in support of migratory marine species experiencing climate change–induced range shifts. In all cases the climatic envelope in the medium term should be sufficient to sustain the habitat. Four criteria to be met if considering translocation to establish viable population: a) Source population sufficiently large and genetically diverse and resilient to withstand donating individuals; b) Risks of unintended ecological consequences are low; c) Operations, including long-term ecological and genetic monitoring of translocated and source populations, are logistically and financially feasible and viable; d) Social and cultural barriers do not exist, and there is evidence of community support.

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ANNEX 2

DRAFT DECISIONS

CLIMATE CHANGE AND MIGRATORY SPECIES

Directed to Parties

15.AA Parties are requested to:

a) identify case studies evidencing successful actions that have supported migratory species' adaptation to climate change and share them with the Secretariat.

Directed to Parties, intergovernmental and non-governmental organizations

15.BB Parties, intergovernmental and non-governmental organizations are encouraged to:

a) use the guidance on barriers as summarized in Annex 5 of document UNEP/CMS/COP15/Doc.28.12 to identify and mitigate barriers likely to impede the movements of migratory species, including potential range shifts in response to climate change, and share any observations with the Secretariat; and

b) use the recommendations contained in the *Report on the Impacts of Climate Change on Cetacean Welfare and Conservation*, summarized in Annex 2 to document CMS/COP15/Doc.25.4.1, to improve understanding of the impacts of climate change on cetacean species and support their conservation in the face of climate change, and share any experiences and lessons learned in applying the recommendations with the Secretariat.

Directed to the Scientific Council

15.CC The Scientific Council is requested, subject to the availability of resources, to:

a) re-establish its Climate Change Working Group and update its Terms of Reference as needed;

b) undertake a horizon scan of potential impacts of climate change on migratory species, including the identification of threats, opportunities and disrupters, as well as potential conservation actions and how they can be pragmatically implemented;

c) Convene a workshop, to:

i. identify those migratory species most likely to be impacted by climate change, including by changes to their migration routes, and therefore most in need of conservation interventions, with a focus on those listed on Appendix I, as well as species for which interventions might have wider benefits;

ii. conduct a review of the impacts of migratory species' range shifts on ecosystem functioning, including through the loss and introduction of migratory species and their associated ecosystem services, as well as potential policy implications;

d) develop case studies to:

i. showcase how migratory species have adapted to barriers to migration in the context of their adaptation to climate change, and how management interventions have helped migratory species overcome such barriers;

ii. demonstrate effective actions to prepare for and respond to extreme climate events likely to impact vulnerable migratory species, including early-warning systems and response protocols;

e) organize webinars outlining synergies between migratory species conservation and the delivery of wider international goals and targets, including the IPBES Nexus Assessment response options;

f) promote knowledge exchange and collaboration between the CMS Scientific Council Working Groups on Climate Change and on Ecological Connectivity on overlapping areas of work;

g) identify overlaps between CMS activities related to migratory species and climate change and those of related multilateral environmental agreements (MEAs), including both synergies and trade-offs;

h) develop fact sheets on the benefits of migratory species conservation to the implementation of goals and targets under other MEAs, tailored for different audiences; and

i) address youth concerns in discussions related to migratory species and climate change.

Directed to the Secretariat

15.DD The Secretariat shall, subject to the availability of resources:

a) support the Scientific Council in the implementation of Decision 15.CC;

b) bring to the attention of the Scientific Council any case studies shared by Parties under Decision 15.AA evidencing successful actions that have supported migratory species' adaptation to climate change; and

c) collect and bring to the attention of the Scientific Council any feedback from Parties, intergovernmental and non-governmental organizations on their experience with using the guidance materials and recommendations referred to in Decision 15.BB.

ANNEX 3

SUMMARY OF THE FINDINGS OF THE EXPERT WORKSHOP ON MIGRATORY SPECIES AND CLIMATE CHANGE

An Expert Workshop on Migratory Species and Climate Change (11-13 February 2025, Edinburgh, United Kingdom of Great Britain and Northern Ireland) took place with financial and in-kind support from the Government of the United Kingdom and the UK Joint Nature Conservation Committee (JNCC). Over 80 experts from across the world, representing 13 Parties to CMS and 53 academic and policy organizations, discussed issues identified in Decision 14.214 b)-h). The Expert Workshop was chaired by the COP-appointed Councillor for Climate Change.

