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STATE OF THE WORLD'S MIGRATORY SPECIES

Convention on the Conservation of Migratory Species of Wild Animals

State of the World's Migratory Species

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Authors: Frances Davis, Andrew Szopa-Comley, Sarah Rouse, Aude Caromel, Andy Arnell, Saloni Basrur, Nina Bhola, Holly Brooks, Giulia Costa-Domingo, Cleo Cunningham, Katie Hunter, Matt Kaplan, Abigail Sheppard and Kelly Malsch.

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UN Environment Programme World Conservation Monitoring Centre (UNEP-WCMC)
219 Huntingdon Road, Cambridge CB3 0DL, UK
Tel: +44 1223 277314
www.unep-wcmc.org

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Saiga Antelope (*Saiga tatarica*)

Foreword

Billions of animals are regularly on the move every year. Migratory species include some of the most iconic species on the planet such as sea turtles, whales and sharks in our oceans, elephants, wild cats, and herds of hooved species that cross plains and deserts, raptors, waterbirds and songbirds that cross through the skies, and even insects such as the monarch butterfly.

With their incredible journeys connecting different parts of the world, migratory species provide a unique lens through which we can understand the scale of the profound changes affecting our world.

Migratory species rely on a variety of specific habitats at different times in their lifecycles. They regularly travel, sometimes thousands of miles, to reach these places. They face enormous challenges and threats along the way, as well at their destinations where they breed or feed. When species cross national borders, their survival depends on the efforts of all countries in which they are found.

The Convention on the Conservation of Migratory Species of Wild Animals (CMS) was established in 1979 for this very reason: international cooperation is essential for the conservation of migratory species. It is uniquely placed to bring countries and stakeholders together to agree on the actions needed to ensure that these species survive and thrive.

Effective policies and actions for migratory species require a solid scientific grounding to understand their conservation status, the areas they depend on, and the threats that they face. The information presented in this ground-breaking report, the first ever *State of the World's Migratory Species*, represents a significant milestone in efforts to synthesize and communicate the knowledge needed to drive forward action.

The report finds that the conservation status of migratory species overall is deteriorating. Species listed for protection under CMS, despite positive successes, reflect this broader trend. The conservation needs and threats to migratory species need to be addressed with greater effectiveness, at a broader scale, and with renewed determination. In particular, urgent action is needed to prevent the extinction of species that are categorised as Critically Endangered and Endangered, which includes a substantial proportion of all of the marine and freshwater fish species (79%) and marine turtles (43%) that are listed under CMS. The report also highlights nearly 400 threatened species not currently covered by the Convention that deserve greater attention.

Among the startling results, overexploitation emerges as the greatest threat for many migratory species, surpassing habitat loss and fragmentation. This includes the taking of species from the wild through intentional removal, such as through hunting and fishing, as well as the incidental capture of non-target species. Bycatch of non-target species in fisheries is a leading cause of mortality of many CMS-listed marine species.

Habitat loss, fragmentation, and barriers to migratory movements continue to be a major threat facing migratory species. Globally, although 49% of the sites already identified as being important for CMS-listed species are subject to some level of protection, many critical sites for CMS-listed species are yet to be mapped. This information is crucial for area-based conservation measures, and in order for safeguards for migratory species related to investments in infrastructure and other economic activities to be fully met. Moreover, among the important sites for CMS-listed species that have been identified, well over half are facing unsustainable levels of human-caused pressure.

Other key threats to migratory species include pollution (including light and noise pollution), climate change and invasive species.

The good news is that the actions that are needed are clear, and are highlighted in the recommendations of this report. Among the most important: efforts need to be stepped up to address unsustainable and illegal taking of migratory species at the national level; bycatch and other incidental capture must be massively reduced; all important sites for migratory species need to be identified; and actions need to be taken to protect or conserve such sites.

Actions under CMS will be crucial for achieving the global commitments set out in the Kunming-Montreal Global Biodiversity Framework. These include commitments to restore and establish well-connected networks of protected areas and other effective area-based conservation measures, targets to halt human-induced extinctions and to ensure that any taking of wild species is sustainable, safe and legal, and targets to address climate change and pollution. Delivering on these commitments in a fair and just way will not only benefit migratory species but will also help secure a better future for people and nature.

Producing the first ever *State of the World's Migratory Species* would not have been possible without the excellent collaboration between UNEP-WCMC and CMS, as well as the vital support of donors and the expertise provided by many dedicated reviewers.

Migratory species are a shared natural treasure, and their survival is a shared conservation responsibility that transcends national boundaries. This landmark report will help underpin much-needed policy actions to ensure that migratory species continue to traverse the world's skies, lands, oceans, lakes and rivers.

Amy Fraenkel
CMS Executive Secretary

Foreword

When we talk about the triple planetary crisis of climate change, nature and biodiversity loss and pollution and waste, we often focus on hard-hit ecosystems and the communities and species that live, and suffer, in them year-round. We rarely talk about the migratory species that undertake astonishing journeys between these ecosystems, often through air, land and water increasingly damaged by unsustainable human activities.

The *State of the World's Migratory Species* for the first time sets out compelling evidence of the peril facing these awe-inspiring animals. The report finds that migratory species are being hit hard, particularly by overexploitation and habitat loss, degradation and fragmentation. As a result of these pressures, one in five CMS-listed species are threatened with extinction and 44 per cent have a decreasing population trend. The situation is far worse in aquatic ecosystems, with 97 per cent of Convention on Migratory Species (CMS)-listed migratory fish at risk of extinction.

The urgency for action to protect and conserve these species becomes even greater when we consider the integral but undervalued role they play in maintaining the complex ecosystems that support a healthy planet – by, for example, transferring nutrients between environments, performing migratory grazing that supports the maintenance of carbon-storing habitats, and pollination and seed dispersal services.

There is hope, however. Building on the CMS's strong track record of protecting and conserving these species for over 40 years, the report translates a robust scientific understanding of the threats into a set of actions. The report calls for urgent and coordinated efforts to protect, connect and restore habitats, tackle overexploitation, reduce environmental pollution (including light and noise pollution), address climate change, and ensure that the protection of the CMS extends to all species in need of conservation. Under each area, the report provides a clear set of concrete recommendations.

This report is a significant step forward in the development of a conservation roadmap for migratory species. Given the precarious situation of many of these animals, and their critical role for healthy and well-functioning ecosystems, we must not miss this chance to act – starting now by urgently implementing the recommendations set out in this report.

Inger Andersen
UN Under-Secretary-General
& Executive Director,
UN Environment Programme

Cerulean Warbler (*Setophaga cerulea*)

Executive Summary

Migratory species are found all over the world - on land, in the water and in the skies. Traversing thousands of miles, these species rely on a diverse range of habitats for feeding, breeding and resting, and in turn, play an essential role in the maintenance of healthy and functional ecosystems. Often their migrations take them across national borders, and thus international cooperation is essential for their conservation and survival. The recognition of this need led to the negotiation of the Convention on the Conservation of Migratory Species of Wild Animals (CMS), which came into force in 1979. CMS is the global treaty that addresses the conservation and effective management of migratory species and their habitats. The Convention aims to conserve migratory species, particularly those listed in its two Appendices and those included in a range of CMS instruments, through international cooperation and coordinated conservation action.

This report, the first ever *State of the World's Migratory Species*, provides a comprehensive overview and analysis of the conservation status of migratory species. It summarizes their current status and trends, identifies the key pressures they face, and highlights illustrative examples of the efforts underway to conserve and promote the recovery of these species. It aims to improve conservation outcomes for migratory species, by providing support for evidence-based decision-making by CMS Parties, and more broadly, by raising awareness of the challenges and success stories in the conservation of migratory species. The report was produced in response to a decision adopted at COP13 in 2020, which mandated that work be undertaken to further develop the preliminary review of conservation status submitted to COP13. The focus of this report is on those species listed in the CMS Appendices; however, as other migratory species may benefit from protection under CMS, it also provides information on the wider group of all migratory species.

Silky Sharks (*Carcharhinus falciformis*) are Vulnerable to extinction, and listed in CMS Appendix II.

The available evidence suggests that the conservation status of many CMS-listed species is deteriorating. One in five CMS species are threatened with extinction and a substantial proportion (44%) are undergoing population declines. When considering the Appendices separately, 82% of Appendix I species are threatened with extinction and 76% have a declining population trend. Meanwhile, 18% of Appendix II species are globally threatened, with almost half (42%) showing decreasing population trends. The current situation and trajectory of CMS-listed fish is of particular concern, with nearly all (97%) of CMS-listed fish threatened with extinction. Indeed, on average, there has been a steep decline in the relative abundance of monitored fish populations over the last 50 years.

Levels of extinction risk are rising across CMS-listed species as a whole. Between 1988 and 2020, 70 CMS species showed a deterioration in conservation status, substantially more than the 14 species that showed an improvement in conservation status. Extinction risk is also escalating across the wider group of migratory species not listed in CMS. A novel analysis produced for this report identified 399 globally threatened and Near Threatened migratory species (mainly birds and fish) that are not yet listed in the CMS Appendices that may benefit from international protection.

The deteriorating status of migratory species is being driven by intense levels of anthropogenic pressure. Due to their mobility, their reliance on multiple habitats, and their dependence on connectivity between different sites, migratory species are exposed to a diverse range of threats caused by human activity. Most migratory species are affected by a combination of threats, which often interact to exacerbate one another. Habitat loss, degradation and fragmentation (primarily driven by agriculture), and overexploitation (hunting and fishing, both targeted and incidental) represent the two most pervasive threats to migratory species and their habitats according to the IUCN Red List of Threatened Species™. Pollution, including pesticides, plastics, heavy metals and excess nutrients, as well as underwater noise and light pollution, represents a further source of pressure facing many species. The impacts of climate change are already being felt by many migratory species, and these impacts are expected to increase considerably over the coming decades, not just as a direct threat to species but also as an amplifier of other threats.

Importantly, habitat loss, degradation and fragmentation is increasingly disrupting the ability of migratory species to move freely along their migration routes, particularly when large areas of continuous habitat are converted into smaller, isolated patches that can no longer facilitate these movements. Additionally, obstacles to migration, ranging from physical infrastructure like roads, railways, fences

Maintaining and enhancing ecological connectivity, including by removing or mitigating physical obstacles to migration, is vital in ensuring the survival of migratory species.

and dams to non-physical barriers such as disturbance from industrial development and shipping traffic, represent formidable barriers to migratory populations. By constraining the movement of migratory animals, growing anthropogenic impacts on vital migration corridors and stopover sites pose a significant threat to the phenomenon of migration itself. Indeed, 58% of monitored sites that are recognized to be important for CMS-listed species are facing unsustainable levels of anthropogenic pressure.

Given the breadth and scale of the pressures facing migratory species, coordinated international action is urgently needed to reverse population declines and preserve these species and their habitats. Fortunately, although some important data gaps remain, many of the threats facing migratory species are well understood. Crucially, a wealth of knowledge exists on the responses and solutions that are required to help migratory populations recover. Collaborative actions designed to improve the conservation status of migratory species are already underway under CMS, from international task forces addressing the illegal killing of birds, to multistakeholder platforms to support the sustainable deployment of renewable energy infrastructure without negatively impacting migratory species. However, to curb losses and to promote the recovery of migratory species, these efforts need to be strengthened and scaled up. This should include actions to expand the global network of protected and conserved areas, particularly those areas of importance to migratory species, in line with global targets, while also working to improve the condition and effective management of sites. Maintaining and enhancing the connectivity between these sites should also be a key priority, in part through the targeted restoration of degraded habitats. Coordinated action is also required to combat overexploitation, including the expansion of collaborative international initiatives to prevent the illegal or unsustainable taking of migratory species.

The Convention on Migratory Species provides a global platform for international cooperation, and active engagement across governments, communities and all other stakeholders is critical for addressing the myriad of challenges that migratory species face. With recently renewed global commitments established to address the threats to biodiversity through the Kunming-Montreal Global Biodiversity Framework, and with the adoption of a new strategy anticipated at CMS COP14, collective efforts to follow through on these commitments and deliver on ambitions for migratory species are urgently needed.

one in **five** CMS-listed species are **threatened** with **extinction** globally and **44%** have a **decreasing population** trend

global extinction risk

is escalating for both CMS-listed species and all migratory species

82% of CMS Appendix I

18% of CMS Appendix II

species are globally threatened

90% average **decline** in CMS-listed fish populations since 1970

3 in 4 CMS-listed species affected by **habitat loss**, **degradation** and **fragmentation**

58% **of monitored sites** for CMS-listed species are under **unsustainable** pressure

7 in 10 CMS-listed species affected by **overexploitation**

399 globally threatened and Near Threatened migratory species are **not yet CMS-listed**

Recommendations for priority actions

Based on the findings of this report, the following key actions should be prioritized:

Protect, connect and restore habitats

- **Identify key sites for migratory species along their entire migratory pathways**. Further work is needed to identify critical habitats and sites for migratory species. For example, Key Biodiversity Areas (KBAs) identify nearly 10,000 important sites for CMS-listed species, but there are taxonomic and geographic gaps in the existing site network, particularly for migratory terrestrial mammals, aquatic mammals and fish, and in the Caribbean, Central and South America and Oceania. Other priority site identification processes relevant for specific taxonomic groups can also support CMS efforts to identify and protect key sites.
- **Increase the coverage of KBAs and other critical habitats by protected and conserved areas**. In line with global targets to expand the network of protected and conserved areas to over 30% by 2030, prioritizing those sites that are important for biodiversity is vital to ensuring successful outcomes for nature. Currently more than half of the area of KBA sites identified as being important for CMS-listed species is not covered by protected or conserved areas, indicating there are clear gaps and more needs to be done.
- **Enhance the management effectiveness of protected and conserved areas.** This includes ensuring sufficient resources are put into the management of protected and conserved areas to maximize the benefits for biodiversity. Given the scale of the threats to migratory species, improving the ecological condition of protected and conserved areas is essential to maintain strongholds for many species. To ensure the management needs of migratory species are taken into account, key priorities for migratory species should be integrated into management plans for these areas. More broadly, it is important that key conservation priorities for migratory species are also integrated into National Biodiversity Strategies and Action Plans (NBSAPs).
- **Establish, support and expand regular monitoring of important sites for migratory species**, and of populations of migratory species at these sites, following standardized protocols. This is essential to identify the threats taking place and their impacts on species and ecosystems. These efforts are needed to prioritize conservation actions, evaluate the effectiveness of management interventions and help to pinpoint any drivers of population change in CMS-listed species. They can also provide indicators needed to demonstrate national progress in achieving global and national targets.
- **Follow through on ecosystem restoration commitments**, including those linked to the UN Decade on Ecosystem Restoration and Target 2 of the Kunming-Montreal Global Biodiversity Framework to ensure that at least 30% of degraded terrestrial, inland water, and coastal and marine ecosystems are under effective restoration by 2030. To support these efforts, develop and implement national restoration plans focussed on restoring and maintaining important habitats for migratory species.
- **Prioritize ecological connectivity in the identification, design and ongoing management of protected and conserved areas**, noting that to date, less than 10% of protected land is connected. Connectivity should be explicitly considered in national land, marine and freshwater use planning, the designation of future protected and conserved areas, and when selecting areas for targeted restoration efforts. More broadly, maintaining the integrity (the completeness and functionality) of the ecosystems that migratory species form a part of should also be a key consideration.
- **Minimize the negative impacts of infrastructure projects on flyways, swimways and migration pathways for migratory species**, with avoidance of impacts on critical sites for migratory species as a primary aim. Projects should be carefully planned from the outset in accordance with the relevant Environmental Impact Assessment and Strategic Environmental Assessment guidelines, which should be adapted, where necessary, to include migratory species considerations. Guidance developed under CMS on key threats to migration and connectivity, including on renewable energy, linear infrastructure, light pollution and noise pollution (see recommendations on *Pollution*) should be followed.

Tackle overexploitation

- **Ensure that national legislation fully and effectively protects CMS Appendix I-listed species from take**, including by closely regulating any exceptions to the general prohibition of take and by participating in the CMS National Legislation Programme.
- **Improve and encourage the use of tools for monitoring and collecting standardized data on legal take** at the national level. Efforts should also be made to improve the reliability and comprehensiveness of reporting in order to understand the scale, intensity and sustainability of national take.
- **Fill knowledge gaps on the main drivers and scale of illegal take of migratory species, including in regions where this threat has not yet been assessed, to inform the priority actions needed to tackle this issue.** This should include improved monitoring of illegal take, as well as research to understand the effectiveness of efforts to address it.
- **Assess the cumulative impact of harvest pressure on migratory species at the flyway and population level** and use this information to manage levels of take. These aims could be supported by increasing efforts to collate data on both legal and illegal take at national and international scales.
- **Strengthen and expand collaborative international efforts to tackle illegal and unsustainable take**, focussing on the main drivers of taking and on geographical areas identified as hotspots for illegal killing. Such initiatives could be based on the Task Forces established to tackle the illegal killing of migratory birds. At the national level, multistakeholder action plans should be developed to agree priorities and foster collaboration to tackle this issue.
- **Take action to reduce the impacts of overfishing and incidental catch on marine migratory species**. This should include, for example, establishing catch/mortality limits for non-target marine species, increasing observer coverage and remote monitoring of marine capture fisheries, and increasing international collaboration, in particular between the CMS Secretariat and the relevant fisheries and regulatory bodies. Support to the ratification and implementation of the new Biodiversity Beyond National Jurisdiction (BBNJ) Treaty will also be important given the large numbers of ocean-going migratory species that are found in the High Seas. Such measures are urgently needed, considering the deteriorating conservation status of CMS-listed fish, including sharks and rays, and the impact of incidental catch on many populations of seabirds, marine mammals and marine turtles.

Reduce the damaging impacts of environmental pollution

- **Promote the widespread adoption of light pollution mitigation strategies**, including those outlined in the Light Pollution Guidelines for Wildlife endorsed by CMS Parties, focussing in particular on brightly lit areas that overlap with crucial habitat or migration corridors.
- **Restrict the emission of underwater noise in sensitive areas for marine species**, including by making use of the CMS Family Guidelines on Environmental Impact Assessments for Marine Noise-generating Activities, and through the application of quieting technologies in key marine industries (as highlighted by a CMS report outlining best practices for mitigating the impact of anthropogenic noise on marine species).
- **Accelerate the phase-out of toxic lead ammunition and lead fishing weights**, including by implementing relevant recommendations outlined in the CMS Guidelines to Prevent the Risk of Poisoning to Migratory Birds.
- **Reduce the harmful effects of pesticides on migratory species**, and their food sources, by lowering usage in or close to critical habitats and by promoting and incentivizing nature-friendly agricultural practices.
- **Tackle the issue of plastic pollution on land, at sea and in freshwater ecosystems** by eliminating problematic and unnecessary plastics and by reducing the unnecessary use and production of plastics through regulations, incentives and practices (as recommended in the CMS report "Impacts of Plastic Pollution on Freshwater Aquatic, Terrestrial and Avian Migratory Species in the Asia and Pacific Region").
- **Reduce the impacts of abandoned, lost and otherwise discarded fishing gear on marine migratory species** by implementing changes to gear design and by providing alternative disposal options. This will have benefits linked to both reducing pollution and tackling overexploitation of marine species.

Address the root causes and cross-cutting impacts of climate change

- **Deliver on international commitments to address climate change,** including on pledges to reduce greenhouse gas emissions and enhance the removal of these gases from the atmosphere by maintaining and increasing carbon stocks in vegetation and soils. Carbon stocks should be managed in ways that align with internationally agreed biodiversity conservation goals.
- **Future-proof the network of important sites for migratory species** against the likely consequences of climate change by ensuring that there is sufficient connectivity between sites to facilitate dispersal and range shifts, and that this connectivity will persist in the face of projected climate impacts. Efforts to review the adequacy of the current network – and to expand this network – should fully integrate these projected impacts to ensure resilience.
- **Help migratory species adapt to a changing climate through targeted ecosystem restoration efforts**, designed to improve habitat quality and connectivity and reduce the impact of extreme weather events, such as drought and thermal stress, by facilitating dispersal and range shifts.
- **Identify and implement dynamic management measures** that address changing migration pathways and patterns resulting from climate change.
- **Ensure renewable energy infrastructure expansion** is planned and developed in a way that **avoids harm to migratory species**, following guidance developed by the CMS Energy Task Force.

Ensure the CMS Appendices protect all migratory species in need of further conservation action

- **Urgently take additional action to conserve at-risk Appendix II species:** a total of 179 Appendix II species were identified in this report as 'very high' or 'high' priorities for further action under CMS, due to their unfavourable conservation status.
- **Consider migratory species threatened with extinction not yet listed in CMS:** 399 globally threatened and Near Threatened migratory species are not listed in the CMS Appendices (see Annex B) but many may benefit from listing in the Convention. Further review of these species should be undertaken to determine whether individual species meet all of the criteria for listing, including in relation to the CMS definition of migration. Once suitable candidates for listing have been identified, consideration should be given as to how these gaps in the Appendices can be filled.
- **Prioritize research on 'Data Deficient' migratory species:** a disproportionate number of migratory crustaceans, cephalopods and fish are classified as 'Data Deficient' or have not been recently evaluated in the IUCN Red List, and little is known about the conservation status of many migratory insects. Further research into the conservation status and threats facing these species is needed.