Following presentations on the policy context in relation to CMS, the UN Framework Convention on Climate Change (UNFCCC) and the UN Convention on Biological Diversity (CBD), the meeting noted the report, *Climate change and migratory species: a review of impacts, conservation actions, indicators and ecosystem services,* published in December 2023.

Four workshop sessions were held to address various aspects of Decision 14.214:

- Identification of species potentially/probably impacted by climate change, which may require conservation actions to facilitate range changes.
- Measures to manage migratory routes and range changes, including nature-based solutions and/or ecosystem-based approaches, which embrace the conservation of migratory species' habitats, including maintaining or enhancing connectivity and ecosystem integrity.
- How work under CMS on climate change could interact with implementation of the Kunming-Montreal Global Biodiversity Framework (GBF) and its monitoring framework.
- Developing an interpretation of the term 'barrier', to ensure consistency in the obligation to remove obstacles to migratory species.

Workshop discussions were informed by a series of documents produced by JNCC, which were then revised based on the Expert Workshop's comments.

In addition, there was a joint session with the International Whaling Commission (IWC) on cetaceans and climate change; presentations on the impacts of climate change on migratory species, covering different taxa and regions; presentations on nature-based solutions to address the impacts of climate change; and a moderated discussion on horizon scanning.

The Expert Workshop Report highlights important new findings from research and collaborative efforts on climate change and migratory species that should be considered by CMS, and identifies priorities to be taken forward by the Convention, including:

- undertaking a horizon scan of climate-related issues, strengthening alignment between CMS and the delivery of the GBF and assessments produced by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES),
- developing case studies to demonstrate how 'barriers' to migratory species' movements can be overcome, and

- developing case studies to demonstrate how conservation actions can support migratory species' adaptation to climate change.

The Expert Workshop further made a series of recommendations on how work under CMS on climate change could interact with implementation of the GBF, including, but not limited to, area-based conservation measures, connectivity and restoration, and the Paris Agreement adopted under the UNFCCC:

- For Parties to strengthen or establish a mechanism for focal point coordination nationally.
- To consider an addition to CMS Resolution 12.21 (Rev. COP14) encouraging collaboration between Secretariats, and for Parties to enhance coordination between national focal points of related MEAs and domestic policy and delivery teams.
- To review the internal coherence of CMS Decisions, Resolutions and Concerted Actions with regard to climate change and related actions.
- To review overlaps between CMS activities and those of closely related MEAs, including the IWC, CMS Family Agreements and the CBD.
- To develop a mechanism to identify any negative impacts on CMS species and their habitats that result from actions to address climate change in other Conventions or work programmes.
- To continue to promote ecological connectivity as a unifying concept between CMS and other MEAs.
- To explore opportunities within the planned IPBES Spatial Planning and Connectivity Assessment due for completion in 2027.
- To develop fact sheets and case studies as shorter form materials tailored for different audiences, particularly for those that may have found previous materials inaccessible.
- For the COP-appointed Councillor for Climate Change and the CMS Secretariat to act as advocates for ecological connectivity and collaboration in the context of climate change with other frameworks.

ANNEX 4

SUMMARY OF THE FINDINGS OF THE ONLINE MEETING OF THE WORKING GROUP ON CLIMATE CHANGE AND MIGRATORY SPECIES

The Working Group on Climate Change and Migratory Species met twice during the intersessional period: as part of the Edinburgh Expert Workshop meeting in February 2025, and online in June 2025.

The Working Group discussed the implementation of actions related to Decision 14.214 and future priorities. The meeting included presentations from the Secretariats of IPBES, UNFCCC, CBD and the United National Convention to Combat Desertification (UNCCD), as well as discussions on how best to promote synergies between CMS and other international mechanisms, and key upcoming meetings and upcoming reports to engage with.