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Goitered Gazelle (*Gazella subgutturosa*)

Introduction

This report is the first ever *State of the World's Migratory Species*. It provides an overview of the conservation status of migratory species and the pressures they face around the globe, highlights examples of actions being taken to conserve and promote the recovery of these species and their habitats, and provides conclusions that help define additional actions that should be taken.

The CMS Parties provided a clear mandate for this report. Preparation of a review on the conservation status of species listed in the CMS Appendices was identified as a high priority activity to pursue within the CMS Programme of Work in 2014 at the 11th meeting of the Conference of the Parties (COP11, Quito) and reaffirmed at the 12th meeting in 2017 (COP12, Manila). A preliminary compilation and analysis of information on conservation status, population trends and threats for CMS species was presented to the 13th meeting in 2020 (COP13, Gandhinagar); given the preliminary nature of the analysis, the COP13 document did not attempt to draw conclusions but identified aspects that could merit further work. In response, the Conference of the Parties adopted Decision 13.24, which directed the Secretariat to "*further develop the preliminary review of the conservation status of migratory species submitted to the Conference of the Parties at its 13th meeting (COP13)*".

This report follows through on this COP13 mandate and provides information on the status and threats to CMS-listed species, as well as on knowledge and implementation gaps, to help inform ongoing and future actions by CMS Parties and the wider global community to conserve these species.

Acknowledging that the species listed in the CMS Appendices represent just a subset, this report also provides information on all migratory species, some of which may also benefit from protection under the CMS Family.

Chapter I provides a brief introduction to CMS and how it operates, and provides background on the unique nature and importance of migratory species. Chapter II provides an overview of the current conservation status of CMS-listed species. It also describes long-term trends in conservation status and population abundance of CMS-listed and all migratory species using data from the Red List Index and the Living Planet Index. Chapter III details the key threats to migratory species and the impacts that these threats are having. Chapter IV highlights illustrative examples of key responses being implemented globally to tackle these threats and discusses the areas that need further action. The report also includes recommendations for consideration by the CMS Parties and Scientific Council.

Migrating Bar-tailed Godwits (*Limosa lapponica*) currently hold the world record for the longest non-stop flight by a migratory bird. It flies non-stop between Alaska and Australia, a journey of over 13,000 kilometres.

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Thresher Sharks (*Alopias* spp.)

I. CMS at a glance

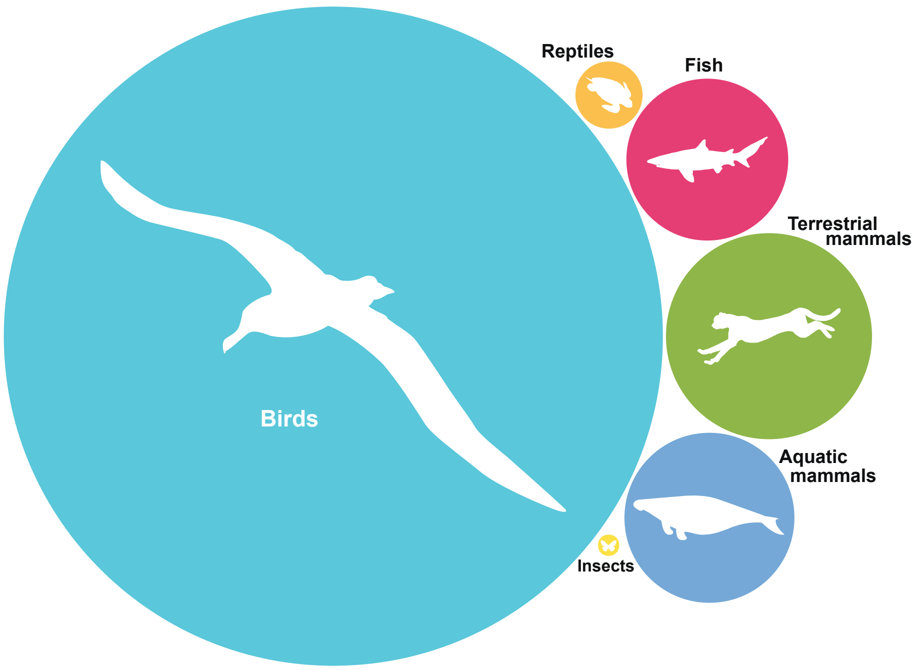
The Convention on the Conservation of Migratory Species of Wild Animals (CMS) is the global treaty of the United Nations that addresses the conservation and effective management of migratory species and their habitats. The Convention was established in recognition of the fact that conservation of migratory species requires the cooperation of countries across national borders, in all of the places where such species spend any part of their life cycle. The Convention therefore aims to conserve migratory species throughout their range through international cooperation and coordinated conservation measures.

The Convention has grown in scope and scale over the past four decades since its adoption in June 1979. There are now 133 Contracting Parties to CMS[a]. These Parties have made commitments to take action, both individually and together, to conserve migratory species and their habitats, as well as to address factors that impede their migration. In addition to the 133 CMS Parties, there are a further 28 countries that, although not Party to the Convention, are Party to one or more of the Agreements and/or are signatories to one or more of the Memoranda of Understanding (MOU) concluded under the umbrella of CMS.

The CMS Appendices

CMS has two Appendices that list the species to which the Convention applies (Figure 1.1). Species determined by Parties to meet the criteria can be listed within one or both of these Appendices. These Appendices cover a wide variety of bird species, as well as antelopes, elephants, bears, bats, whales, dolphins, sea turtles, sharks, rays, sawfish and sturgeons, to name but a few.

The species included in the Appendices are reviewed by the Conference of the Parties (COP), which convenes approximately every three years to review the implementation of the Convention and consider proposals for the amendment of the Appendices.



Group	I	I&II	II
Terrestrial mammals	21	5	68
Reptiles	1	7	2
Aquatic mammals	9	13	42
Fish	2	22	34
Birds	29	71	862*
Insects	0	0	1

***Figure 1.1:** **Overview of species listed in the CMS Appendices by taxonomic group and by Appendix:** birds (962 species*), terrestrial mammals (94), aquatic mammals (64), fish (58), reptiles (10) and one species of insect. (*The list of species covered under the higher-level listings for birds is under review, so numbers are approximate, see Annex A: Additional notes on the methods for further details.)*

[a] As of September 2023.

Article III of the Convention establishes that **Appendix I** is for listing of migratory species which are endangered. For species included in Appendix I, CMS Parties are obliged to prohibit the 'taking' of these species, with a narrow set of exceptions. CMS Parties are additionally directed to endeavour to conserve and restore important habitats of Appendix I species; to prevent, remove, compensate for or minimize the adverse effects of activities or obstacles that seriously impede or prevent migration; and to prevent, reduce or control factors that are endangering or are likely to further endanger the species[b].

Article IV of the Convention establishes that **Appendix II** is for listing of migratory species *"which have an unfavourable conservation status and which require international agreements for their conservation and management, as well as those species which have a conservation status which would significantly benefit from the international cooperation that could be achieved by an international agreement"*[c]. Range States to species listed in Appendix II are encouraged to conclude global or regional Agreements and Memoranda of Understanding (MOUs), where these would benefit the species, prioritizing those species with an unfavourable conservation status. These can be tailored to the implementation requirements of particular regions and/or conservation needs of specific taxonomic groups. Currently, seven legally binding Agreements and 19 international MOUs operate under the umbrella of CMS, covering almost 600 species, a large proportion of which are also listed in the CMS Appendices.

In addition to these Agreements and MOUs, CMS provides for the development of other instruments or processes. **Concerted Actions**[d] are priority conservation measures, projects, or institutional arrangements undertaken to improve the conservation status of selected Appendix I and II species or species groups[e]; 38 species were designated for Concerted Actions for the intersessional period between COP13 and COP14. **Single or Multi-Species Action Plans**, for example, a recent Single Species Action Plan for the Hawksbill Turtle (*Eretmochelys imbricata*), and **Special Species Initiatives**, such as the Joint CITES-CMS African Carnivores Initiative, offer further tools for coordinating conservation measures.

What is a migratory species?

Migratory behaviour is found in all major taxonomic groups of animals, including mammals, birds, reptiles, amphibians, fish and insects. The reasons why animals migrate are complex and can be driven by a combination of factors, including tracking of seasonal resources and favourable climatic conditions, and seeking optimal breeding sites. While many animal migrations occur in a regular and predictable pattern, some animal migrations can happen irregularly over longer timeframes, depending on the species and their specific ecological requirements.

Some species, such as sea turtles, undertake long solitary migrations, while others migrate collectively in vast numbers. Within species and populations, there can also be variation in migratory behaviour, with some populations or individuals that are resident in parts of the species' range and others that undertake long-distance migrations.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Green Turtle (*Chelonia mydas*)

The Convention defines a 'migratory species' as: *"The entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries."*

- Article I, paragraph 1 (a)

[b] Article III.4 and III.5 of the Convention.

[c] Article IV.1 of the Convention

[d] At COP11, Cooperative Actions, a rapid mechanism for Parties to cooperate to assist the conservation of species listed in Appendix II, and Concerted Actions, conservation initiatives to implement the provisions of the Convention through bilateral or multilateral cooperation for a selected number of species listed in Appendix I, were consolidated into a single process.

[e] Resolution 12.28 (Rev. COP13) Concerted Actions.

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Sanderlings (*Calidris alba*)

The importance of migratory species

Migratory animals are essential components of the ecosystems that support all life on Earth. Globally, billions of individual animals embark on migratory journeys each year, connecting distant continents, countries and habitats through their migration routes. Migratory species are of ecological, economic and cultural importance. Within ecosystems, migratory species perform a variety of crucial functions, ranging from the large-scale transfer of nutrients between environments, to the positive impacts of grazing animals on grassland biodiversity[1,2]. People around the world are reliant on these species as sources of food, income and enjoyment. Along their migration routes, migratory species provide vital benefits for people, from pollination of crops to supporting sustainable livelihoods. Migratory species are also valuable indicators of overall environmental health: trends in the conservation status and behaviour of migratory species can provide an indication of the state of habitats along entire migration routes.

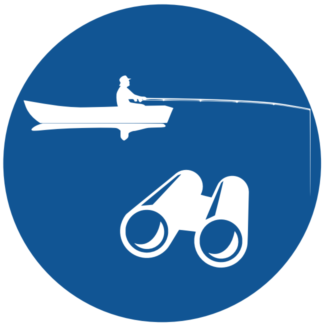
Declines in the abundance of migratory species may result in the loss of important functions and services. Conserving migratory species can also support the continued resilience of ecosystems in the face of a changing environment, including by mitigating climate change impacts. Emerging research on this theme is summarized within a recent review of 'Climate Change and Migratory Species: a review of impacts, conservation actions, ecosystem services and indicators'.

Nutrient cycling
Migratory species transfer energy and nutrients between marine, freshwater, and terrestrial ecosystems

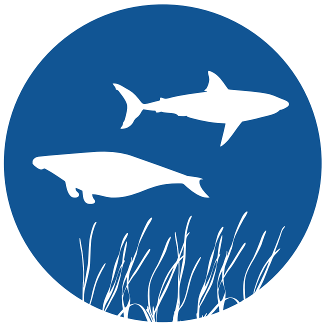
Pollination and seed dispersal
Migratory birds, bats, and insects pollinate flowering plants and shape ecosystem structure by dispersing seeds

Ecosystem regulation
Migratory species provide food for other animals and can regulate ecosystems through predation and grazing

Cultural values
Migratory species provide aesthetic enjoyment, educational value, and are spiritually significant



Sustainable use and livelihoods
Migratory species can be an important source of food and ecotourism attractions can generate income for local communities



Climate change mitigation
Marine migratory species sequester carbon and help maintain habitats that are effective carbon sinks

The following illustrative examples showcase the importance of migratory species to ecosystems and society:

Bats pollinate flowers and disperse seeds

Nectar-feeding and fruit-eating bats perform important ecosystem functions of pollination and seed dispersal. Bat pollination occurs in at least 528 species of flowering plants, and bats are involved in the propagation of cashew, mango, papaya, passionfruit and numerous species of fig (*Ficus*) used for rubber, timber, paper, fibers and medicine[3]. Large colonies of the Straw-coloured Fruit Bat (*Eidolon helvum*; CMS Appendix II) are known to play a role in the dispersal of Iroko (*Milicia*), an economically important timber; however, this species is threatened by deforestation and hunting for wild meat. Currently, more than 50 bat species are listed in the CMS Appendices, and all European bats are afforded additional protection under the EUROBATS CMS Agreement.

Straw-coloured Fruit Bat (*Eidolon helvum*)

Cultural importance of migratory birds

Migratory species have held cultural significance throughout human history, inspiring art, music and literature. Migratory birds, in particular, have been associated with journeys, new beginnings, and the coming of seasons. Heralding the start of spring, the Egyptian Vulture (*Neophron percnopterus*; CMS Appendix I/II) signals a good omen for health and productivity[4], while the arrival of the White Stork (*Ciconia ciconia*; CMS Appendix II) is considered a widespread symbol of birth and prosperity. Bird migrations play essential roles in many traditions and practices. The migration of the Black-necked Crane (*Grus nigricollis;* CMS Appendix I/II) in south and southeast Asia, for example, has sacred symbolic meaning in Buddhist culture[5]. The cultural significance of species can often help to encourage conservation efforts; for example, the importance of the Andean Condor (*Vultur gryphus*) to Indigenous Peoples and local communities in South America has led to their participation in species recovery and awareness programmes[6].

Andean Condor (*Vultur gryphus*)

The European Eel plays an important role in freshwater food webs

The Critically Endangered European Eel (*Anguilla anguilla*; CMS Appendix II) undergoes the longest and most complex migration of any freshwater eel[7], with the first direct evidence of its journey from the Atlantic coast of Europe to the Sargasso Sea to spawn published in 2022[8]. The species historically represented over 50% of fish biomass in most European freshwater environments, and therefore played an important role in the freshwater food web and ecosystem functioning[9]. However, European Eel juvenile recruitment has declined by 95% since the 1980s[10] due to a series of threats ranging from barriers to migration to overexploitation during its early life stages[7].

European Eel (*Anguilla anguilla*)

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Red Knot (*Calidris canutus*)

II. STATE – Conservation status

Conservation status and trends

- Overall, more than one in five CMS-listed species are threatened with extinction and 44% have a decreasing population trend
  - 82% of Appendix I species are threatened with extinction and 76% are declining
  - 18% of Appendix II species are globally threatened; yet 42% have a decreasing population trend
- The conservation status of CMS-listed fish is of particular concern. Almost all (97%) of CMS-listed fish are threatened with extinction and, on average, are decreasing in population abundance
- Extinction risk is rising overall across CMS-listed species: between 1988 and 2020, 70 CMS species moved to a higher IUCN Red List threat category due to a deterioration in conservation status, while 14 species showed a genuine improvement

Migratory species that may benefit from increased protection or conservation action under CMS

- There are 399 globally threatened and Near Threatened migratory species (mainly birds and fish) that are not listed in the CMS Appendices; these species deserve closer scrutiny from CMS Parties and the Scientific Council, and may benefit from being listed in the CMS Appendices
- A total of 179 species listed in Appendix II were identified as ‘very high’ (52 species, 5%) and ‘high’ (127 species, 13%) priorities for further conservation measures

The overarching mission of CMS is to “promote actions to ensure the favourable conservation status of migratory species and their habitats”[a]. This chapter lays the foundation for understanding the conservation status of migratory species, which is essential to provide context for the steps to be taken to conserve them. It provides an overview of the conservation status of CMS-listed species overall, by Appendix, by taxonomic group and by region, where appropriate. It also provides insights into the extinction risk and abundance trends of all migratory species. The information is drawn primarily from IUCN Red List assessments and data from the Living Planet Index (managed by the Zoological Society of London in collaboration with WWF), which together provide the most comprehensive assessments of conservation status and population abundance for species worldwide.

Dalmatian Pelicans (*Pelecanus crispus*)

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[a] CMS Strategic Plan for Migratory Species 2015-2023

Conservation status of CMS-listed species

An analysis of data from the IUCN Red List shows that 22% (260 species) - or over one in five - of the 1,189 CMS-listed species are considered threatened with extinction (i.e. assessed as Critically Endangered (n = 68), Endangered (n = 78), or Vulnerable (n = 114) (Figure 2.1a)[b]. Of these 260 species threatened with extinction, over half (56%) are listed in CMS Appendix I. Almost all CMS-listed species assessed as Least Concern (n = 819) are listed in Appendix II (99%), with the vast majority of these covered by Appendix II under higher level genus or family listings.

Appendix I

Of the 180 species listed in Appendix I, 147 (82%) are categorized as threatened with extinction; of these, 43 are Critically Endangered and 52 are Endangered (Figure 2.1b).

Among the remaining 33 Appendix I species, 16 species are categorized as Least Concern, some of which have been favourably reassessed as they have been experiencing recoveries after historically suffering significant population losses. Notably, however, at least five of these Least Concern species have subpopulations or subspecies that are assessed as threatened (see example in Box 1), and two species have decreasing global populations trends.

Appendix II

There are currently 112 (10%) species listed in Appendix II that are categorized as Critically Endangered or Endangered, which includes 60 species that are also listed in Appendix I. Excluding those species listed in both Appendices, there are 52 species (5% of Appendix II species) listed exclusively in Appendix II that are either Critically Endangered (24) or Endangered (28) (Figure 2.1b). Almost half of these 52 species are fish, including several species of sturgeon, shark, ray and sawfish (for further details, see the section *Migratory species that may benefit from increased protection or conservation action under CMS*).

The majority of the Appendix II species that are assessed as Least Concern are birds and a smaller number of bats listed at the genus or family level (86%). Of the 814 Least Concern species in Appendix II, 27% have a declining population trend, highlighting that populations are decreasing even within non-threatened categories.

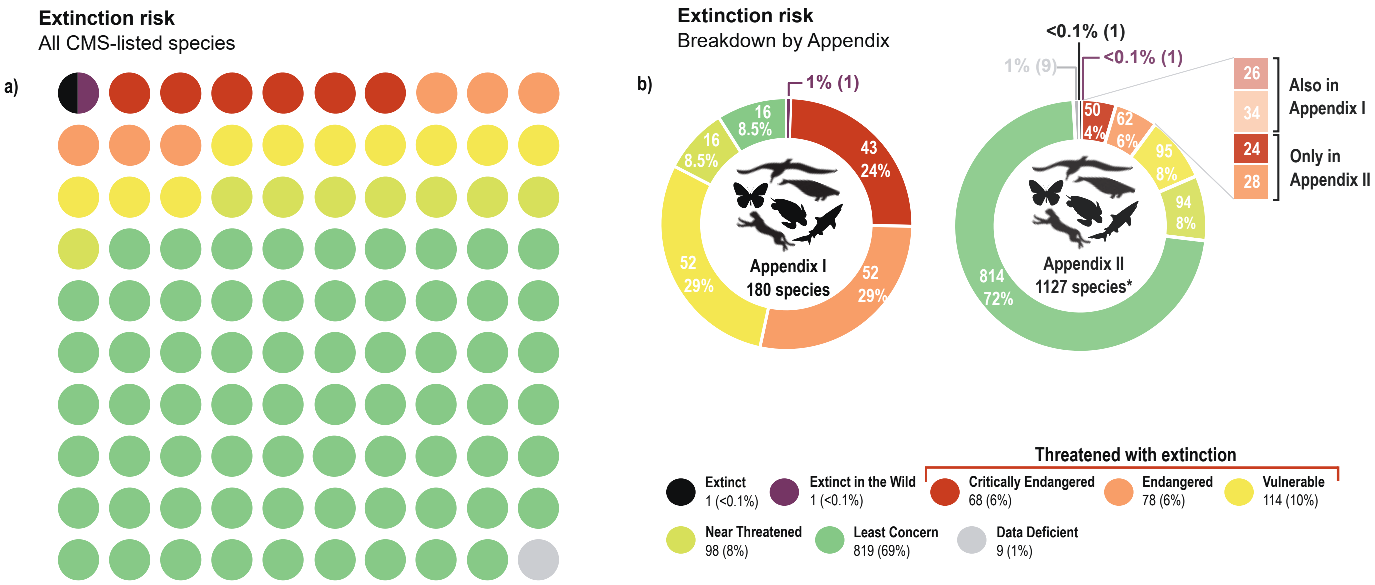


Figure 2.1: ***a)*** *Proportion of CMS-listed species in each IUCN Red List category (one circle represents 1% of CMS-listed species; see key for the number of CMS-listed species in each category).*
b) *breakdown of extinction risk by CMS Appendix. There are 118 species that are listed in both Appendix I and II; these are shown in both charts in b). (*One CMS Appendix II species,* Gazella erlangi*, has not been assessed by the IUCN Red List). See methodology in Annex A.*

NB: It is important to note that the vast majority of CMS-listed Least Concern species (86%) are birds and a smaller number of bats listed in the Appendices at the genus or family level.

[b] As global IUCN Red List assessments were used as the source of information for most CMS-listed species, the IUCN Red List categories presented in this analysis therefore mostly reflect global extinction risk. In cases where subspecies or specific populations are listed in the CMS Appendices, information was obtained from a corresponding regional, subspecies or subpopulation-level IUCN assessment; but only in a limited number of cases where relevant and up-to-date assessments were available (see Annex A for further details).

Population trends

According to the IUCN Red List, 520 (44%) species listed in the CMS Appendices are showing declining population trends. By Appendix, 137 (76%) CMS Appendix I species and 477 (42%) CMS Appendix II species are decreasing in global population size (Figure 2.2). Only 12% of species in each Appendix are showing increasing population trends: 21 and 133 species are increasing in population size in Appendix I and Appendix II, respectively. Just nine (5%) Appendix I species have a stable population trend, compared to 371 (33%) Appendix II species. A further 150 CMS-listed species (7% of Appendix I species and 13% of Appendix II species) have an unknown or unassessed population trend.

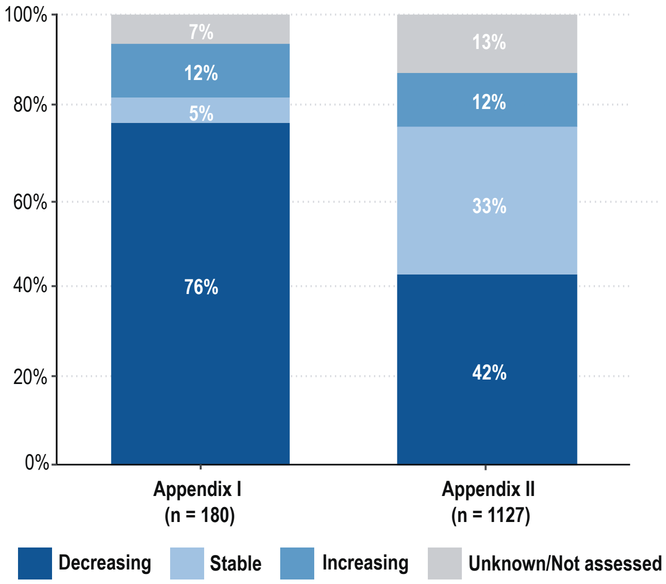


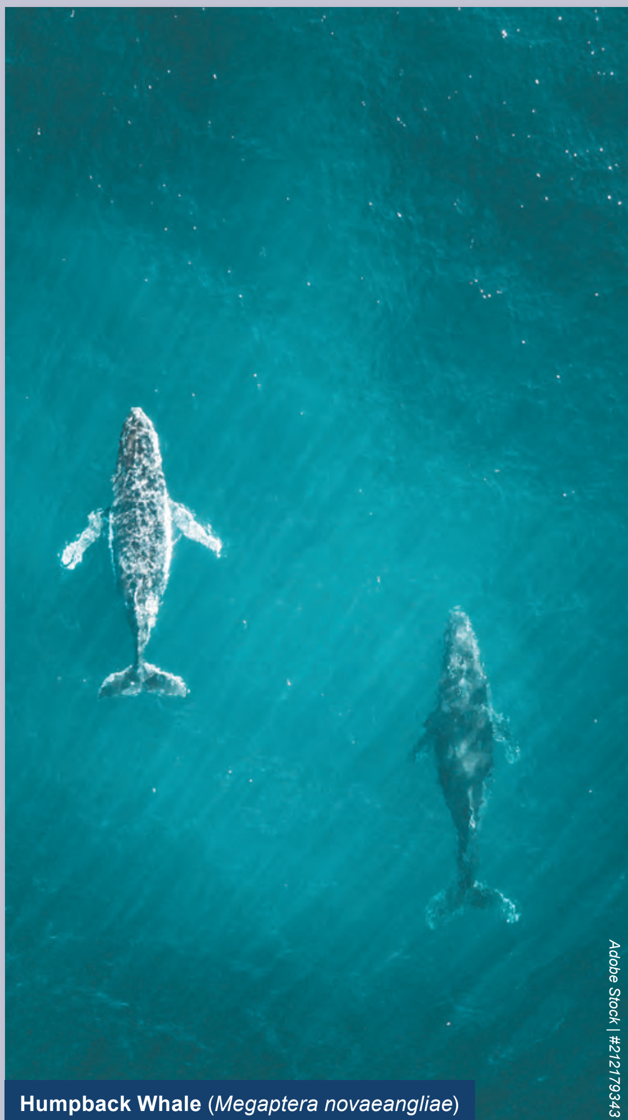
Figure 2.2: *Population trends of CMS-listed species by Appendix. Species listed in both Appendix I and II are represented in both bars.*

Box 1. Humpback Whale (Megaptera novaeangliae)*: CMS Appendix I (1979)*

Like many whale species, the Humpback Whale, *Megaptera novaeangliae*, was heavily hunted for its oil and baleen from the 1700s to early 1900s before international restrictions on commercial whaling were introduced[1]. Following centuries of commercial whaling, populations were heavily depleted, and the species was assessed by the IUCN Red List as globally Endangered in 1986[1]. However, following the introduction of protections from commercial whaling, the Humpback Whale population has been increasing at a global level and the species is now categorized as Least Concern with an estimated global population of over 80,000 mature individuals[1].

The western South Atlantic population, following a sharp decline from a pre-whaling abundance of 27,000 individuals to 450 individuals in the mid-1950s, was estimated in 2019 to have recovered to approximately 93% of its pre-whaling population size[2]. However, other Humpback Whale subpopulations have not seen such recoveries. For example, the Arabian Sea subpopulation is estimated to number fewer than 250 individuals[3] and was categorized as Endangered by IUCN in 2008[4]. Due to the isolation and genetic distinctiveness of this subpopulation and threats including entanglement in fishing gear and ship strikes, a Concerted Action for Humpback Whales (*Megaptera novaeangliae*) of the Arabian Sea was adopted at CMS COP12 and was extended for an additional three years at COP13[3]. The Concerted Action defines a list of priority activities to support improved understanding and conservation management of the Humpback Whale in the Arabian Sea, with the goal of producing a regional management plan for the subpopulation.

This example illustrates that while on a global scale a species may have an overall favourable conservation status, this might not be reflected at local scales, and geographically targeted actions may still be necessary.



Humpback Whale (*Megaptera novaeangliae*)

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Conservation status by taxonomic group

Analysis of the IUCN Red List assessments by taxonomic group (Figure 2.3) reveals a mixed picture – with certain groups having a more unfavourable conservation outlook overall than others. For example, over two thirds (70%) of the CMS-listed reptiles and nearly all (97%) of the CMS-listed fish are threatened with extinction, including 28 fish species that are categorized as Critically Endangered.

In contrast, the outlook for birds and mammals appears more favourable overall, with more than three quarters (78%) of the birds and almost half of the CMS-listed mammals (44%) - terrestrial (43%) and aquatic (45%) - categorized as Least Concern.

It is important to note, however, that, in real terms, there are still large numbers of birds (134 species, 14%), and mammals (63 species, 40%) that are globally threatened. While the proportion of threatened birds and mammals appears to be small (due to the large numbers of birds and mammals listed in the CMS Appendices overall), these percentages still represent a high number of species that require conservation action. The high proportion of CMS-listed bird species that are 'Least Concern' is largely a result of higher-level listings for whole genera or families (e.g. Appendix II listings for Muscicapidae). Of the 962 bird species in the Appendices, 85% are covered under higher-level listing.

Monarch Butterfly (*Danaus plexippus*)

The only insect listed in the CMS Appendices - the Monarch Butterfly (*Danaus plexippus*) – is assessed as Least Concern, though the migratory monarchs (subspecies *plexippus*) were recently classified as Endangered, due to declines in the abundance of migratory populations and the small size of their over-wintering range. This is just one example that illustrates the importance of careful interpretation of global conservation status, as the status of subpopulations can differ considerably from the species' global status.

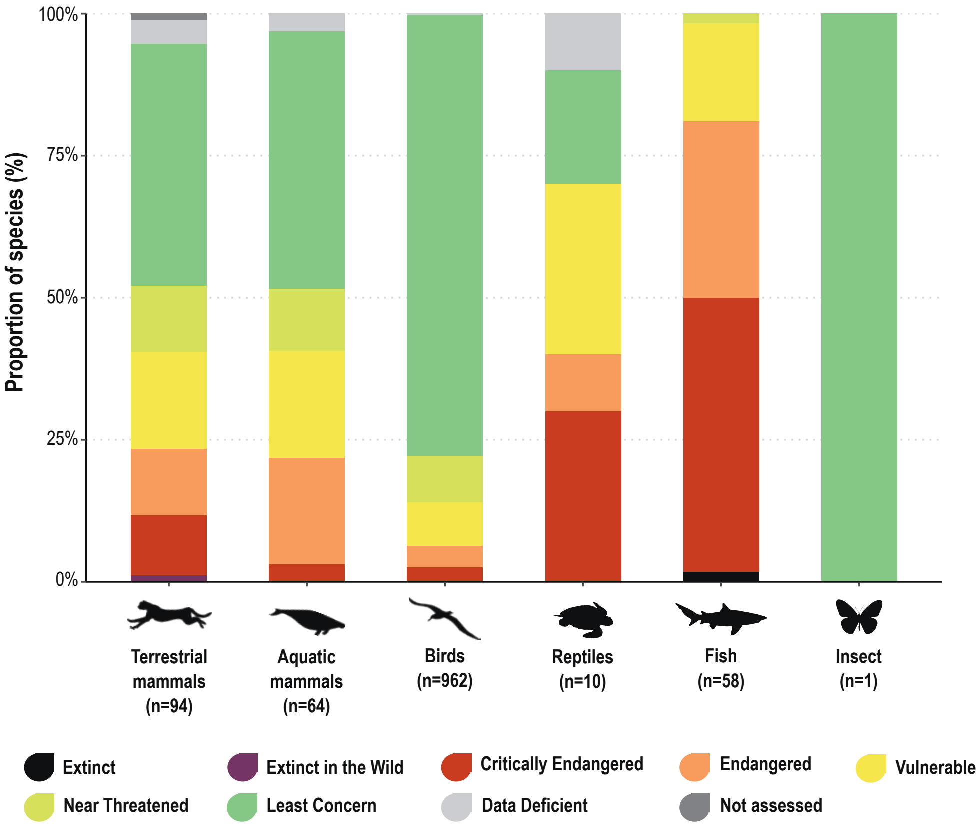

Figure 2.3: *Proportion of CMS-listed species classified in each IUCN Red List category, by taxonomic group.*

Beyond extinction risk: the IUCN Green Status of Species

While an IUCN Red List assessment quantifies a species' risk of extinction, a complementary tool, the IUCN Green Status of Species, has been recently developed to present a road map to recovery. It assesses the extent to which a species has recovered, and quantifies the importance of past, present, and future conservation efforts for the species, to evaluate its potential for recovery.

The recent 2021 assessment of the Whale Shark (*Rhincodon typus*), for example, indicated that while the species is Endangered with a Species Recovery Category of 'Largely Depleted' (29%)[c], the potential for future recovery of functional populations across its historical range is high[5]. Assuming increased and sustained conservation efforts to counter its principal threats (high levels of fishing, bycatch in gillnet and purse seine fisheries, ship strikes and marine pollution), it is expected that populations would stabilize within a 10-year period[6].

The Green Status has been an optional part of Red List assessments since 2020. To date (April 2023), six CMS-listed species have been assessed; here, their Species Recovery Category and recovery potential[d] are summarized:

- Saiga (*Saiga tatarica*) (Largely Depleted, 38%; Recovery potential: Medium)
- Vicuña (*Vicugna vicugna*) (Moderately Depleted, 67%; Recovery potential: Medium)
- Black Stork (*Ciconia nigra*) (Moderately Depleted, 67%; Recovery potential: Medium)
- African Penguin (*Spheniscus demersus*), (Largely Depleted, 33%; Recovery potential: Medium)
- Whale Shark (*Rhincodon typus*) (Largely Depleted, 29%; Recovery potential: High)
- White Shark (*Carcharodon carcharias*) (Moderately Depleted, 56%; Recovery potential: Indeterminate)


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Whale Shark (*Rhincodon typus*) is threatened by overexploitation and collisions with vessels. Its potential for recovery is high, but this is reliant on sustained conservation efforts.

[c] The 'Species Recovery Category' is based on an estimated recovery score ranging from 0-100%, which indicates the extent to which a species is "fully recovered" (0% = Extinct; 100% = fully recovered, i.e. viable and ecologically functional in every part of its range). Further details of the IUCN Green Status of Species, including definitions and methodologies, are available at: https://portals.iucn.org/library/sites/library/files/documents/2021-022-En.pdf

[d] 'Recovery potential' is an "aspirational yet achievable vision for the recovery of a species" (see Akçaya et al., 2018); it measures the extent to which a species' conservation status could improve over the next 100 years, given the state of the world today.

Trends in the conservation status and population abundance of migratory species

The Red List Index

The Red List Index (RLI)[e] shows trends in overall extinction risk by measuring the change in survival probability for a subset of species; this is determined based on genuine changes in the number of species in each extinction risk category in the IUCN Red List (i.e. excluding any changes that result from improved knowledge or revised taxonomy). It is important to note that the RLI for a subset of species is calculated as an aggregate of the survival probabilities of the species contained in that subset, and therefore that individual species may be doing better, or worse, than the overall resulting trend. The RLI value ranges from 1 (if all species are categorized as 'Least Concern') to 0 (if all species are categorized as 'Extinct'). A lower RLI value therefore indicates that a group of species is closer to extinction. A steeper downward RLI slope indicates a faster move towards extinction.

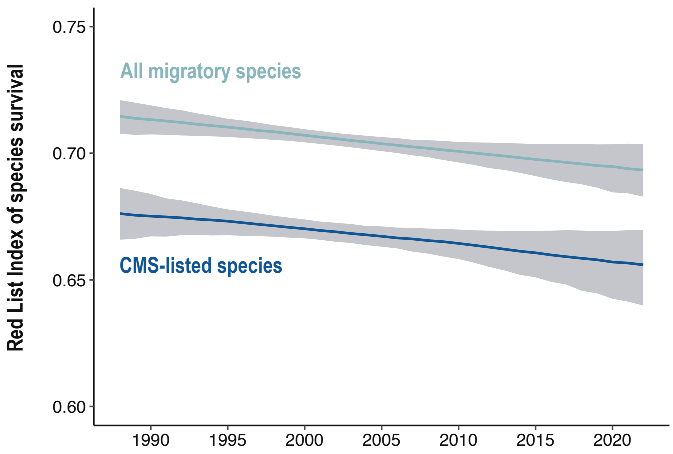

Figure 2.4:** Red List Index of species survival for CMS-listed (n=1,118)* ***and all migratory *(n=2,428)* ***species for which data were available.*** *Grey shading shows confidence intervals. An index value of 1 equates to all species being categorized as 'Least Concern', while an index value of 0 equates to all species being categorized as 'Extinct'.*

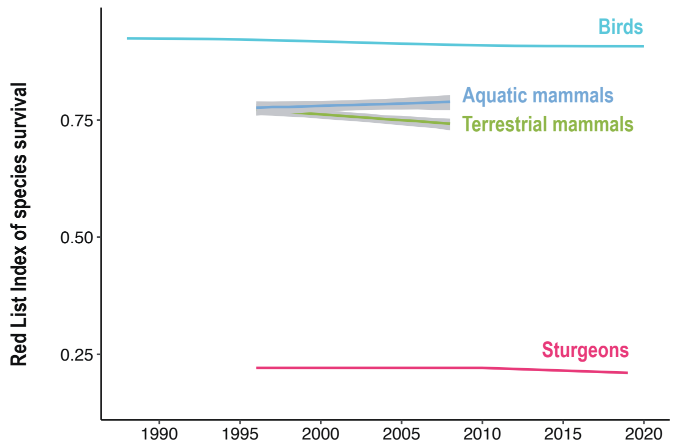

***Figure 2.5:** Red List Index of species survival for CMS-listed species for which data were available* *(birds n=955; terrestrial mammals n=90, aquatic mammals n=54 and sturgeons n=19). Grey shading shows confidence intervals; those for birds and sturgeon are overlaid by the line. An index value of 1 equates to all species being categorized as 'Least Concern', while an index value of 0 equates to all species being categorized as 'Extinct'.*

While trends can be disaggregated by region, taxonomic group, or threat types, certain subsets of the data result in too few species in the group with sufficient data to calculate meaningful Indices; it was therefore only possible to obtain disaggregates by taxonomic group for aquatic mammals, terrestrial mammals, birds and sturgeons. The data required to calculate the Indices for other fish groups, such as sharks and rays, were not available, which also precluded the calculation of the Index for fish overall. Additionally, the RLI for mammals could only be calculated for the period 1996-2008; as the mammals were comprehensively reassessed by IUCN recently, the evaluation of whether any changes in survival probability represent genuine changes in status is still ongoing and this data could not yet be integrated into the calculation of the index.

Globally, the extinction risk for migratory and CMS-listed species is increasing

The Red List Index for CMS-listed species and for all migratory species show a decreasing trend, indicating that these subsets of species, overall, are moving towards extinction (Figure 2.4). For CMS-listed species, this trend represents 70 species which have moved to higher threat categories over the period, outweighing the 14 species which showed an improvement in status. The rate of decline of the RLI for CMS-listed species is comparable to that of all migratory species, but CMS-listed species are more threatened overall (i.e. the aggregated RLI values for this subset of species are lower) (Figure 2.4).

CMS-listed birds are the least threatened group[f], while CMS-listed sturgeons (the only fish group for which the data needed to calculate the Index were available) are the most threatened (Figure 2.5). All groups except aquatic mammals show declines, with terrestrial mammals exhibiting the fastest decline (Figure 2.5). The increasing RLI trend for aquatic mammals overall is likely driven in part by the improved status of certain whale species following international restrictions on whaling[6,7]. It is important to remember, however, that the RLI is an aggregate of changes for species within a subset, and therefore this overall positive trend may mask deteriorations in status of individual species.

When disaggregating species by region, the RLI shows that CMS-listed species occurring in Asia are the most threatened overall and, along with those in Africa and North America, are experiencing the fastest declines (Figure 2.6). The RLI for CMS-listed species present in Europe and the South and Central America and the Caribbean regions, however, have shown increases in the last 10 years, reflecting more positive changes in IUCN Red List threat status classifications than deteriorations (Figure 2.6). In most regions, the trend in RLI for CMS-listed species is comparable to those for migratory species in general, with the exception of North America and Oceania (Figure 2.6). While CMS-listed species in the Oceania region appear to have a relatively stable trend, migratory species as a whole in this region are experiencing the fastest decline of any region (Figure 2.6).

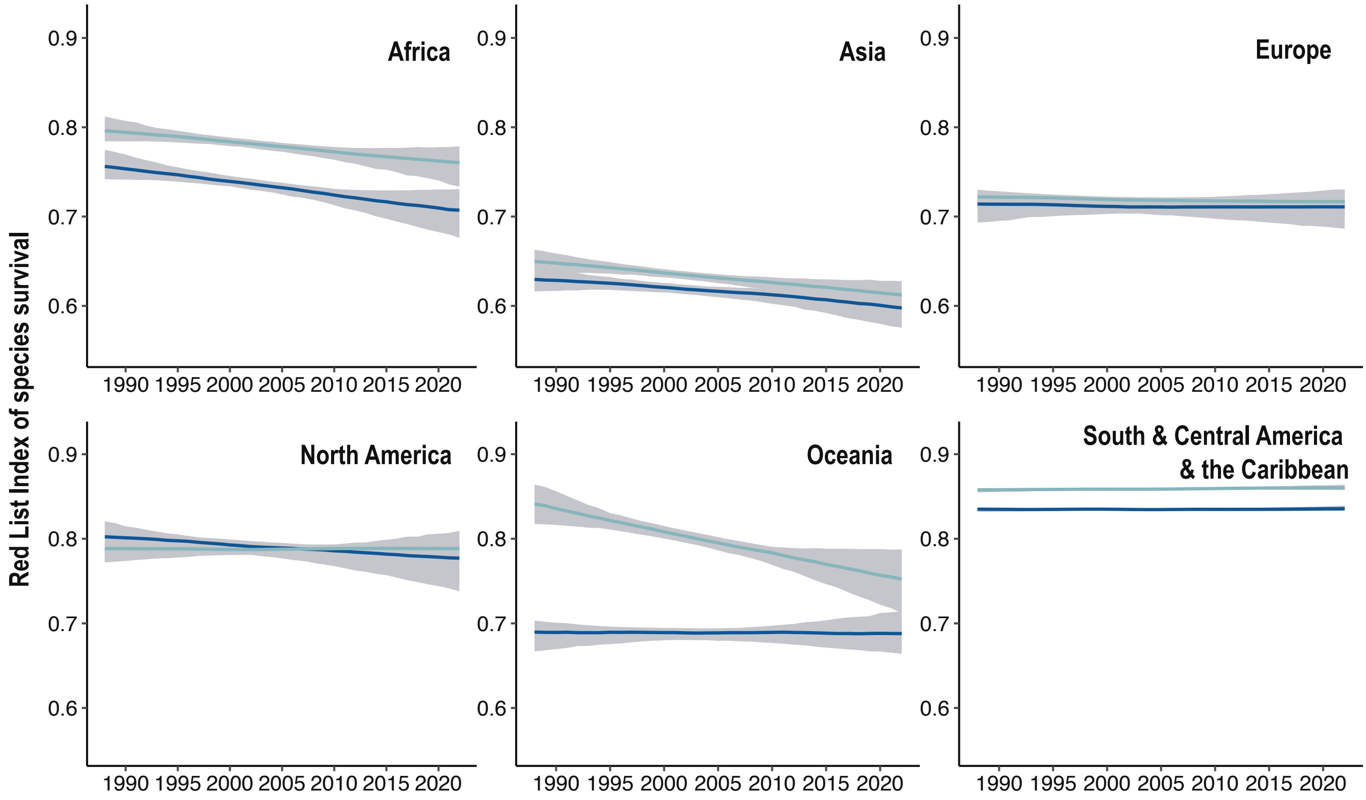

Figure 2.6:* Red List Index of species survival by CMS region for CMS-listed species** *(dark blue lines; Africa n=438; Asia n=622; Europe n=481; North America n=235; Oceania n=212; South & Central America & the Caribbean n=233)* ***and all migratory species *(light blue lines; Africa n=704; Asia n=1,011; Europe n=784; North America n=675; Oceania n=505; South & Central America & the Caribbean n=804). Grey shading shows confidence intervals. An index value of 1 equates to all species being categorized as 'Least Concern', while an index value of 0 equates to all species being 'Extinct'.*

The Living Planet Index for Migratory Species

The Living Planet Index (LPI) tracks the average change in relative abundance of wild species' populations over time. The global Index is constructed by calculating an average trend for tens of thousands of terrestrial, freshwater and marine vertebrate populations from across the globe. The underlying database (Living Planet Database) contains data on over 38,000 populations of more than 5,200 species, collated from a variety of sources. The LPI data can be disaggregated to show trends in certain subsets of data, such as species listed in the CMS Appendices; the following section, based on analyses by the Zoological Society of London (ZSL) produced for this report, summarizes the key trends in the LPI for migratory species, with a focus on those species which are listed in the CMS Appendices.