In implementation of Decision 14.72b) (see document UNEP/CMS/COP15/25.4.1), and with input from the Working Group and external experts, JNCC developed a report on climate change impacts on cetaceans (document UNEP/CMS/COP15/Inf.25.4.1b), which includes four case studies on the Amazon river dolphin (*Inia geoffrensis*), gray whale (*Eschrichtius robustus*), common bottlenose dolphin (*Tursiops truncatus*) and Cuvier's beaked whale (*Ziphius cavirostris*). The report draws together key findings across the literature and provides Parties with a set of recommendations to improve understanding of the impacts of climate change on cetacean species and support their conservation in the face of climate change. These recommendations were developed with support from the Scientific Council Working Group on Climate Change and are outlined in UNEP/CMS/COP15/Doc.25.4.1 *Conservation Priorities for Cetaceans.*

Ahead of COP15, the Working Group agreed to finalize the report on barriers to CMS species, as well as case studies on the ecosystem services migratory species support and case studies on barriers to CMS species. The Group also agreed to progress work on the refinement of the decision framework included in Resolution 12.21(Rev.COP14) Annex 2, to ensure its applicability to aquatic environments and provide further context on strategy definitions and conditions for their applicability. Additionally, the Group agreed the Secretariat should create a dedicated 'Topic Page' for climate change on the CMS website to promote the different case studies related to climate change.

Looking beyond COP15, the Working Group discussed future priorities and agreed several activities that should be undertaken in the following triennium to further the Convention's work on climate change and migratory species. This work includes:

- further development of species vulnerability assessments to identify those migratory species most likely to be impacted by climate change and therefore most in need of conservation interventions,
- further development of case studies demonstrating how migratory species have adapted to barriers and how management interventions have helped migratory species overcome barriers,
- promoting better collaboration with the CMS Working Group on Ecological Connectivity, through joint meetings and the sharing of outputs,
- a horizon scan of potential impacts of climate-change on migratory species, including the identification of threats, opportunities and disrupters, as well as potential conservation actions and how these can be pragmatically implemented,

- the development of case studies demonstrating effective actions to prepare for and respond to extreme climate events likely to impact vulnerable migratory species, including early-warning systems and response protocols, and
- a review of the impacts of migratory species' range shifts on ecosystems functioning, including through the loss, or indeed gain, of migratory species and their associated ecosystem services, as well as potential policy implications.

ANNEX 5

SUMMARY OF THE REPORT ON THE INTERPRETATION OF THE TERM "BARRIER" IN THE CONTEXT OF MIGRATORY SPECIES CONSERVATION

(The full report can be found in UNEP/CMS/COP15/Inf.28.12d)

Introduction

This document addresses CMS Decision 14.214(h) directed at the Scientific Council:
Develop an interpretation of the term "barrier", so that there is consistency in the obligation to remove barriers to migratory species;

It offers a comprehensive interpretation of the term "barrier" in the context of migratory species conservation under the Convention on the Conservation of Migratory Species (CMS). It aims to provide conceptual clarity and consistency regarding the obligations of Parties to remove or mitigate barriers impeding the free movement of migratory species between critical habitats necessary for their life cycles.

The terminology employed within the CMS text predominantly references the term "obstacle" when addressing impediments to the movement of migratory species. This document, however, employs the term "barrier" for conceptual clarity and broader ecological applicability. The terms "barrier" and "obstacle" are acknowledged as closely interrelated, and this interpretation seeks to standardize their application in the context of CMS obligations. This interpretation aligns with the CMS's overarching objective to promote the conservation and sustainable management of migratory species by addressing all forms of impediments that may restrict their natural migratory behaviours.

This document is intended to serve as a guidance tool for Parties, the Scientific Council and other relevant stakeholders in identifying, categorizing and addressing barriers to migration. Furthermore, it provides a foundational framework to inform standardized policy approaches across regions and species.

What is a barrier?

A 'barrier' refers to any physical, ecological, environmental, social or regulatory framework, feature or modification that disrupts, blocks or impedes the natural migratory movements of species, or novel dispersal / colonizing movements as a response to changing environmental conditions.