Taxonomic coverage of the LPI dataset is not complete but can be considered good for CMS-listed species, with over half of species represented in the index, ranging from 50% representation (birds) to 100% (reptiles). By contrast, coverage for migratory species overall ranges from 23% (fish) to 85% (reptiles), with only one in three species represented in the dataset across all taxonomic groups.

South Andean Deer (*Hippocamelus bisulcus*)

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[e] For more information on the Red List Index, visit http://iucnredlist.org/assessment/red-list-index

[f] This differs from the trends reported in the 2019 assessment of the Strategic Plan for Migratory Species due to an increase in the number of bird species included in the underlying dataset based on ongoing work to disaggregate the higher-level Appendix II listings for birds.

Globally, monitored populations of migratory species have declined by an average of 15% between 1970 and 2017

Based on abundance information from 15,923 populations of 1,710 migratory species[g] of mammals, birds, reptiles and fish, the Living Planet Index shows an overall average decline of 15% for all migratory species (range: -23% to -6%) between 1970 and 2017[h] (Figure 2.7). The LPI for the subset of these migratory species which are listed in the CMS Appendices shows an overall average increase of 1% (range: -11% to +16%) over the same time period (based on 9,801 populations of 615 species) (Figure 2.7). It is important to note that these figures represent average rates of change in the abundance of monitored species over time, so some populations may be increasing or declining at higher rates compared to the average[i].

The difference in average trend between all migratory populations and those listed in the CMS Appendices is likely explained in part due to the difference in the number of species in different taxonomic groups: for example, while the dataset for all migratory species contains 582 species of migratory fish, which tend to show negative population trends, the CMS-listed species dataset contains 37 migratory fish species.

The finding of an overall average increase in the relative population abundance of CMS-listed species contrasts with the Red List Index for this subset, which saw an increase towards extinction (Figure 2.4); this difference could reflect differences in methodology or arise from differences in taxonomic composition of the species lists for which data were available.

Wandering Albatross (*Diomedea exulans*)

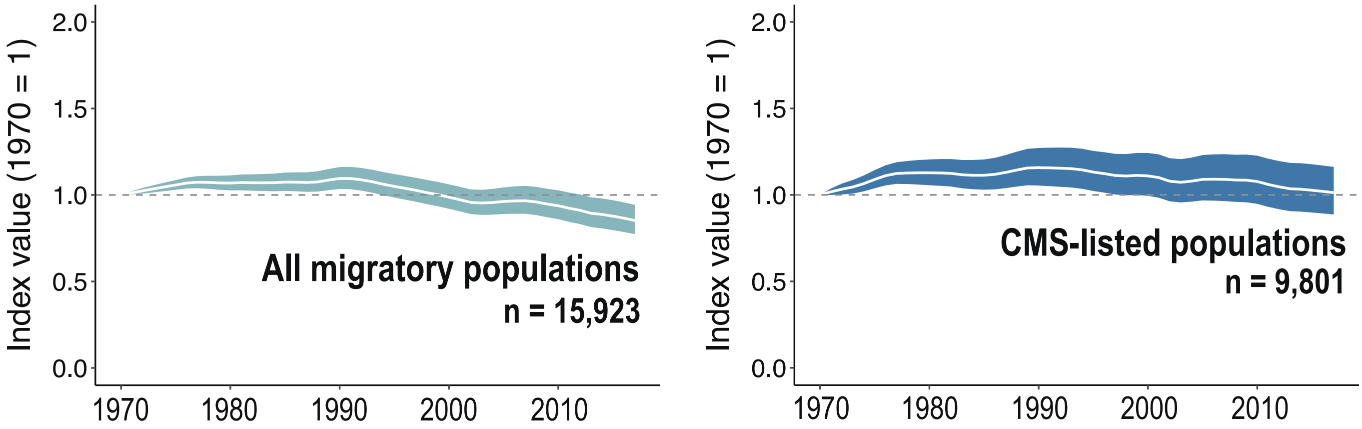


Figure 2.7: ***Average change in relative abundance, between 1970 and 2017, of all monitored migratory species of birds, mammals, fish and reptiles*** *(based on 15,923 populations of 1,710 species) and of* ***CMS-listed species monitored globally*** *(based on 9,801 populations of 615 fishes, birds, mammals and reptiles). Shaded areas represent the statistical uncertainty surrounding the trend.*

[g] This includes CMS-listed species, in addition to species recognized as 'Full Migrants' by the IUCN Red List or identified as a longer-distance migrant by the Global Register of Migratory Species (GROMS).

[h] 2017 is the most recent year for which LPI data were available for migratory populations in this analysis.

[i] Additionally, the LPI does not show the number of individual animals or the proportion of a population that has been lost. For further guidance on interpretation, see: https://www.livingplanetindex.org/documents/LPR_2022_TechnicalSupplement_DeepDiveLPI.pdf

Globally, according to the LPI, average abundance trends of most taxonomic groups of CMS-listed species are stable or increasing since 1970

For CMS-listed species, most taxonomic groups are showing either an average increase or a stable trend in population abundance since 1970 (Figure 2.8). Notably, migratory fish are the only taxonomic group showing an average decreasing trend in population abundance, with CMS-listed fish species showing the largest declines (-90%) (Figure 2.8).

It is important to note that trends at the broad taxonomic level may mask population declines in specific subsets of species. For example, although the LPI indicates that populations of CMS-listed birds have increased by 11% on average (Figure 2.8), analyses based on other datasets provide strong evidence for declines in the abundance of long-distance migratory birds[8,9]. Additionally, for some groups, population declines may have mostly occurred prior to 1970; for example, large-scale exploitation of aquatic mammals (such as whales and dolphins) largely occurred prior to the 1970 LPI baseline[6], therefore the monitoring started when these populations were already at a depleted state.

-90%

Average decline in CMS-listed fish populations since 1970

Global populations of the Critically Endangered Scalloped Hammerhead (*Sphyrna lewini*) have undergone steep declines.

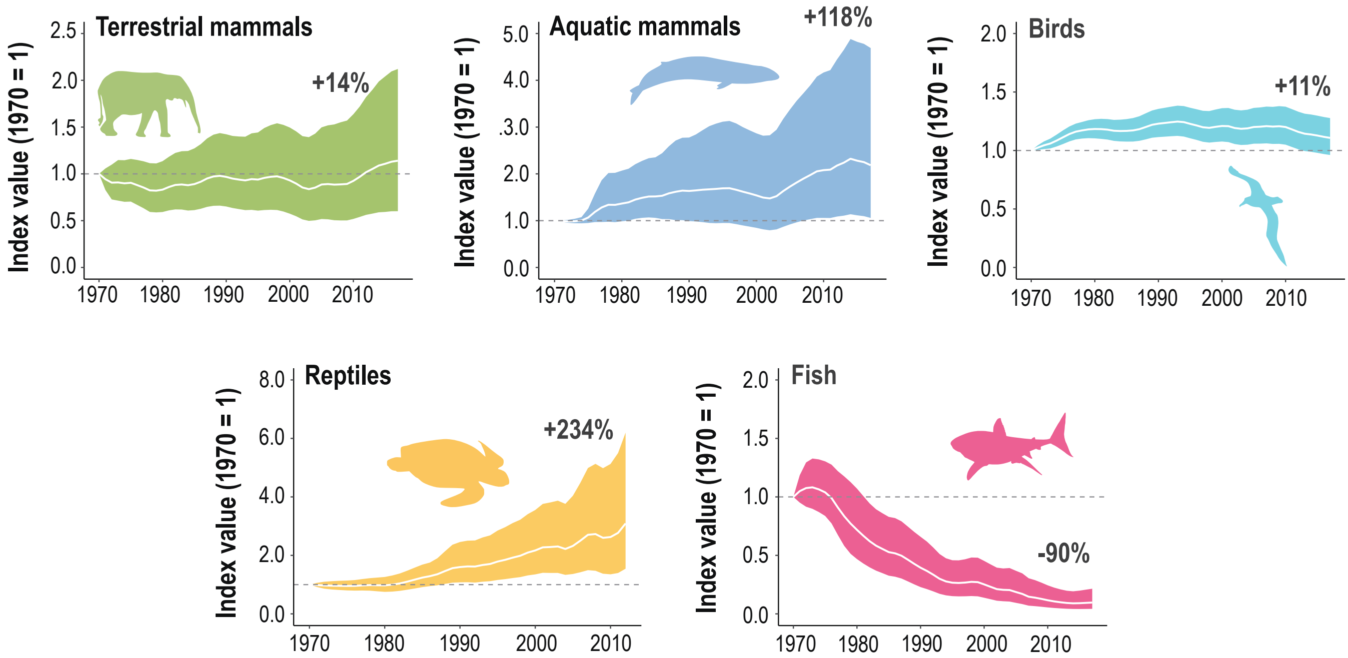


Figure 2.8:* Average change in relative abundance, between 1970 and 2017 of CMS-listed species by taxonomic group.** *From left to right, trends are for 8,822 monitored populations of 479* ***bird species *(+11%, range: -4% to +28%); 176 populations of 37* ***fish species*** *(-90%, range: -96% to -78%); 325 monitored populations of 50* ***terrestrial mammal species*** *(+14%, range: -40% to +112%); 233 populations of 39* ***aquatic mammal species*** *(+118%, range: +6% to +369%); and 245 populations of 10* ***reptile species*** *(+234%, range: +64% to +582%), and shaded areas represent the statistical uncertainty surrounding the trend. Note the different y-axis scales due to different ranges of confidence intervals across taxonomic groups.*

Hawksbill Turtle (*Eretmochelys imbricata*)

Average declines of CMS-listed species are generally observed more in the tropics

When disaggregating CMS-listed species by region, for regions with more tropical climates – Africa, Asia and Oceania – and Antarctica, the LPI reveals an average decrease in abundance between 1970 and 2017, ranging from -66% in Asia to -27% in Africa (Figure 2.9). However, in South America, monitored populations of CMS-listed species show an average 90% increase (range: -34% to +439%) in abundance compared to the baseline but with the greatest amount of variation in the underlying species trends among the regions. While on average, CMS-listed fish are declining (see Figure 2.8), a small number of CMS-listed fish in South America are increasing in abundance[j], which along with reptiles and terrestrial mammals, contribute to the positive average trend observed for this region. While relatively stable and increasing average trends are observed for North America and Europe, respectively (Figure 2.9), it is important to note that much of the habitat changes in Europe and North America occurred prior to the 1970 baseline, meaning that monitored populations for these regions are starting from a more depleted state compared to other regions.

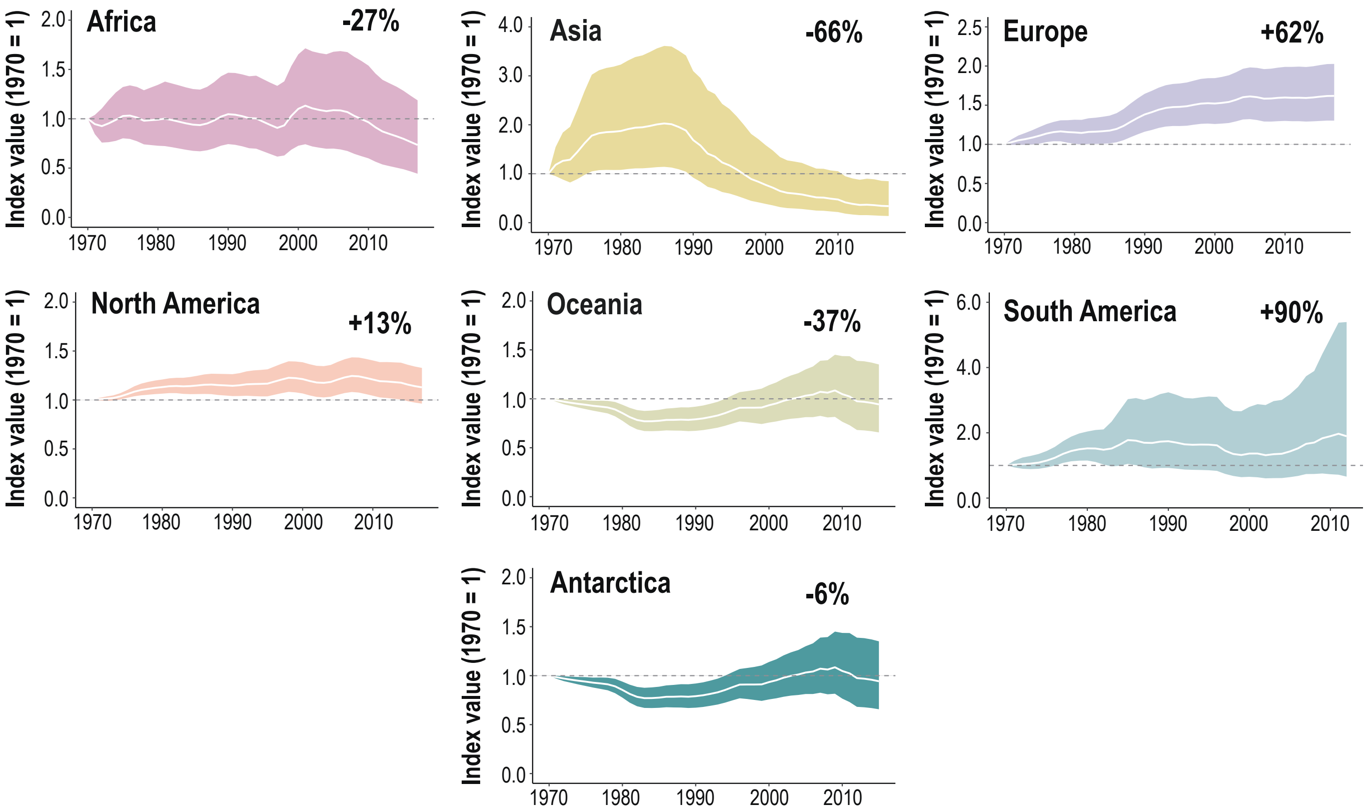


Figure 2.9: ***Average change in relative abundance, between 1970 and 2017, of CMS-listed species by region.*** *Trends are for 631 populations of 161 species in* ***Africa*** *(-27%, range -56% to +19%); 370 populations of 126 species in* ***Asia*** *(-66%, range -86% to -15%); 1,627 populations of 291 species in* ***Europe*** *(+62%, range +30% to +103%); 420 monitored populations of 206 species in* ***North America*** *(+13%, range -4% to +33%); 6,356 monitored populations of 52 species in* ***Oceania*** *(-37%, range -60% to 0%); 86 populations of 13 species in* ***Antarctica***[k] *(6%, range -34% to +35%); and 270 populations of 74 species in* ***South America*** *(+90%, range -34% to +439%). Shaded areas represent the statistical uncertainty surrounding the trend. Please note the different y-axis scales due to the large range of confidence intervals across regions.*

[j] These are three shark species: *Carcharhinus longimanus* (Oceanic Whitetip), *Isurus oxyrinchus* (Shortfin Mako), and *Lamna nasus* (Porbeagle). Abundance information is based on catch per unit effort (CPUE) data.

[k] Antarctica is not a CMS region but contains populations of CMS-listed species.

Migratory species that may benefit from increased protection or conservation action under CMS

One function of the CMS Scientific Council is to formulate recommendations on migratory species to be included in Appendices I and II, and to review the current composition of these Appendices. To support this function, this section identifies migratory species that may benefit from being listed in CMS, and also considers currently listed Appendix II species that may benefit from increased protection under CMS.

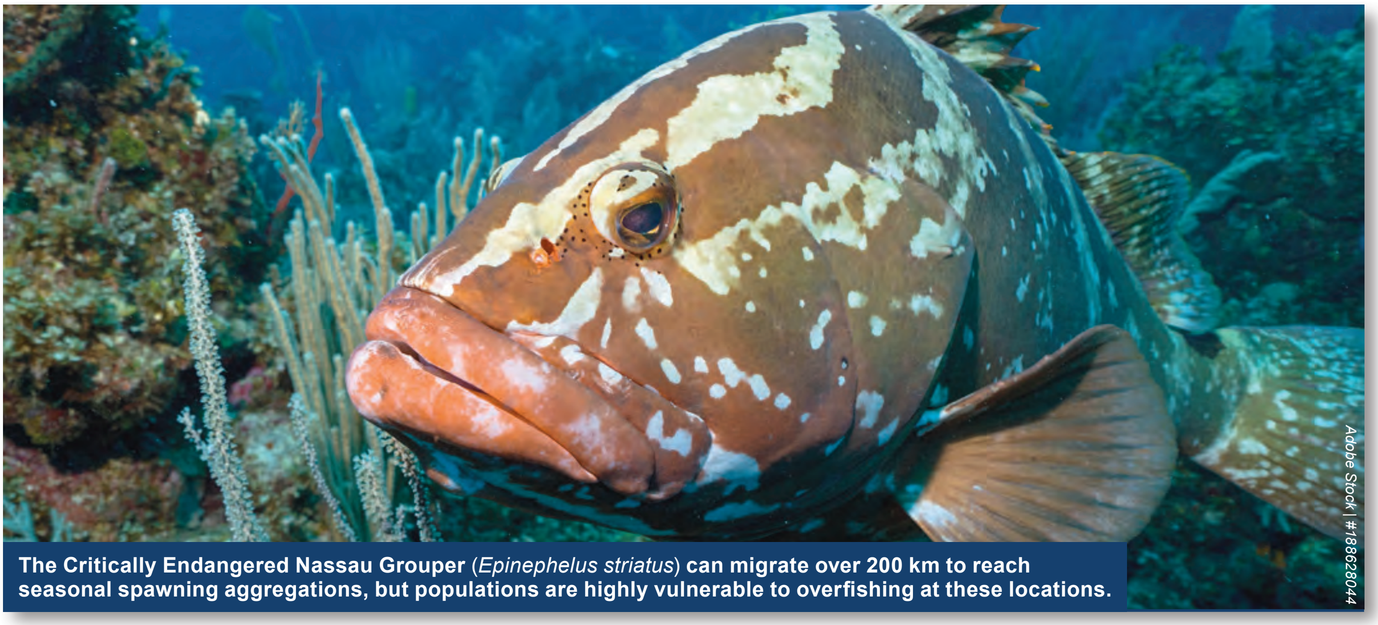
Threatened migratory species that may benefit from being listed in the CMS Appendices

The CMS Appendices include only a subset of all migratory species. Migratory species that are endangered[l] are eligible to be listed in Appendix I, while Appendix II includes migratory species that have an "*unfavourable conservation status*[m] *and which require international agreements for their conservation and management, as well as those which have a conservation status which would significantly benefit from the international cooperation that could be achieved by an international agreement*"[10]. Importantly, the CMS Appendices represent only a subset of the species which could qualify for, and may benefit from, listing.

To determine the proportion of migratory species that are threatened, but that are not yet listed, available data on species' migratory behaviour was first used to generate a non-exhaustive list of migratory species[n] that are not endemic to a single country[o]. This list was then combined with information on extinction risk and population trends from species assessments from the IUCN Red List.

There are 4,508 species that are 1) considered to be migratory, 2) have had a global IUCN Red List assessment and 3) occur in multiple Range States (non-endemic species). Of these, 3,339 (74%) are not currently listed in the CMS Appendices (Figure 2.10a).

Among these 3,339 non-CMS species[p] (Figure 2.10b), 277 (8%) are considered to be globally threatened and a further 122 species (4%) have been classified as Near Threatened. This subset of 399 globally threatened and Near Threatened species (Figure 2.10c) may be worth considering further to determine if they meet the CMS criteria and would benefit from being listed in the CMS Appendices (see Annex B Table B1 for a full list of species). It is important to note these species have not been comprehensively assessed in relation to the CMS definition of migration, with the exception of birds, where a comprehensive assessment has been undertaken. Further consideration is therefore required to determine if individual species meet the criteria for listing. It is also worth noting that there may be some populations of globally Least Concern species that could meet the criteria for listing in the CMS Appendices; these were beyond the scope of this analysis.