Regulatory frameworks, where inconsistent or inadequate across borders, may present as impediments, and parties are encouraged to ensure that these frameworks are robust and responsive to address possible shifting ranges of migratory species, enabling conservation actions and mitigation of emerging barriers. Social barriers (people-based) may interact with these frameworks (institution-based), arising from societal behaviours, values or perceptions rather than from formal governance structures. They can influence the implementation or effectiveness of regulations and, in some cases, may restrict species movement even where policy support exists. This can be addressed through targeted education, outreach or incentive-based approaches. The focus of this document is to understand how these barriers affect connectivity between two or more functional areas (regions essential for completing a species' lifecycle by providing critical resources at specific times, such as essential habitats for breeding, feeding or resting), and if they increase resistance to movement.

Types of barriers

For migratory species, a barrier may take the form of four types: permeable, impermeable, impediment and blockage (see also Table 1 in UNEP/CMS/COP15/Inf.28.12d). The distinction between these categories is based on their permeability, which refers to the degree to which barriers inhibit or allow passage. Permeability affects individual or population-level movement, where barriers may be crossed but not circumnavigated without cost. At the scale of ecological realms (encompassing landscapes, seascapes and airspaces), the term porosity extends the idea of permeability by considering how the overall structure of these realms facilitates or hinders species movement (see also Table 2 in UNEP/CMS/COP15/Inf.28.12d). While individual barriers may obstruct movement, a porous realm provides alternative pathways or routes. Therefore, the porosity of an ecological realm indicates how well it supports migration across multiple interconnected habitats, even if those habitats are not physically connected.

A more porous realm offers better opportunities for movement despite the presence of barriers, by providing accessible routes or corridors that facilitate connectivity. Ecological connectivity can be achieved even when habitats are not physically connected, if the realm allows species to navigate between them effectively – for example, vegetation patches acting as 'stepping stones' which help some species move through otherwise fragmented realms.

The presence of barriers can lead to fragmented populations, increasing risks such as higher mortality rates, exposure to other threats like disease, reduced genetic diversity, and decreased population resilience. However, it is important to note that species may also rely on certain barriers to be successful. For example, natural barriers such as mountain ranges or seasonal environmental changes can help regulate movement patterns, preventing population over-abundance, and ensuring the species migrate or breed at optimal times.

Natural barriers may be a driving force behind evolutionary adaptation and ecological balance. The severity of impacts associated with additional, mainly anthropogenic, barriers often depend on the species' adaptability, with generalist species typically better equipped to adapt to changes compared to specialists.

Temporal variability in barriers

Some barriers, such as seasonal ice coverage or mountain glaciers, are shifting due to climate change, thus creating new obstacles for species in their migratory patterns. This may result in the extension or reduction of ice cover, changing the timing and routes of migration, and may lead to range change for the species. These shifts in natural barriers can interact with or compound existing anthropogenic barriers. These changes may also lead to new anthropogenic barriers as humans may exploit new areas that were previously inaccessible.

Cumulative effects of a range of obstacles

It is also important to consider the cumulative effects of multiple barriers, where the combined impact of various obstacles across a species' migration route may significantly impact its ability to complete its life cycle. Quantifying the number and type of barriers, particularly in critical areas, is essential for assessing vulnerability and identifying priority areas for mitigation. These cumulative impacts occur across all spatial and temporal scales, from local to global, and from immediate to long-term. While large-scale, long-term processes such as climate dynamics may be less directly manageable, coordinated local and short-term actions can collectively influence them. Such actions are integral to maintaining ecological connectivity, enabling species to migrate and adapt, and should be recognized as complementary to, rather than in competition with, broader global objectives.

Examples of physical and non-physical barriers

This document provides examples of barriers under four categories: (a) physical anthropogenic, (b) physical natural, (c) non-physical anthropogenic, and (d) non-physical natural, as well as (e) specific climate change related barriers. UNEP/CMS/COP15/Inf.28.12d outlines potential mitigation strategies for the anthropogenic barriers, as well as the non-physical natural barriers where anthropogenic activities have accelerated their negative impacts. For some species, the negative effects of some barriers can be partially mitigated through improved landscape design. Strategies such as barrier concealment, which reduces visual and auditory disturbances, or other design elements that minimize the perception of a barrier's presence, can help restore connectivity and reduce resistance. These approaches aim to enable species to navigate altered realms more effectively, promoting resilience and maintaining ecological balance.