The Critically Endangered Nassau Grouper (*Epinephelus striatus*) can migrate over 200 km to reach seasonal spawning aggregations, but populations are highly vulnerable to overfishing at these locations.

[l] According to the Guidelines for Assessment of Appendix I and II Listing Proposals (UNEP/CMS/Resolution 13.7/Annex 1), species classified as Extinct in the Wild, Critically Endangered or Endangered by the IUCN Red List are eligible for listing in CMS Appendix I. Species categorized as Vulnerable and Near Threatened by the IUCN Red List may also be eligible for listing in Appendix I, if there is substantive additional evidence for a deterioration in conservation status, as well as information about the conservation benefits that listing in Appendix I would bring.

[m] 'Unfavourable conservation status' encompasses species classified as Extinct in the Wild, Critically Endangered, Endangered, Vulnerable or Near Threatened by the IUCN Red List (UNEP/CMS/Resolution 13.7/Annex 1).

[n] Non-avian species were considered migratory if they were listed in the CMS Appendices, or, following a precautionary approach, if there was evidence for migratory behaviour in any of the following data sources: the IUCN Red List of Threatened Species (only species classified as 'Full Migrants'); the Global Register of Migratory Species; migratory sharks and rays identified by Fowler (2014). The Conservation Status of Migratory Sharks. UNEP/CMS Secretariat, Bonn, Germany. 30 pp. The list of migratory birds that meet the CMS movement criteria was based on ongoing work by the CMS COP-appointed co-Councillor for birds.

[o] As non-endemic species occur in multiple countries, they are more likely to migrate across one or more national jurisdictional boundaries, thus meeting an important aspect of the CMS definition of a migratory species. Endemic status was determined using information on countries of occurrence obtained from species assessments for the IUCN Red List. Only countries where the species' presence was classified as 'Extant', 'Possibly Extant', 'Possibly Extinct' or 'Presence Uncertain' and where its origin was classified as 'Native', 'Reintroduced' or 'Origin Uncertain' were considered in the analysis.

[p] Although not listed in the CMS Appendices, some of these species may be covered under other CMS Agreements/Memoranda of Understanding.

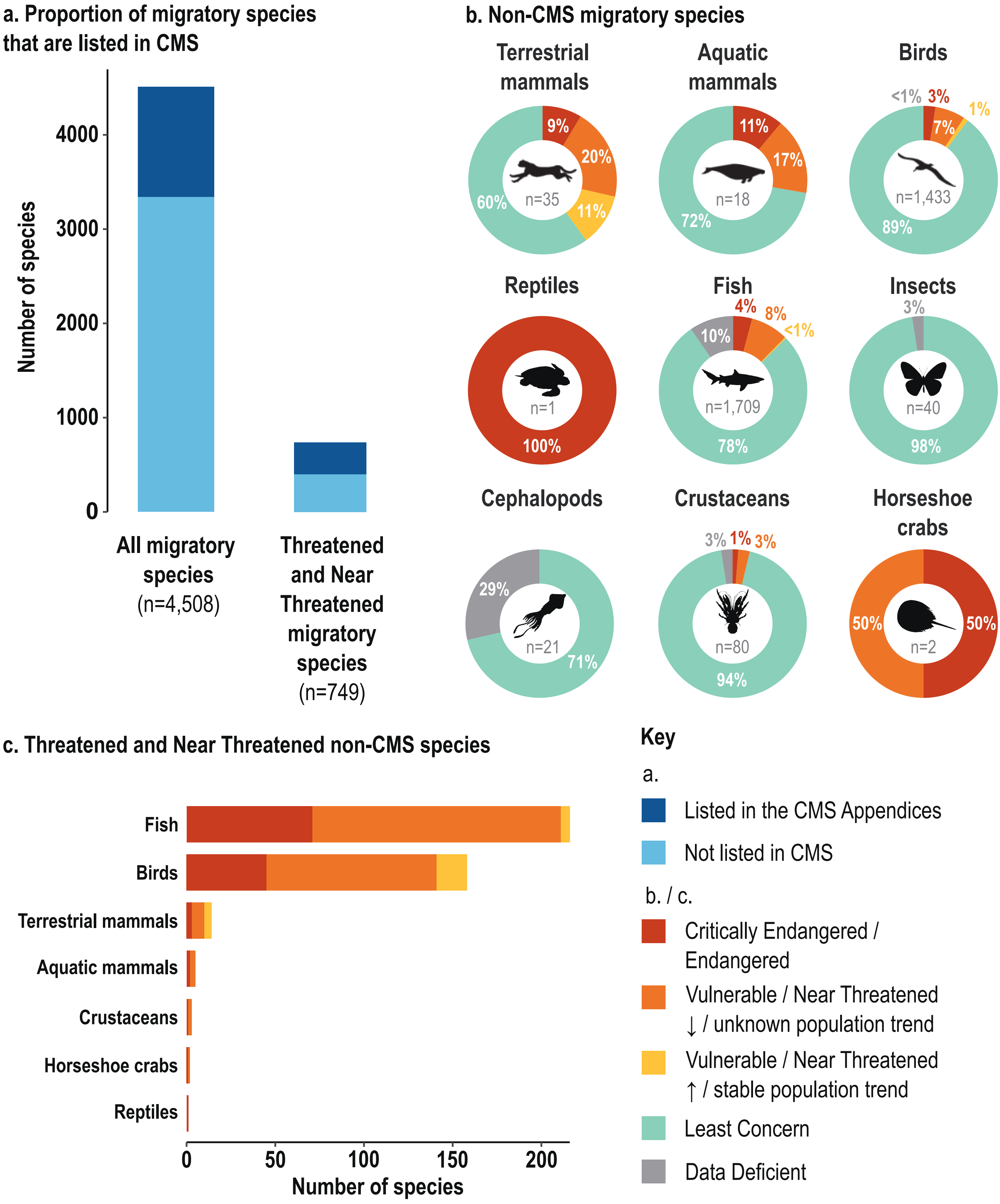


Figure 2.10: ***Overview of migratory species that are globally threatened and Near Threatened and not yet CMS-listed, showing:*** *a) Number of migratory species assessed by the IUCN Red List that are listed in the CMS Appendices. b) Proportion of non-CMS migratory species (n=3,339) that have been classified as globally threatened (Endangered, Critically Endangered or Vulnerable) or Near Threatened and thus may potentially benefit from being listed in the CMS Appendices, by taxonomic group. c) Number of globally threatened and Near Threatened non-CMS species (n=399), by taxonomic group.*

Of the 399 globally threatened and Near Threatened non-CMS migratory species, **124 species (4% of non-CMS migratory species) are classified as either Critically Endangered (35 species) or Endangered (89 species), and thus may benefit from inclusion in Appendix I**. A further 7% of non-CMS migratory species (249 species) are classified as Vulnerable or Near Threatened with a decreasing, unknown or unspecified population trend, suggesting that their conservation status may be deteriorating. The remaining 26 Vulnerable and Near Threatened migratory species may be lower priorities for action at this time, given that their population trends are stable or increasing.

Fish accounted for over half of the 399 globally threatened or Near Threatened non-CMS migratory species. An additional 40% of these species were birds. Among the fish, the Cypriniformes (carps, loaches, minnows and relatives; 40 species), the Perciformes (perch-like fishes; 29 species) and the Carcharhiniformes (ground sharks; 27 species) were the orders that contained the most globally threatened or Near Threatened species. Within the birds, members of the Procellariiformes (albatrosses, petrels and shearwaters; 49 species) and Passeriformes (passerine birds; 34 species) were most prevalent.

399

Number of migratory species that are globally threatened or Near Threatened and not yet listed in CMS

Due to taxonomic biases in the completeness of the underlying data on conservation and migratory status, some taxonomic groups may appear to have fewer globally threatened or Near Threatened migratory species, as an artefact of missing data. While birds have been assessed comprehensively by BirdLife International as the IUCN authority for birds, Red List coverage for invertebrates and marine species is comparatively poor[q]. Insects are likely to be particularly under-represented in the list of of non-CMS migratory species provided in Annex B Table B1 despite mounting evidence highlighting the scale and ecological importance of insect migrations[11,12,13], as well as population declines that have been reported for many insect species, across a variety of geographic scales[14]. This is due to a lack of species-level information on the migratory status of insect species across many taxonomic groups.

179

Number of Appendix II species considered 'very high' or 'high' priorities for further conservation measures

In addition, a further 175 non-CMS migratory species are classified as Data Deficient, including a disproportionate number of migratory fish and cephalopods (Figure 2.10b). Although the information needed to assess the conservation status of these species is lacking, they are generally more likely to be threatened than data-sufficient species[15].

The Snowy Owl (*Bubo scandiacus*) is classified as Vulnerable with a declining population trend.

Appendix II species that could be considered for further conservation measures

As part of a *Review of the status of CMS Appendix II-listed taxa*, the 1,011 species listed exclusively in Appendix II[r] were assigned to different categories reflecting the degree to which they should be prioritized for further conservation measures under CMS, such as inclusion in Appendix I.

- Fifty-two Appendix II-listed species (5%) were identified as 'very high' priorities for closer scrutiny by CMS, on the basis that these species are classified as Critically Endangered or Endangered in the IUCN Red List (Figure 2.11).
- A further 127 (13%) Appendix II species were classified as Vulnerable or Near Threatened in the IUCN Red List with a decreasing population trend, or with an unknown population trend combined with high levels of intrinsic biological vulnerability[s]. These species were also considered to be 'high' priorities for further conservation action.

[q] Although vertebrates and marine species comprise 31% and 15% of all IUCN Red List assessments for animals, respectively, these groups are still poorly covered, compared to their overall size.

[r] Not including the species listed in both Appendices I and II.

[s] Using data from several publicly available datasets, biological vulnerability was assessed by scoring species against three criteria chosen to reflect susceptibility to a range of threats: body size, life history and habitat breadth.

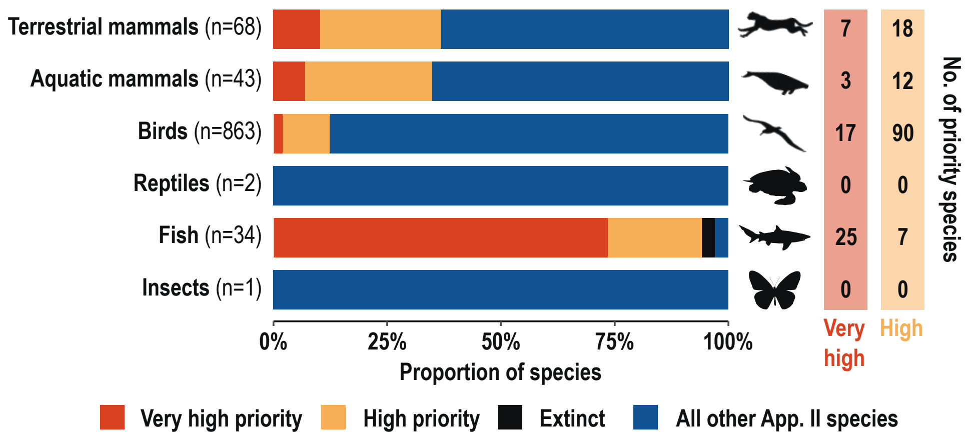


Figure 2.11: ***Proportion of species listed exclusively in CMS Appendix II (n=1,011) that are considered to be 'very high' (52) and 'high' (127) priorities for further conservation measures under CMS by taxonomic group.*** *Based on the prioritization methodology outlined in a* Review of the status of CMS Appendix II-listed taxa.

Most notably, almost all (94%) of the Appendix II-listed fish (32 of 34 species), including 17 from the Acipenseridae (sturgeon) family and 15 sharks and rays, fell in the two highest priority groups (Figure 2.11). Over half of Appendix II-listed Artiodactyla (even-toed ungulates; 8 of 11 species) and Procellariiformes (albatrosses, petrels and shearwaters; 14 of 26 species) were also included within the two highest priority groups. Given the findings of this analysis, it is also notable that none of the species of the order Acipenseriformes listed in CMS Appendix II appear to be included in any of the instruments or processes for conserving and managing Appendix II species (including Agreements, MOUs, Special Species Initiatives, Concerted Actions, or Action Plans).

In summary, a substantial proportion of CMS Appendix II-listed species (18%, 179 species) were identified as priorities in the context of the review, on the basis of their conservation status and biological vulnerability. These species may warrant closer scrutiny by CMS Parties and the CMS Scientific Council.

Grey-headed Albatrosses (*Thalassarche chrysostoma*) are listed in CMS Appendix II. This species is categorized as Endangered due to rapid global population declines, primarily caused by incidental capture in longline fisheries.

Adobe Stock | #293492971

Indian Skimmers (*Rynchops albicollis*) are Endangered and not currently listed in the CMS Appendices.

Adobe Stock | #240813889

III. PRESSURE – Threats to migratory species

- ‘Habitat loss, degradation and fragmentation’ and ‘overexploitation’ are the two main threats facing CMS-listed species and migratory species as a whole.
- These two threats are the principal threats affecting both Appendix I and Appendix II-listed species.
  - 89% of Appendix I species are impacted by ‘overexploitation’; 86% are affected by ‘habitat loss, degradation and fragmentation’
  - 74% of Appendix II species are affected by ‘habitat loss, degradation and fragmentation’; 68% are impacted by ‘overexploitation’
- 58% of the monitored sites recognized as being important for CMS-listed species are experiencing unsustainable levels of human-caused pressure.

Migratory species face a multitude of pressures, which are overwhelmingly caused by human activities. Due to their reliance on multiple geographically distinct areas, and their dependence on connectivity between these areas, migrants are more likely to be exposed to a diverse range of these threats, which can impact them at different stages of their migratory cycle[1,2]. Additionally, as migratory species typically cross international boundaries, they are often subject to different legal frameworks and varying levels of protection across their range.

Migratory species are increasingly being impacted by growing human impacts on ecosystems and by climate change. These pressures range from insurmountable anthropogenic barriers blocking free movement (such as dams[3] and fences[4]) to pollutants that interfere with navigation (such as light pollution[5]). Migratory species that travel together in groups, congregate in large numbers within a localized area or are channelled through narrow routes constrained by physical features, are particularly vulnerable to threats that impact key sites or the crucial habitat corridors connecting them. The importance of long-lived individuals, collective memory and social learning for successful migration in some species may also amplify the consequences of individual losses on populations[6].

A core goal outlined in the CMS Strategic Plan for Migratory Species 2015-2023 is to *“reduce the direct pressures on migratory species and their habitats”*[a]. This chapter provides an overview of the myriad of threats impacting both **migratory species themselves** and the **key sites** that they rely on. The first section summarizes the most significant threats affecting migratory species, by combining an analysis of threats reported in species assessments for the IUCN Red List with additional insights from the scientific literature. The second section outlines an approach that can be used to identify sites that support globally significant populations of migratory species, and provides an overview of the threats currently facing these important sites.

Overview of the threats to migratory species

Methodology

The IUCN Red List of Threatened Species is recognized globally as the most comprehensive source of information on the threats that are considered to impact species’ survival. The IUCN Red List categorizes threats following a hierarchical classification scheme, focussing on the proximate human activities that drive negative impacts. Threats are grouped into 11 broad categories, which are then sub-divided further into two levels of more specific sub-categories[b], providing detailed information on the drivers of extinction risk.

European Turtle Doves (*Streptopelia turtur*) have declined due to changes in agricultural practices and unsustainable hunting.

[a] Goal 2 of the CMS Strategic Plan 2015-2023 (UNEP/CMS/Resolution 11.2).

[b] A full list of threat categories and sub-categories with definitions is available online in Version 3.3 of the IUCN Threats Classification Scheme: www.iucnredlist.org/resources/threat-classification-scheme.

There is no single category for 'habitat loss, degradation and fragmentation' in the IUCN threat classification and a number of categories in the classification contribute to this threat[c]. In order to understand more about the relative importance of 'habitat loss, degradation and fragmentation' as a threat to CMS-listed and all migratory species, the relevant IUCN categories were combined into a single high-level group in some sections of the following analysis. One further change was made to the IUCN data: the IUCN threat category 'biological resource use' was amended to include only direct impacts on animals and to exclude the indirect effects of activities such as logging. To avoid confusion with the IUCN definition of 'biological resource use', this amended category was renamed as 'overexploitation' for the purposes of this report. This definition of 'overexploitation' includes both the deliberate effects of harvest and persecution and the unintentional impacts of harvesting on non-target species[d].

The first section of the following analysis ('Main threats to CMS-listed and migratory species') focusses on comparing the number of CMS-listed and migratory species affected by 'habitat loss, degradation and fragmentation' and 'overexploitation' with the remaining IUCN threat categories ('climate change and severe weather', 'invasive species, genes and diseases' and 'pollution'). Subsequent sections consider the IUCN categories and sub-categories underlying 'habitat loss, degradation and fragmentation'.

The destruction of intact forest ecosystems is just one example of the habitat loss, degradation and fragmentation that affects 3 out of 4 CMS-listed species.

3 out of 4

CMS-listed species are affected by 'habitat loss, degradation and fragmentation'

7 in 10

CMS-listed species are affected by 'overexploitation'

Main threats to CMS-listed and migratory species

The combined IUCN threat categories that relate to **'habitat loss, degradation and fragmentation' represent the most common threat affecting CMS-listed species as a whole, closely followed by 'overexploitation'.** 'Habitat loss, degradation and fragmentation' is reported to impact 481 (75%) of the 641 CMS-listed species for which one or more threats had been identified[e], and 'overexploitation' is reported to affect 446 CMS species (70%) (Figure 3.1a).

These two threats are the principal threats reported to affect both Appendix I and Appendix II-listed species: 158 (89%) Appendix I species are affected by 'overexploitation' and 152 (86%) by 'habitat loss, degradation and fragmentation' (Figure 3.1b). In contrast, a higher proportion of Appendix II species (428 species, 74%) are reportedly impacted by 'habitat loss, degradation and fragmentation' than by 'overexploitation' (394 species, 68%).

Across the wider group of all migratory species[f] assessed by the IUCN Red List, 'overexploitation' and 'habitat loss, degradation and fragmentation' are also the most pervasive threats (Figure 3.1c). Both of these threats are reported to affect 65% of the 2,300 migratory species for which at least one threat had been documented[g] ('overexploitation': 1,498 species; 'habitat loss, degradation and fragmentation': 1,494 species). **'Pollution'**, which encompasses a wide range of threats arising from the release of contaminants or energy into the environment, **also emerges as one of the most common threats facing migratory species in general** (Figure 3.1c). This threat is reported to affect 42% of migratory species (968 species).

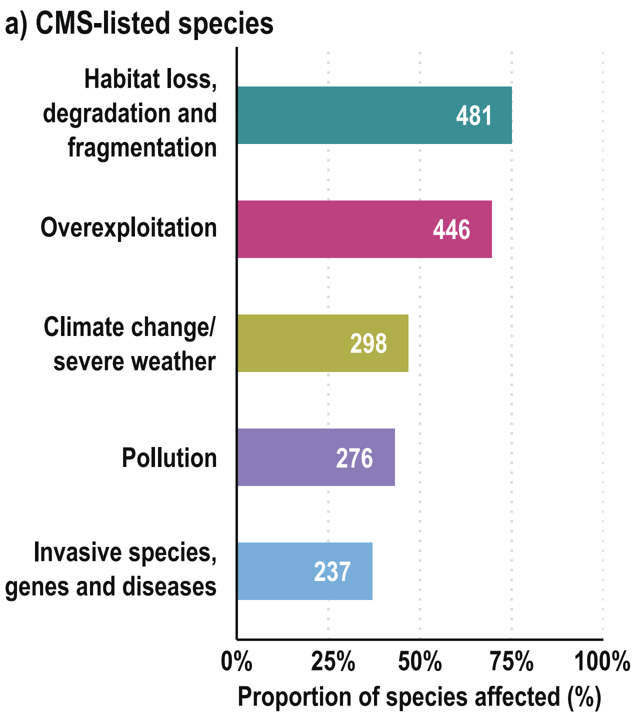
[c] 'Agriculture and aquaculture', 'energy production and mining', 'human disturbance and intrusions', 'natural system modifications', 'residential and commercial development' and 'transportation and service corridors', in addition to the unintentional impacts on animal species of 'gathering terrestrial plants' and 'logging & wood harvesting' (normally considered by IUCN to fall within 'biological resource use').

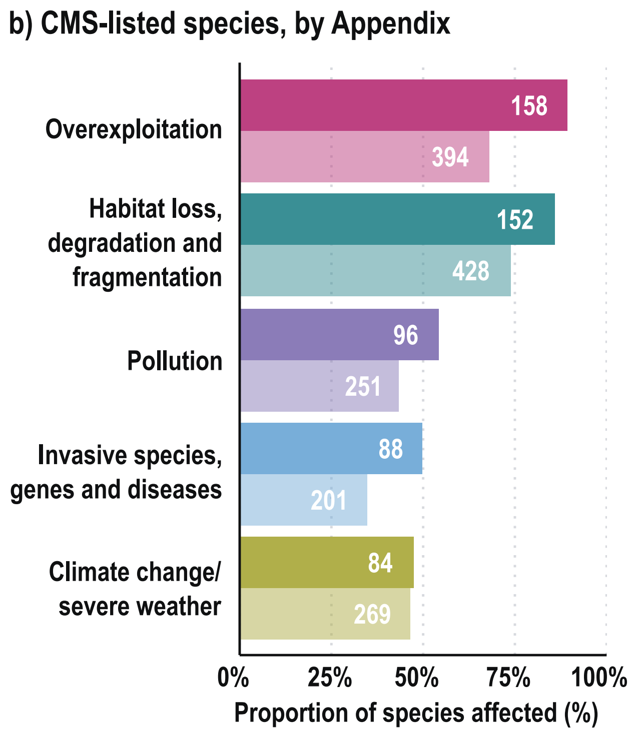
[d] For the purposes of this analysis, the direct impact of overexploitation corresponds to two IUCN sub-categories of threat, normally included within 'biological resource use': 'hunting & collecting terrestrial animals' and 'fishing & harvesting aquatic resources'.

[e] 54% of the 1,189 CMS-listed species had at least one current or future threat documented in their IUCN Red List assessment. The IUCN Red List requires only major threats to be documented for taxa assessed as Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable and Near Threatened. The absence of documented threats for Least Concern or Data Deficient taxa does not necessarily indicate that these taxa are unaffected by any threats.

[f] Includes CMS-listed species, in addition to species categorized as 'Full Migrants' by the IUCN Red List or identified as migratory by the Global Register of Migratory Species (GROMS).

[g] 49% of the 4,696 migratory species had one or more threats identified in their Red List assessments.





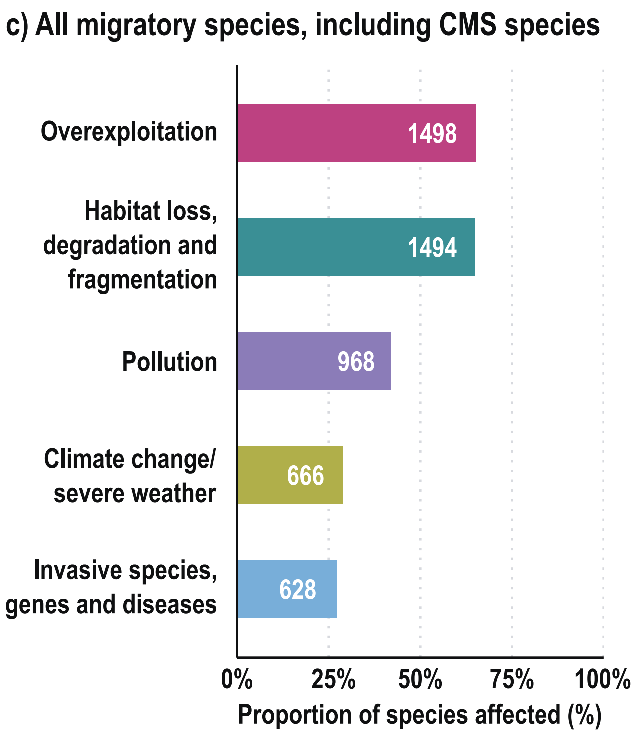
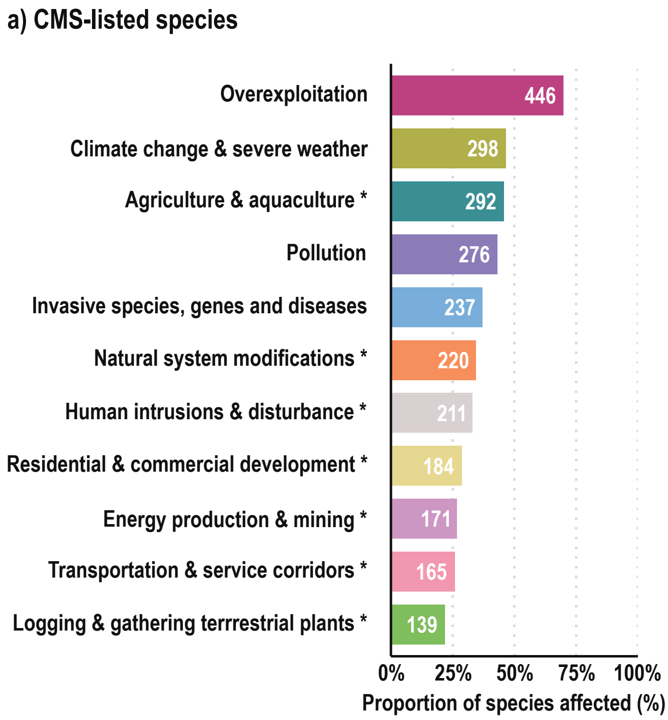


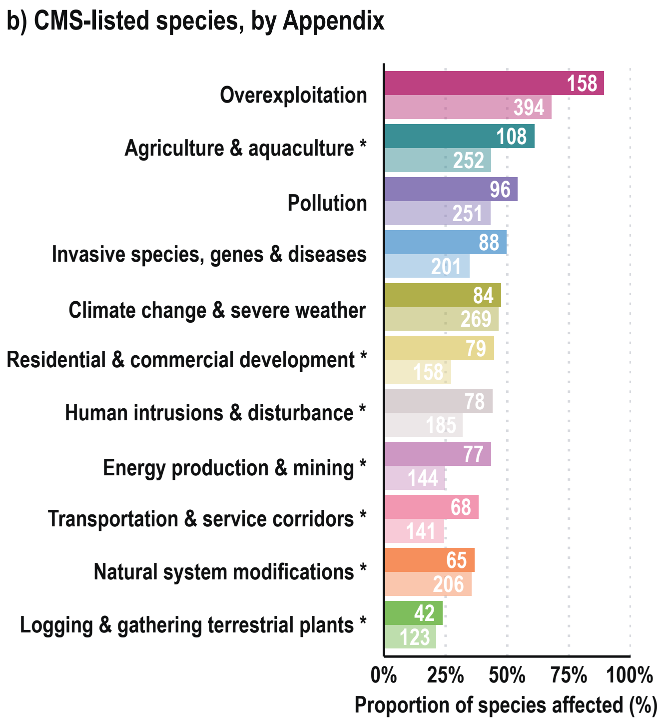
Figure 3.1: ***Habitat loss, degradation and fragmentation and overexploitation are the principal threat types affecting (a, b) CMS-listed species and (c) all migratory species, based on the IUCN Red List.*** *The proportion and number of species reported as being impacted by each overall threat type is shown for: a) CMS-listed species (n=641), b) species listed in CMS Appendix I (dark bars, n=177) and Appendix II (pale bars, n=580), and c) the full set of migratory species (n=2,300). Proportions in a), b) and c) are relative to the total number of species in each group for which data on threats were available in IUCN Red List assessments.*

Key drivers of threats

The following analysis explores the main drivers of negative impacts reported for CMS-listed and migratory species, by disaggregating the combined group 'habitat loss, degradation and fragmentation' into its component IUCN threat categories and sub-categories. These provide more detailed information on the human activities and processes that threaten species' survival.

When 'overexploitation', 'pollution', 'climate change/severe weather' and 'invasive species, genes and diseases' are compared against the individual IUCN threat categories that comprise 'habitat loss, degradation and fragmentation', 'overexploitation' emerges as the most common human activity or process driving extinction risk across both CMS-listed species and the wider group of all migratory species (Figure 3.2). Within this category, 277 CMS-listed species (43%) are affected by 'hunting and collecting' and 217 species (34%) are impacted by 'fishing and harvesting aquatic resources'. A full overview of the IUCN threat categories and sub-categories reported as affecting CMS-listed species is shown in Figure 3.3.





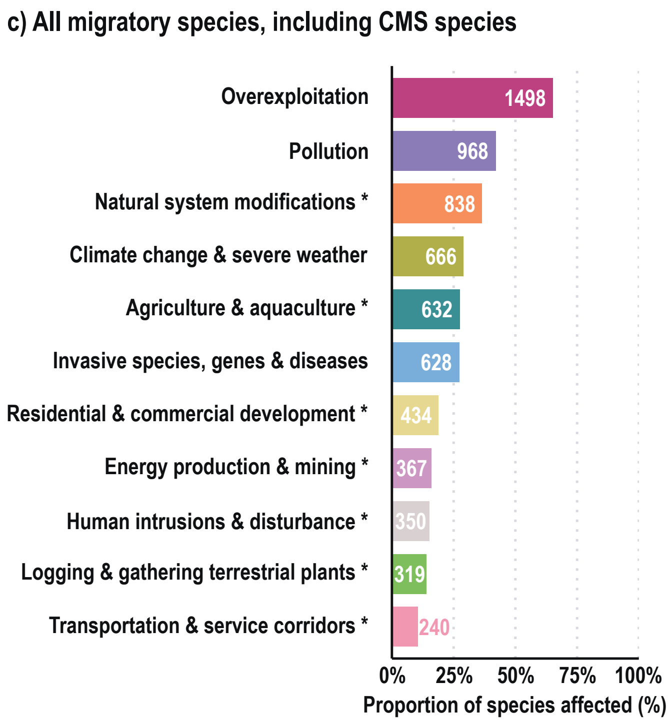


Figure 3.2: ***Overview of the proximate human activities and processes threatening (a, b) CMS-listed species and (c) all migratory species, based on the IUCN Red List.*** *The number of species reported as being impacted by each threat is shown for: a) CMS-listed species (n=641), b) species listed in CMS Appendix I (dark bars, n=177) and Appendix II (pale bars, n=580), and c) the full set of migratory species (n=2,300), for which data on threats were available in IUCN Red List assessments. Asterisks (*) indicate the IUCN threat categories which contribute to 'habitat loss, degradation and fragmentation'. 'Geological events' and 'other threats' affected <5% of species in both groups and are not shown.*

The second and third most common threats affecting CMS-listed species as a whole are 'climate change/severe weather' (298 species) and 'agriculture and aquaculture' (292 species), which each affect 46% of CMS-listed species (Figure 3.2). Within these two categories, most CMS-listed species are reported as being affected by habitat shifts due to climate change (203 species, 32%) and threats associated with non-timber crop production (218 species, 34%) (Figure 3.3). Over one third of CMS-listed species are also reportedly affected by 'pollution' (276 species, 43%), 'invasive species, genes and diseases' (237 species, 37%) and 'natural systems modifications' (220 species, 34%) (Figure 3.2).

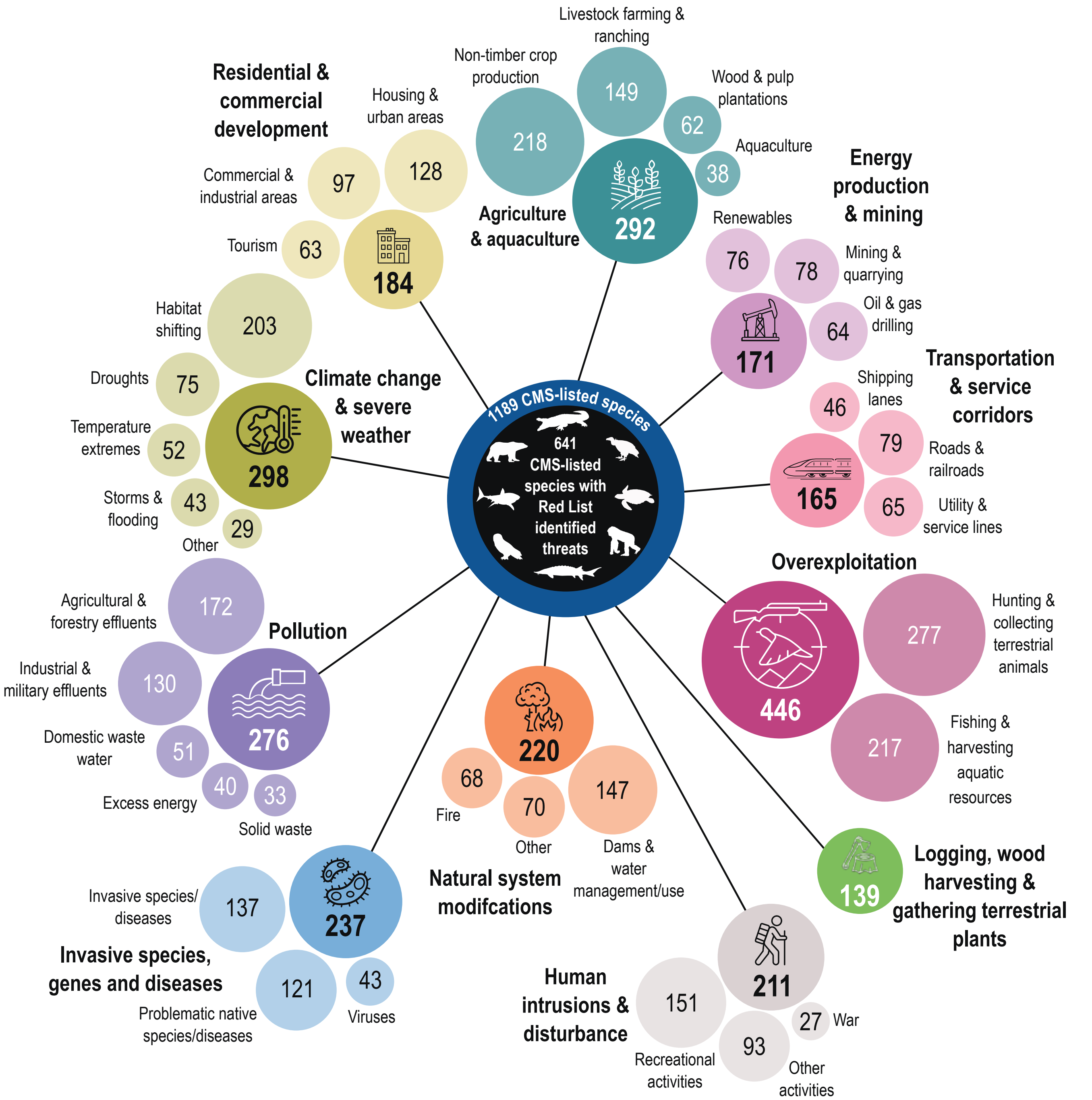


Figure 3.3: Overview of threats to CMS-listed species. *The number of CMS-listed species impacted by each category and sub-category of threat, based on the IUCN Red List threat categories. Only CMS-listed species with one or more reported threats are included (n=641). As individual species are often affected by multiple threat categories and sub-categories, the sum of the numbers shown in the coloured bubbles exceeds 641. Threats associated with 'logging, wood harvesting & gathering terrestrial plants' refer to indirect impacts on CMS-listed species. 'Geological events' and 'other threats' affected <5% of CMS-listed species and are not shown.*

Across migratory species as a whole, 'overexploitation', 'pollution' and 'natural system modifications' are the most prevalent threats (Figure 3.2). All three of these threats reportedly impact over one third of all migratory species. 'Natural system modifications', which is reported to affect 36% of migratory species (838 species), relates to the human actions that convert or degrade habitat, such as fire and fire suppression (i.e. changes in fire frequency and/or intensity outside of the natural range of variation), or the impact of dams and water management on ecosystems.

Threats by taxonomic group

Looking across taxonomic groups, 'overexploitation' emerges as the most common driver of reported impacts on CMS-listed and migratory aquatic mammals, birds, fish and reptiles (Figure 3.4). Terrestrial mammals are principally reported as being affected by 'agriculture and aquaculture', which is also the second most prevalent threat affecting CMS-listed birds and migratory insects. The most pervasive threat facing migratory insects is 'pollution', which covers a diverse range of environmental contaminants and inputs, from industrial effluents and pesticides to noise and light pollution. This threat is also one of the most common threats reportedly affecting migratory aquatic mammals, reptiles and fish ('pollution' is also reported to impact 40% of migratory birds). 'Climate change and severe weather' also features among the top three threats to migratory aquatic mammals and birds (and also affects 43% of terrestrial mammals).

If the IUCN categories comprising 'habitat loss, degradation and fragmentation' are re-combined into a single category, this threat emerges as the primary threat facing terrestrial mammals and birds, while 'overexploitation' remains the most common threat facing aquatic mammals and fish. Migratory reptiles are equally impacted by 'habitat loss, degradation and fragmentation' and 'overexploitation'. Similarly, migratory insects are equally affected by 'habitat loss, degradation and fragmentation' and 'pollution'.

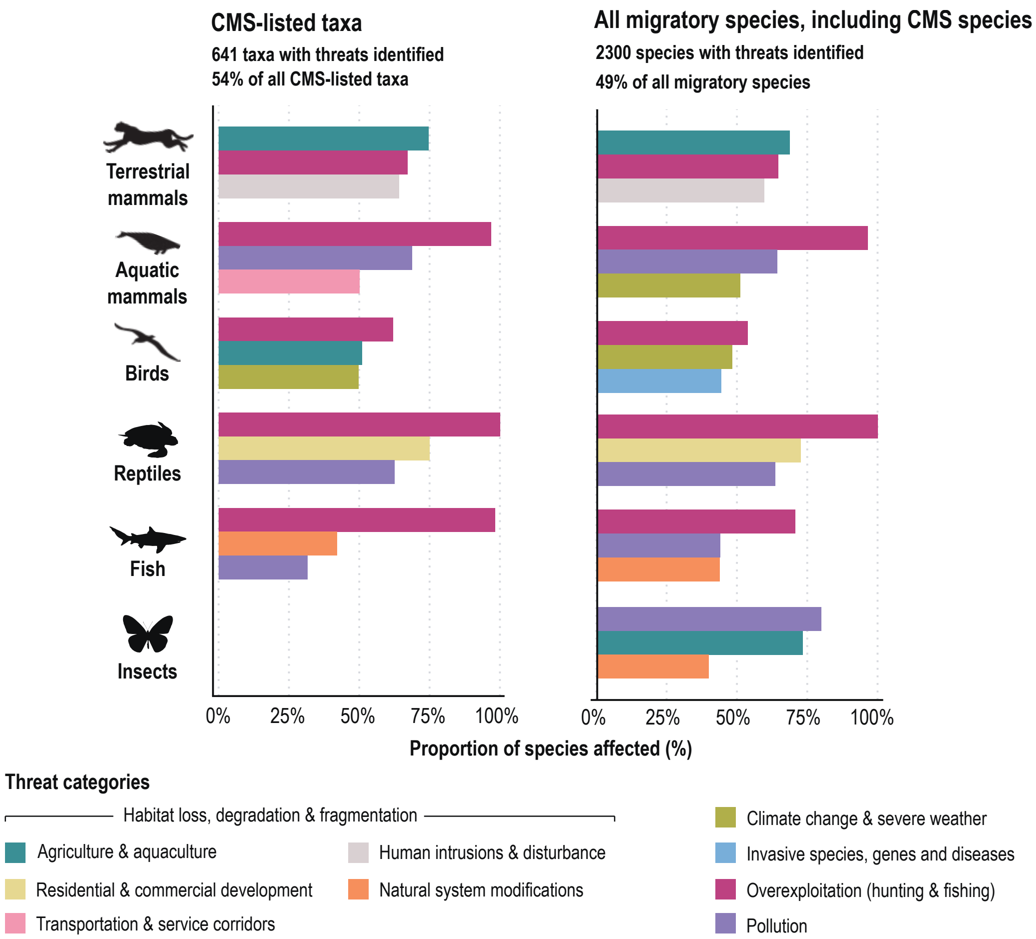


Figure 3.4: ***Top three threats to CMS-listed and migratory species by taxonomic group, based on the IUCN Red List.*** *The figure includes the top three threat categories affecting each taxonomic group, showing the proportion of species affected relative to the total number in each group (for which threat data were available). Only taxonomic groups containing CMS-listed species are shown (n=641 migratory species; n=2,263 migratory species); 37 migratory species with available threat data from other taxonomic groups (primarily cephalopods and crustaceans[h]) are not shown. No threats are shown for CMS-listed insects, as only one insect species is listed in the CMS Appendices (the Monarch Butterfly,* Danaus plexippus*) and so all eight threats affecting this species would have equal ranking[i].*

Main threats in detail

The following sub-sections summarize the impacts of the four most critical threats facing migratory species: **'overexploitation'**, **'habitat loss, degradation and fragmentation'**, **'climate change'** and **'pollution'**. These four areas were selected for in-depth consideration because they collectively affect the greatest number and broadest range of migratory species, as revealed by the analysis of IUCN threat data (Figure 3.1). These areas have also been identified as priorities for further action by CMS. It is important to note that the majority of CMS-listed species face multiple threats, which seldom act in isolation[j]. In many cases, the impact of one threat can often exacerbate the effects of others.

[h] 'Overexploitation' is the dominant threat affecting the vast majority (95%) of migratory cephalopods (n=21) for which threats were documented. Migratory crustaceans (n=12) are principally impacted by 'natural system modifications' and 'pollution'.

[i] The Monarch Butterfly (*Danaus plexippus*) is affected by the following categories of threat: 'agriculture and aquaculture', 'biological resource use', 'climate change and severe weather', 'invasive species, genes and diseases', 'natural system modifications', 'pollution', 'residential and commercial development' and 'transportation and service corridors'.