A. Examples of physical anthropogenic barriers

1. **Fences and walls** – block migratory paths, fragment habitats, and force animals to detour long distances.

2. **Roads and railways** - create high-traffic pathways, often intersecting with the migratory routes of terrestrial and avian species, which can fragment habitats and isolate populations.

3. **Bridges and tunnels** - can alter light, temperature and noise, which disrupt natural movement patterns. However, specific wildlife overpasses and underpasses may allow animals to cross safely over or under roads, railways or other barriers.

4. **Energy infrastructure** - power lines and wind turbines fragment habitats and can cause collision-related injuries and fatalities both on land and offshore, while underwater cables can cause electromagnetic interference which impacts the navigation and migratory patterns of marine species.

5. **Dams and hydroelectric installations** – can obstruct migratory fish species movements, and disrupt sediment transport, water temperature and nutrient flow, which degrades important habitats for migratory species.

6. **Shipping lanes and marine traffic** - can lead to direct collisions with large marine animals, while noise pollution can also disrupt species that rely on echolocation, affecting their ability to navigate successfully.

7. **Canals and water diversion projects** – can provide a barrier for some terrestrial species that cannot crossover. They can also change water flow and availability, and introduce invasive species, which can impact aquatic species movements.

8. **Dredging activities** - can alter aquatic habitats, directly impacting migratory species movements as well as destroying spawning grounds and feeding habitats.

9. **Sea walls and coastal infrastructure** - can impact the migration of species that rely on tidal flats, estuaries and sandy shores, for example by blocking or eroding important nesting and feeding sites.

10. **Urban and industrial development** – can fragment habitats and have toxic runoffs, pollutants and artificial lights, which impact migratory species' safe passage.

11. **Agricultural fields and plantations** – can create negative interactions with humans and domestic farm animals, while large monocultures can reduce habitat connectivity and food availability for migratory species.

12. **Mining and quarrying operations** – can fragment habitats and create impassable areas within migratory routes, while also exposing species to toxic waste, and noise and light pollution.

13. **Oil and gas exploration, production and transportation** – pipelines can fragment habitats due to noise, vibration and human activity, while exploration for oil and gas can impact marine species' movements due to noise and habitat alterations**.**

14. **Conflict zones and military areas** – can obstruct migratory pathways through direct changes to terrain, noise and light pollution, and chemical warfare, oil spills and deforestation can alter important habitats.

15. **Plastic pollution** – entanglements and ingestion can result in injury or death, while plastic debris can create hazardous zones that block migratory routes, leading to long-term disruptions in feeding patterns and habitat connectivity**.**

16. **Traps** – can cause injury, stress or mortality, particularly when they are placed along migratory routes.

B. Examples of physical natural barriers

1. **Mountain ranges** – for example, the Himalayas, Andes or Alps.

2. **Large Oceans** – for example, the Atlantic Ocean and Pacific Ocean.

3. **Deserts** – for example, the Sahara Desert and Gobi Desert.

4. **Frozen landscapes** – for example, Arctic Sea ice and Antarctic ice sheets.

5. **Deep canyons and escarpments** – for example, the Grand Canyon and Great Rift Valley.

6. **Large rivers** - for example the Amazon River and Congo River.

7. **Atmosphere** – for example, solar storms (e.g. Aurora Borealis) and the Earth's magnetic field.

C. Examples of non-physical natural barriers

1. **Climate change** - can impact environmental conditions, causing migrations to no longer align with optimal conditions for breeding and rearing young. Climate change can also trigger migrations too early or late (see also section E).

2. **Changes in food availability** - changes in environmental factors such as temperature, or anthropogenic impacts such as intensive agriculture, can cause vital food resources to be unavailable at key migratory stopover sites or destinations.