[j] 74% of the 641 CMS-listed species with documented threats are affected by more than one of 'climate change and severe weather', 'habitat loss, degradation and fragmentation', 'invasive species, genes and diseases', 'overexploitation' and 'pollution'.

Overexploitation

Overexploitation of natural resources is the primary cause of biodiversity loss in the world's oceans and the second most important driver of global biodiversity loss on land[1]. Migratory species across the world are harvested, taken and traded for a variety of reasons, including consumption as food (i.e. wild meat), transformation into products such as clothing and handicrafts, use as pets, belief-based use and sport hunting. Many migratory species return in large numbers to the same sites at predictable times of year, which makes them highly susceptible to overexploitation.

According to the IUCN Red List, 'overexploitation'[k] is one of the main threats facing migratory species, and affects 70% of CMS-listed species. While overexploitation of terrestrial mammals and birds principally occurs through deliberate harvest[l], for aquatic mammals and reptiles, the unintentional impacts of harvesting are more common than deliberate harvest[n] (Figure 3.5). When comparing across the CMS Appendices, overexploitation caused by deliberate harvesting threatens almost two thirds of CMS Appendix I-listed species[2].

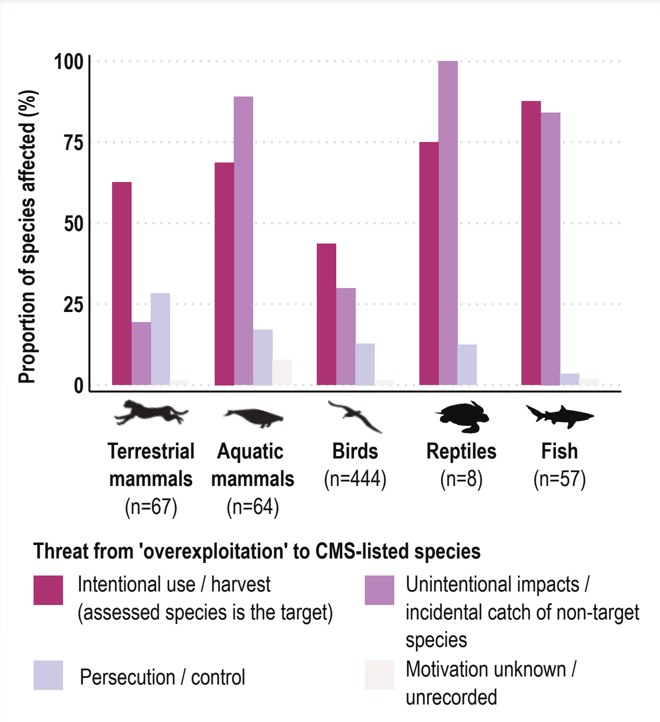


Figure 3.5: ***Proportion of CMS-listed taxa affected by deliberate or unintentional impacts from 'overexploitation' by taxonomic group, according to the IUCN Red List.*** *Only CMS-listed species for which one or more threats are documented are shown (n=641; the one insect species with threats identified is not shown). The data shown excludes threats related to the indirect impacts of gathering plants and logging on animal species.*

Unsustainable and/or illegal taking is a major pressure facing migratory terrestrial mammals and birds

Unsustainable hunting and collecting affects a wide range of terrestrial migratory species. Nearly three quarters of all CMS-listed terrestrial mammals (70%) are targeted by hunters, largely to supply domestic demand for wild meat[3]. Hunting is more likely to be unsustainable in regions affected by political instability or poverty, or in areas where infrastructure has been expanded[3]. For example, wild populations tend to be more severely depleted by harvesting when they are close to roads and settlements[4].

Hunting for food, sport and other purposes is also a pervasive threat to the many migratory birds that use the East Asian-Australasian flyway[5] or migrate between Africa and Europe[6]. Unsustainable hunting can result from the failure to regulate legal harvest[7] or can be driven by illegal activity[8]. While migratory birds often benefit from some legal protection, many are subject to pressure from illegal taking. Between 11 and 36 million birds are estimated to be illegally killed or taken annually in the Mediterranean region[8], with a further 1.7-4.6 million estimated to be illegally killed or taken in the Arabian Peninsula, Iran and Iraq[9]. Early indications suggest that the scale of unsustainable and illegal take may be even higher in Southeast Asia[9]. Migratory shorebirds are also intensively hunted in some areas of the Caribbean and north-eastern South America[11].

Although estimates of the impacts of hunting are available in some regions, for many species of migratory terrestrial mammals and birds, levels of offtake are unknown[3]. For example, despite evidence that many migratory birds are hunted unsustainably across the East Asian-Australasian flyway[9,12-13], and that birds in general are subject to intense hunting pressure in several countries in western and south-eastern Africa[6], there is a lack of coordinated monitoring of hunting impacts across these regions[6,12-13]. As a result, the cumulative impact of legal and illegal take at the population or flyway scale cannot be assessed. This vital information, needed to set appropriate national harvest limits for species that can be hunted legally, is therefore missing. For both migratory birds and terrestrial mammals, the lack of systematically collected data on levels of taking severely limits the ability of the international community to fully understand the scale of this issue and to identify which terrestrial migratory species are being harvested unsustainably.

[k] Corresponds to 'biological resource use', excluding sub-categories of threat that directly affect plant species and only indirectly impact animals via the loss of habitat: 5.2 (gathering terrestrial plants) and 5.3 (logging and wood harvesting).

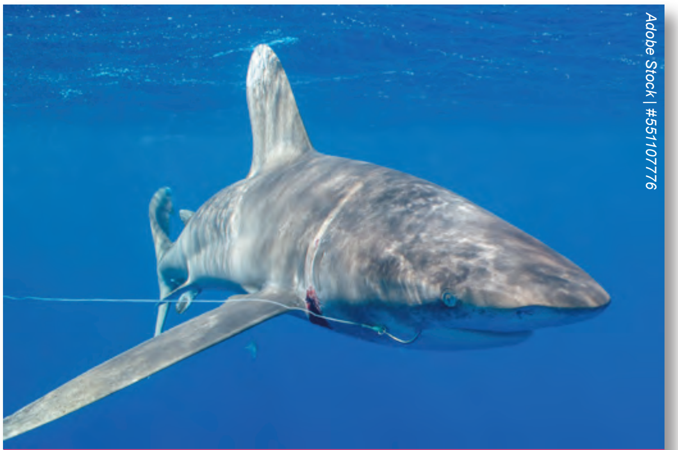
[l] Where the species being assessed is the target of harvest. Includes the following sub-categories of threat for animals: 5.1.1 (hunting & collecting terrestrial animals), 5.4.1 (subsistence/small scale fisheries) and 5.4.2 (large scale fisheries).

[m] Where the species being assessed is not the target. Includes the following sub-categories of threat for animals: 5.1.2 (hunting & collecting terrestrial animals), 5.4.3 (incidental catch in subsistence/small scale fisheries) and 5.4.4 (incidental catch in large scale fisheries).

[n] Many sharks and rays are caught incidentally and are also retained as a welcome byproduct. Although the IUCN threat classification scheme distinguishes between intentional and unintentional harvest, in practice, it can be challenging to determine whether or not incidentally caught species are a welcome byproduct.

Overfishing and incidental catch is affecting many of the world's marine migratory species

Many marine migratory species listed in the CMS Appendices, including marine mammals and some species of sharks and rays, are acutely sensitive to pressure from exploitation due to their inherently low reproductive capacity. This includes mortality arising from incidental catch where the focal species is not the target (often referred to as 'bycatch'). Across coastal regions of the tropics and subtropics, the use of migratory cetaceans, crocodilians, manatees, dugongs and marine turtles for consumption or bait (aquatic wild meat) is widespread, despite the existence of protective legislation[14].



The Critically Endangered Oceanic Whitetip Shark (*Carcharhinus longimanus*) is threatened by overfishing and incidental catch.

Overfishing is a major threat to slow-growing sharks, rays and chimeras. While a few species of sharks and rays are directly targeted to supply international demand for their meat, fins, gill plates and liver oil, the majority of the species in this group are caught incidentally and then frequently retained as by-product for consumption[15]. Satellite tracking has revealed extensive spatial overlap between the areas that are used by migratory sharks and the zones exploited by global industrial fishing fleets, suggesting that few populations remain unaffected by large-scale fisheries[16]. Indeed, global populations of oceanic shark and ray species[o] have declined by 71% since 1970, coinciding with an 18-fold upsurge in fishing pressure[17]. For many species of sharks and rays, pressure from large-scale industrial fisheries has also been compounded by the expansion of small-scale fisheries over recent decades[15]. Artisanal fisheries have contributed significantly to the threatened status of families found primarily in shallower coastal waters, such as Sawfishes (Pristidae) and Wedgefishes (Rhinidae)[18].

Bycatch remains one of the most significant threats to seabirds[19]. The effects are particularly serious for Albatrosses and Petrels[20]. Estimates from the early 2010s suggest that both longline[21] and gillnet fisheries[22] kill hundreds of thousands of seabirds annually, although mitigation strategies (see *Chapter IV – Reducing overexploitation, including mitigating incidental catch of non-target species*) such as bird-scaring lines, night-setting and line-weights have reduced bycatch levels substantially in some key longline and trawl fisheries[23].

Habitat loss, degradation and fragmentation

Habitat loss, degradation and fragmentation is among the main drivers of global biodiversity loss in terrestrial and freshwater ecosystems[1-3]. The Serengeti-Mara ecosystem in the United Republic of Tanzania and Kenya is a prime example, experiencing significant pressure from the expansion of agriculture, settlements, roads and fences. This affects the quality and availability of habitat for some of the world's largest free-ranging populations of migratory ungulates, including Blue Wildebeest (*Connochaetes taurinus*) and Plains Zebra (*Equus quagga*)[4-6], which support populations of CMS-listed apex predators including Cheetah (*Acinonyx jubatus*), Lion (*Panthera leo*) and African Wild Dog (*Lycaon pictus*). Similarly, the modification and fragmentation of European rivers, through the construction of dams and other structures, has drastically reduced the suitability of these freshwater habitats for migrating European Eels (*Anguilla anguilla*)[7,8]. Habitat destruction and degradation is also a significant driver of biodiversity loss in marine ecosystems[1], where the loss of habitats like seagrass meadows as a result of climate change, pollution, land reclamation and port expansion[9] have triggered population declines in species like Dugongs (*Dugong dugon*) that rely on seagrass as a food source[10,11]. As migratory species must be able to move between sites, they are particularly vulnerable to the loss of ecological connectivity that often results from habitat destruction and degradation.

Habitat loss and degradation disrupts connectivity

Around the world, migratory species rely on unimpeded movement to access foraging grounds and breeding sites[12,13]. While some animals use fixed migration corridors year after year, others vary their migratory routes and require the preservation of undisturbed habitat across large landscapes[13]. Both fixed and variable migratory strategies are severely impacted when habitat loss, degradation and fragmentation restricts and disrupts these vital movements.

Globally, intensifying human impacts on natural habitats and barriers to movement have caused significant behavioural changes across a wide range of migratory species. For example, a recent analysis revealed an overall decrease in the migratory movements of many terrestrial mammal species within areas of high human activity[14]. Thus, there is an urgent need to maintain, enhance and restore the ecological connectivity that sustains the ability of migratory populations to move between sites throughout entire ranges and lifecycles[15].

[o] 17 out of 18 shark and ray species included in the analysis of abundance time-series are CMS-listed.

Barriers to migratory movements

The free movement of migratory species along migration routes on both land and in the sea is increasingly being constrained and disrupted by a range of physical and non-physical barriers. These can extend from infrastructure, such as roads, railway lines, pipelines, fences, dams and shipping traffic, to disturbance from human activities[15-17]. The impact of barriers to migration can be particularly significant when they are constructed at critical points or bottlenecks in a migratory journey. The loss of connectivity caused by barriers is particularly visible in transboundary ecosystems where a lack of international cooperation makes it challenging to preserve intact and unfragmented habitats[18]. By preventing the free movement of migratory populations, physical border barriers also have the potential to limit the ability of these species to adapt to changing climatic conditions[19].

Habitat fragmentation caused by the extensive use of dams in river systems is one of the most significant pressures facing freshwater migratory fish[20]. Only 37% of the world's long rivers (>1,000 km) have high levels of connectivity over their entire length, while the rest have dams and other artificial river infrastructure[21]. These barriers prevent migratory fish from reaching their spawning grounds, alter water flow regimes and prevent juvenile fish from dispersing[22]. The habitat fragmentation resulting from dams is currently greatest in East Asia, Europe, the Indian sub-continent, North America and Southern Africa. In the near future, connectivity within tropical river systems, such as the Amazon, Mekong and Congo basins, is predicted to come under increasing pressure from new dams[23].

Barriers to connectivity extend beyond traditionally stationary obstructions to movement to include any impediments that prevent individuals of a species from completing their migratory route. A growing area of concern within marine ecosystems is the impact that shipping traffic is having on migratory species, from disturbance to seabirds[24,25] to lethal ship strikes of cetaceans and Whale Sharks (*Rhincodon typus*)[26,27]. Similarly, on land, electrocution on power lines and collisions with, wind turbines, tall towers and buildings impact several bird and bat species[15, 28], while mortality through vehicle collisions affects many species of ungulates[29]. Disturbance resulting from human activities, such as energy infrastructure and traffic, can also function as a semi-permeable barrier to migratory ungulates. For example, reductions in the long-range movements of Mongolian Gazelles (*Procapra gutturosa*) have been linked to increasing levels of road traffic[30]. Disturbance from industrial energy development also prevents Mule Deer (*Odocoileus hemionus*) from synchronising their migration with the emergence of spring vegetation[31], highlighting the potential of human activities to disrupt a key movement tactic observed in other migratory ungulates[32].

Agricultural expansion and intensification is a key driver of 'habitat loss, degradation and fragmentation'

The expansion of agriculture to meet the demands of growing human populations is a key driver of the habitat loss, degradation and fragmentation that affects many migratory species. Approximately 46% of the world's terrestrial land surface (that is habitable by humans) is agricultural land[33]. Annual global rates of cropland expansion have nearly doubled from 5.1 million hectares per year in 2004 to 9 million hectares per year in 2019[34]. The growth in agricultural land has been particularly rapid in Africa and Southeast Asia, where 79% and 61% of the new cropland area, respectively, was converted from natural vegetation over the past two decades[33].

Habitat loss and degradation caused by the expansion of intensive agriculture is recognized as one of the main drivers of large-scale declines in the populations of many insect species[35], which, in addition to their own intrinsic value, are a vital food source for many migratory birds, fish and bats[36]. Agricultural expansion and industrial development have also caused the rapid loss and degradation of wetlands in the East Asian-Australasian Flyway, which represent critical stopover sites for migrating waterbirds, including Endangered species such as the Far Eastern Curlew (*Numenius madagascariensis*) and Great Knot (*Calidris tenuirostris*)[37,38]. Expanding agriculture additionally affects terrestrial migratory mammals by blocking ungulate migration routes and excluding these animals from parts of their seasonal ranges[4], as well as by reducing the availability of roosting sites for migratory bats[39].

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Historically, deforestation and loss of Mountain Gorilla (*Gorilla beringei beringei*) habitat in Uganda has been caused by agricultural expansion.

Climate change

The impact of climate change is already being felt by many migratory species, and the role of climate change as a direct threat to biodiversity is expected to increase considerably in the coming decades[1]. In addition to increasing temperatures, climate change will result in changes in precipitation, extreme weather, sea level rise and ocean acidification, all of which have the potential to dramatically change habitats and their species composition[2]. While some migratory species may be able to adapt to climatic changes, many will not be able to do so, particularly where its cascading effects could see the degradation and loss of key habitats and the collapse of food webs[3]. Importantly, climate change may also act as an amplifier of other threats, such as habitat loss, pollution, and overexploitation[1].

Habitats available to many migratory species will rapidly shrink

Warming global temperatures are expected to allow some migratory species to expand their range polewards[3,4,5]. Others are predicted to experience a reduction or shift in range due to a loss of resources or suitable habitat and may lose the benefits of existing protected area networks as they track shifts in climate[6,7]. Polar species, which have limits on how far their range can shift polewards, are of particular concern[8].

Rising sea surface temperatures and sea ice retreat are expected to restrict the habitat range of the Narwhal (*Monodon monoceros*), a species that generally avoids sea water temperatures above 2°C and relies on sea ice for foraging[9,10]. The small Narwhal populations present in Mideast and Southeast Greenland are considered particularly vulnerable to the effects of climate change. In these areas, sharp rises in sea surface temperatures have been observed, with a mean summer sea temperature of up to 6.3°C recorded, beyond the species' known thermal preference[10].

Changing temperatures can cause migratory species to arrive too early, too late or not at all

The arrival of migratory species at their destination site often aligns with the optimum abundance of resources[2]. Climate change can result in a potential mismatch between the species' arrival and peak abundance of resources and may result in migrants arriving at breeding sites when conditions are suboptimal[6,11,12]. A study of population trends of 100 European migratory bird species between 1990-2000 found that bird species with a declining population trend had not altered the timing of their spring migration to coincide with the earlier arrival of spring, whereas species with stable or increasing population trends advanced their spring migration "considerably"[13]. Even if species do alter their migration patterns, they may still be vulnerable. For example, a study of Barnacle Geese (*Branta leucopsis*) found that the study population was arriving at its Arctic breeding grounds earlier in response to changing patterns of snowmelt[14]. However, egg laying had not kept pace with this earlier arrival, meaning that chicks hatched after the seasonal peak in food quality and were more likely to starve[14].

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Narwhal (*Monodon monoceros*) pod in Lancaster Sound, Canadian Arctic. As well as being sensitive to climate change due to their restricted Arctic range, Narwhals are highly susceptible to ocean noise.

Higher temperatures can skew sex ratios and reduce foraging time

Climate change is predicted to pose a threat to species with temperature-dependent sex determination, such as sea turtles. A study of the northern Great Barrier Reef Green Turtle (*Chelonia mydas)* population found that 87% of adult turtles were female, rising to 99% in juvenile and subadult turtles[15]. The difference in sex ratio between these two age groups was suggested to indicate an increase in the proportion of females in recent decades, likely due to rising sand temperatures[15]. Modelling studies predict that sea turtle populations could continue to be viable even if sex ratios are strongly female-skewed due to the long-generation time of sea turtles. However, considerable uncertainty remains regarding the eventual impacts of climate change on long-term population survival[16,17].

In other species, the direct impacts of rising temperatures have already been demonstrated: for example, long-term monitoring data on African Wild Dogs (*Lycaon pictus*) have shown that these animals forage less in extreme heat, and that packs exposed to elevated temperatures rear fewer pups compared to those raising pups in cooler weather[18].

African Wild Dog (*Lycaon pictus*)

Pollution

Pollution is a key driver of recent biodiversity loss worldwide and includes contamination of the environment with artificial light, anthropogenic noise, plastic and chemicals[1,2]. According to the IUCN Red List, pollution is a threat to 276 CMS-listed species (43% of those with threats documented). Pollution can cause mortality directly, through toxic effects on individuals, or indirectly, by reducing food availability and degrading habitat quality. It can also adversely affect reproductive and physiological performance[1] and natural behaviours, including migratory behaviour. Given their reliance on multiple spatially separated habitats, migratory species may be more likely to encounter a diverse range of pollutants.

Globally, light pollution is increasing in extent, and poses a growing threat to migratory species.

Light pollution is a growing threat to migratory species

A growing area of the Earth's surface is affected by artificial night-time lighting[3], with approximately 23% of global land area now impacted by direct emissions from artificial light sources[4]. There is mounting evidence to suggest that artificial night-time lighting can disrupt the migratory behaviour of a wide range of species, by acting as an attractant or a repellent[5]. The distant sky glow of a brightly lit city can disorient migrating animals[5]. On a more local scale, excessive artificial light can also increase the likelihood of fatal collisions with buildings, wires and other structures[5].

Light pollution is a contributing factor to the deaths of millions of birds annually[6]. Many long-distance migrants are most exposed to the threat of light pollution during their migration phase, as they cross urban areas while travelling between breeding and non-breeding locations[7]. Long-term monitoring of fatal collisions at one large building in North America, where over 40,000 dead birds have been recovered since 1978, has shown that mortality increases when the area of lighted windows is larger, indicating that with increased light comes increased deaths[6].

Light pollution also affects migratory mammals, reptiles, amphibians, fish and invertebrates, though these have been less well studied[5]. In coastal areas, artificial night-time lighting near turtle nesting sites significantly lowers survival of turtle hatchlings, which depend on visual brightness cues for 'sea-finding' behaviours[8].

Mass stranding of Pilot Whales (*Globicephala spp.*) in New Zealand. Some stranding events have been linked to ocean noise, such as sonar.

Anthropogenic noise from shipping and sonar stresses and disorients migratory species

Anthropogenic noise is a major stressor that impacts many taxonomic groups, including migratory mammals, birds and fish[9]. Marine environments in particular are increasingly being affected by noise pollution, which is predominantly caused by activities such as commercial shipping, military sonar, seismic exploration and offshore drilling[10] and offshore wind farms. Global noise emissions from commercial shipping, for example, are predicted to double every 11.5 years, if current rates of increase continue[11].

As aquatic mammals depend upon underwater sound to navigate, communicate, find prey and avoid predators, many of these species are significantly impacted by anthropogenic noise[11]. Sustained exposure to noise can force migrating animals to alter their behaviour, can cause injury, or if loud enough, can even kill[12].