3. **Pathogens and disease outbreaks** - species may encounter novel or greater prevalence of pathogens or disease outbreaks along migratory routes that can cause mortality or reduced fitness, impacting migration success.

4. **Weather patterns and events** – extreme weather events, such as storms, heatwaves and droughts can cause changes in habitats or resources required throughout migration. Suitable habitats for many species are shifting polewards, requiring species to modify their migratory routes or change the timing of their migration to avoid mismatch with peak food availability.

5. **Natural hazards** - such as volcanic eruptions, wildfires and flooding can cause short-term disruptions to migration routes, as well as permanent changes to habitats that migratory species rely upon during migration.

6. **Ocean currents and wind patterns** – changes to ocean currents can alter ecosystems and food availably, impacting marine mammal and seabird distribution and mortality, while changes to wind patterns can impact migratory bird oceanic crossings.

D. Examples of non-physical anthropogenic barriers

1. **Light pollution** - can act as an attractant or repellent, and can disorientate migratory animals and cause potentially fatal collisions.

2. **Chemical pollution** - such as heavy metals, oil, industrial chemicals and agricultural pesticides, can directly impact migratory species' movements, as well as the environments and resources they rely on along their migratory route.

3. **Noise pollution** - can cause changes in spatial distribution, by deterring animals from important feeding and breeding areas.

4. **Electromagnetic pollution** - generated by power lines, telecommunications and satellite systems can impact species that rely on the Earth's magnetic field for navigation, causing disorientation or deviation from established routes.

5. **Water quality changes** – such as to salinity, water flow and ocean acidification can alter the physiology of migratory fish and cause reduced growth rate and reproduction, while also degrading important marine habitats for migratory species.

6. **Invasive alien species** - can predate migratory species or compete for resources along migratory routes. They can also spread diseases to migratory species or degrade important habitats at sites along migratory routes.

7. **Hunting, overfishing and depletion of food resources** - unsustainable hunting, fishing and harvest of plants can deplete or remove food resources that migratory species rely upon along their migratory route. Species that migrate in large numbers or form large aggregations can also be subject to overexploitation.

8. **Human disturbance** - caused by development, tourism, recreation and human migration can cause risk-adverse responses in migratory species which affect species distribution, migration routes and population dynamics.

9. **Social barriers** - can influence human behaviours and attitudes that affect species movement and habitat connectivity. These may include local resistance to wildlife corridors, negative perceptions of certain species (such as predators or perceived pests), cultural practices, economic concerns, and human-wildlife conflict.

E. Examples of climate change related barriers

1. **Melting sea ice and glacier retreat** – sea ice loss eliminates platforms for species that rely on ice for hunting, resting and migration. Shrinking glaciers can reduce river systems, impacting fish migration and freshwater availability.

2. **Rising sea levels and coastal erosion** - flooding of coastal areas and mangroves removes critical stopover points for migratory birds and terrestrial species.

3. **Thermal barriers in water** - warmer surface water layers create 'heat blocks', forcing fish species to alter or abandon migration routes.

4. **Loss of freshwater ecosystems** - droughts and reduced snowpack shrink may remove rivers and wetlands.

5. **Desertification** - limits migratory routes for animals like antelope and elephants and creates heat-stressed areas that are physiologically impassable.

6. **Ocean acidification** - disrupts navigation in marine species by impairing sensory abilities and may impact food sources.

7. **Declining oxygen zones** (dead zones) - climate-induced ocean stratification creates low-oxygen zones, making these barriers impassable.

8. **Melting permafrost** - releases methane, alters tundra landscapes, and destroys habitat connectivity for species like caribou.

9. **More frequent and severe wildfires, storms, heat events** - extreme events may destroy habitats and create hazardous areas, disrupting birds, mammals and insects like monarch butterflies.

10. **Altered ocean currents** - disruption of currents like the Gulf Stream forces marine species to reroute or lose access to migratory destinations.

11. **Algal blooms** - warmer waters trigger toxic algae growth that creates physical and chemical barriers for fish and amphibians in rivers and lakes.