Underwater noise pollution from shipping vessels disrupts foraging behaviour in many cetaceans, including Harbour Porpoises (*Phocoena phocoena*) and Killer Whales (*Orcinus orca*), which spend less time feeding when noisy vessels are present[12,13]. Beaked whales (Ziphiidae) are also extremely sensitive to high-intensity sounds, such as military sonar, which may play a role in fatal stranding events[14,15].

Beyond the marine environment, the likely impacts of anthropogenic noise on terrestrial migrating species that use echolocation, such as bats, are becoming clearer. For example, noise pollution can distract foraging bats, resulting in them hunting less efficiently[16].

Plastic pollution is widespread in many habitats and accumulates in the marine environment

Plastic pollution is increasingly ubiquitous throughout the world, from human-populated areas to remote polar habitats and the deep sea[17]. Since the beginning of the industrial revolution, humans have produced 6.3 billion metric tonnes of plastic waste. The majority has ultimately accumulated in landfill or the natural environment[18]. Plastic waste is typically carried by wind and rivers to the sea. Since most plastics are highly resistant to degradation, the world's oceans therefore function as a major 'sink' for plastic debris[19].

The range of migratory species that are impacted by plastic pollution was highlighted in a recent CMS report[20]; plastic pollution is not only pervasive in the marine environment, but also affects terrestrial and freshwater species such as the Indian Elephant (*Elephas maximus indicus*) and the Irrawaddy Dolphin (*Orcaella brevirostris*). Plastic affects wildlife primarily through entanglement (whereby animals become ensnared in items like bags or nets) or through the ingestion of small plastic materials[18].

A major cause of entanglement in the marine environment is abandoned, lost and discarded fishing gear, which leads to 'ghost fishing' where equipment snags animals that are then never harvested[21]. Although there is uncertainty surrounding the quantity of fishing gear that is lost annually[21], geographic hotspots where entanglement rates are likely to be high have been broadly identified in ocean gyres, along coastlines, and semi-enclosed seas, such as the eastern Mediterranean basin[22].

Ingestion of plastic debris can potentially impair an animal's movement and feeding, cause intestinal blockages, or affect reproduction through the absorption of microplastics[23]. While the effects of plastic ingestion can be difficult to assess, the inadvertent consumption of plastic debris has been shown to represent an additional source of mortality in albatrosses[21,24].

Chemical pollution and heavy metals can have an enduring impact on migratory populations

Chemical pollution, the contamination of the environment with chemicals that are not found there naturally, encompasses a vast range of potential pollutants. These include heavy metals, such as lead and mercury, oil, agricultural pesticides, industrial chemicals and organic pollutants[25,26].

Poisoning from spent lead ammunition is having a significant impact on a wide range of birds, including many migratory raptors and waterbirds that inadvertently consume lead when feeding[27]. Approximately one million waterbirds alone are estimated to die from acute lead poisoning annually across Europe[28]. Although it is now illegal to use lead gunshot in and around wetlands in all 27 EU countries[29], elsewhere, the use of lead ammunition remains a significant issue[27,30].

Marine migratory species, including cetaceans, marine turtles and seabirds, are susceptible to the harmful effects of oil spills. In 2010, the Deepwater Horizon oil spill in the Gulf of Mexico is estimated to have caused the deaths of tens of thousands of adult and juvenile marine turtles[31] and hundreds of thousands of birds (primarily seabirds)[32]. The mortality resulting from an oil spill can have an enduring impact on wildlife populations, particularly for long-lived species such as cetaceans[33]. Aquatic mammals are prone to the inhalation, ingestion and dermal absorption of oil, which can compromise reproduction and survival in the long-term[34].

Agricultural and industrial activity can release significant levels of toxic chemicals, such as persistent organic pollutants (POPs), into the environment[35]. Used in pesticides and industrial chemicals, these pollutants are commonly referred to as ‘forever chemicals’ as they are resistant to environmental degradation[36]. Despite increased regulation of POPs, they continue to be detected in migratory species such as the Common Tern (*Sterna hirundo*) in the Great Lakes, United States[37].

Additionally, nutrient run-off from a wide range of sources continues to pose a serious threat to wetland birds. Eutrophication, the excessive growth of algae and other aquatic plants due to an increased concentration of nutrients, leads to deoxygenation of water systems; the resulting reduction in habitat quality has cascading impacts on food webs. For example, populations of five generalist duck species associated with eutrophic water ecosystems in Finland were estimated to have halved on average since the 1990s, likely due to over-eutrophication and the resulting loss of feeding opportunities[38].

Finally, the widespread application of pesticides in intensive agriculture has been recognized as a key factor in the reported declines in the populations of many insect species[39]. These losses can result in food shortages for a wide range of species, including the many insectivorous migratory birds[40,41].

Diving ducks, like the Vulnerable Common Pochard (*Aythya ferina*), as well as other waterbirds and birds of prey, are impacted by lead poisoning from lead shot.

Threats to important sites for migratory species

In order to fully understand the pressures on migratory species, it is important to also assess the threats to the sites that are most critical for their survival. These sites may include important breeding, non-breeding, feeding or stopover sites that ensure species can make the sometimes-arduous journeys across diverse landscapes and seascapes.

This section presents information on some of the most important sites for CMS-listed species globally, by providing an overview of the Key Biodiversity Areas (KBAs) that support significant numbers of CMS-listed species, and by highlighting terrestrial areas that may be of potential significance for CMS species beyond the existing KBA network. Other approaches that are being used to identify important areas for CMS species are also summarized.

The pressures facing important sites for CMS species are then assessed, based on the available threat data for KBAs that have been triggered by CMS-listed species. Finally, this section highlights the crucial data gaps that need to be filled if all critical sites for migratory species globally are to be identified and protected.

Key Biodiversity Areas identify nearly 10,000 important sites for CMS-listed species

Key Biodiversity Areas (KBAs) are "sites that contribute to the global persistence of biodiversity" and are identified through a set of established criteria[1], such as whether a site supports a significant proportion of the worldwide population of a globally threatened species. KBAs are recognized as priorities for protection through protected area networks (e.g. SDG indicator 15.1.2 which measures the proportion of KBAs that are protected), and areas to avoid in development projects (e.g. as established by International Finance Corporation Performance Standard 6).

The Danube Delta in Romania is the Key Biodiversity Area with the largest number of CMS-listed trigger species (73 species).

To date, KBAs have been most comprehensively identified for birds, through 12,000 Important Bird and Biodiversity Areas (IBAs)[2]. However, KBAs also include Alliance for Zero Extinction sites[3] and sites covering multiple taxonomic groups in freshwater[4], marine[5] and terrestrial systems[6,7].

Of the 16,335 KBAs that have been recognized to date, 9,469 KBAs (58%) have been identified[8] through having one or more CMS-listed species at qualifying levels for at least one KBA criterion. Overall, 95% of KBAs with CMS trigger species have been triggered by bird species. This reflects the fact that the overall KBA dataset is currently dominated by IBAs, but also that 81% of CMS-listed species are bird species (Figure 1.2). The majority of the 9,469 sites have one (35%) or two (20%) CMS trigger species. Most KBAs recognized to date are located in Europe, Asia and Africa (Figure 3.7a).

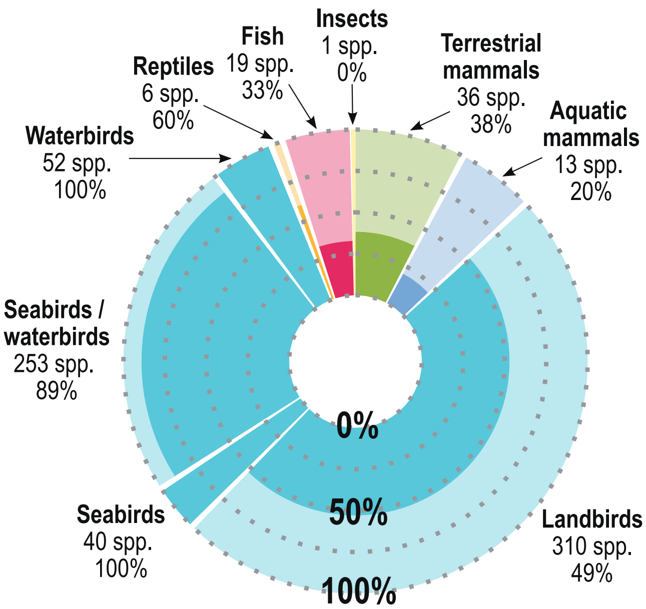

***Figure 3.6:* Almost two thirds (61%) of CMS-listed species have triggered at least one Key Biodiversity Area, but this varies by taxonomic group.** *Shaded areas represent the percentage of species for which at least one KBA has been triggered.*

Of the 1,189 CMS-listed species, 729 species (61%) have triggered KBAs to date. While birds are the taxonomic group with the highest proportion of species triggering a KBA (68%) (Figure 3.6), land birds represent the group with both the highest number of CMS-listed species (276) and the highest proportion not triggering a KBA. The majority of CMS-listed terrestrial mammals, fish and aquatic mammals have not yet been found to trigger a KBA, and there are no KBAs for the one insect species (Monarch Butterfly, *Danaus plexippus*). Additionally, of the 460 CMS-listed species that have not yet triggered a single KBA, 70 species (15%) are globally threatened.

In addition to assessing the proportion of CMS-listed species that have triggered at least one KBA, it is also important to understand the extent to which important sites have been identified throughout the migratory range of each CMS species, as well as the ecological connectivity between those sites: each species will depend on a number of sites as it migrates.

CMS has extensively recognized the importance of identifying and protecting ecological networks for CMS species throughout their ranges (for example CMS Resolution 12.7 (Rev.COP13) on The Role of Ecological Networks in the Conservation of Migratory Species, Pritchard 2014[9] and Target 10 of the strategic plan 2015-2023[10]); however, an indicator is not yet established and the extent to which all key sites have been recognized throughout the ranges of all CMS species has not yet been assessed[10]. Nevertheless, for bird species the concept of flyways is well established, with initiatives to identify sites of importance[q].

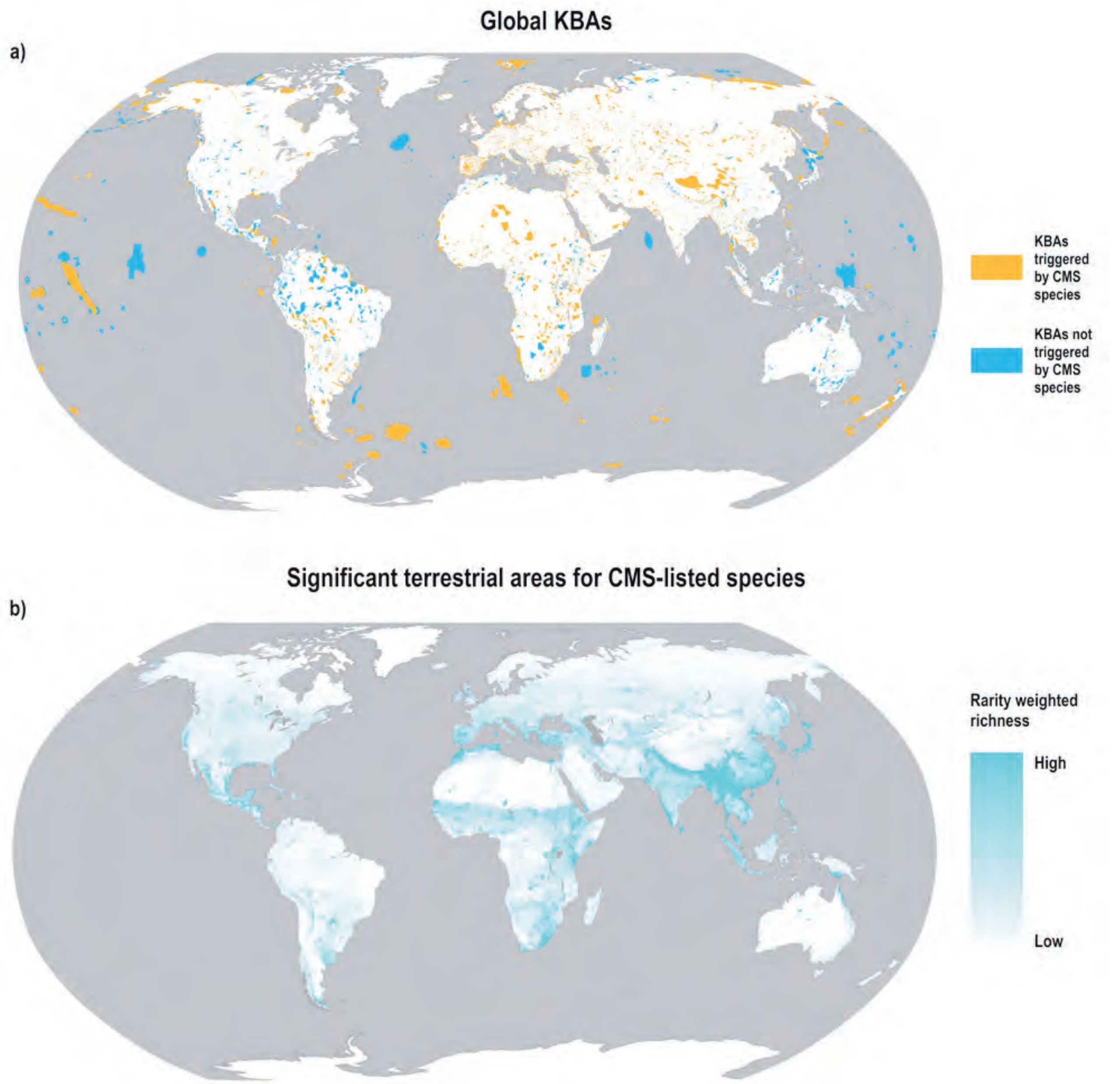

Figure 3.7: ***Maps showing a) the global[p] distribution of Key Biodiversity Areas (KBAs)***[8]*, where KBAs that have been triggered by one or more species listed in the CMS Appendices are shown in orange and KBAs that have been triggered by other species are shown in blue, and* ***b) the terrestrial areas[p] of potential significance for CMS species****, identified using a rarity-weighted species richness metric based on IUCN range data refined to area of habitat (AOH) (marine areas not shown). Comparison between the two maps indicates terrestrial areas of potential importance for CMS-listed species that are not yet covered by the KBA network.*

[p] Base layers: United Nations Geospatial, 2023. Projection: Robinson Sphere. The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

[q] The Critical Site Network Tool 2.0 has identified key sites for over 300 waterbirds across the Africa-Eurasia region; 900 sites have also been identified as part of the East Asian Australasian Flyway network.

Additional areas of potential significance for CMS-listed species

As the identification of KBAs is in progress, other sources of data can support the identification of additional areas of potential significance, indicating gaps in the KBA network for CMS-listed species. Figure 3.7b presents a rarity-weighted richness metric for terrestrial CMS-listed species based on their IUCN Red List ranges each refined to the species' area of habitat (AOH)[11], following a process described by Jung *et al.* (2021)[12] and weighting breeding and non-breeding distributions separately[13]. This metric highlights the terrestrial areas where there are high concentrations of range-restricted CMS-listed species. Marine areas were not included in the analysis as marine AOH data are not yet complete. Comparison of the two maps in Figure 3.7 reveals broad terrestrial areas of potential high significance for CMS species which are not yet recognized within the KBA network. These areas are most notable in South Asia, in a band south of the Sahel, and in pockets in Southern Africa, Uruguay and Patagonia.

A range of other efforts are also underway to identify important sites for CMS-listed species. In the marine realm, Important Marine Mammal Areas (IMMAs) are being identified through an initiative led by the IUCN SSC/WCPA Marine Mammal Protected Areas Task Force (Figure 3.8). Several IMMAs could meet quantitative criteria allowing their conversion into KBAs. Work is underway to identify Important Marine Turtle Areas (IMTAs) and Important Shark and Ray Areas (ISRAs). There has also been significant work to collate data on important at-sea sites for seabirds through the BirdLife International Seabird Tracking Database and marine IBA e-atlas. Over 3,000 marine IBAs have been identified to date, the majority of which are already recognized as KBAs. The Convention on Biological Diversity has also coordinated a series of regional workshops to identify Ecologically or Biologically Significant Areas (EBSAs). Migratory Connectivity in the Ocean (MiCO) is also supporting the identification of key sites through synthesis of tracking data.

Data gaps on sites of importance for terrestrial mammals are being filled through the Global Initiative on Ungulate Migration (GIUM), established in partnership with CMS with the goal of creating a global atlas of migration for ungulate species, and for understanding threats to migration. In freshwater habitats, the Global Swimways Programme also aims to highlight the river systems that support a high diversity of threatened migratory fish species.

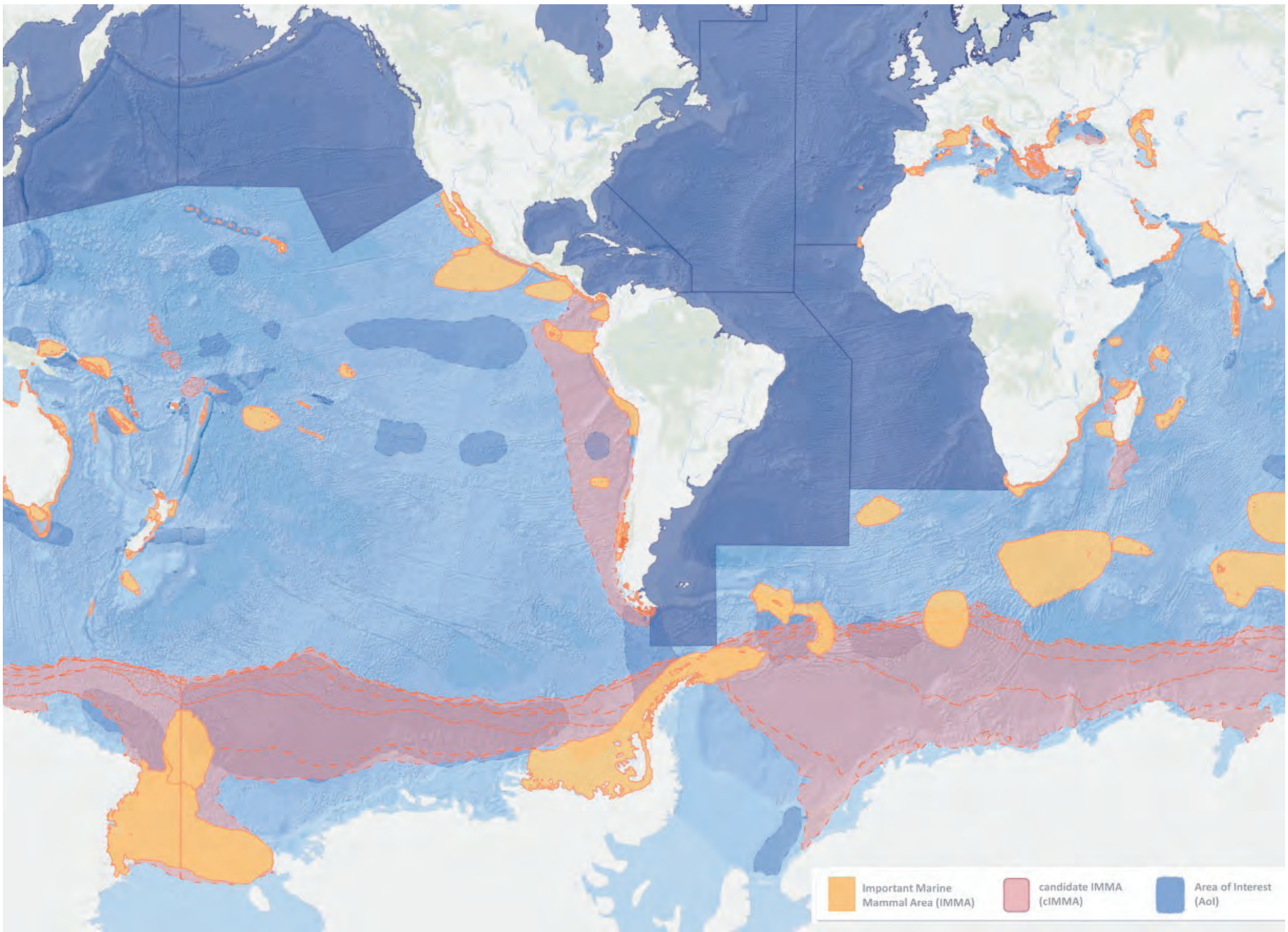

***Figure 3.8:** **Global network of Important Marine Mammal Areas (IMMAs)** totalling 209 IMMAs, 30 candidate IMMAs and 152 Areas of Interest[14]. Map provided by the IMMA Secretariat.*

Data on threats to sites

IBA monitoring data represent the most comprehensive dataset currently available for threats to key sites for CMS species. IBA monitoring uses a protocol established in the early 2000s[15] in which the threats ('pressures') facing a site are identified using the IUCN Threats Classification Scheme[r]. A protocol for monitoring KBAs is currently in development and closely follows the IBA monitoring scheme.

To date, threat data from IBA monitoring assessments are available for nearly one third, or 3,096, of the KBAs triggered by CMS-listed species, with data from 177 countries and a global distribution that is similar to that of KBAs supporting CMS-listed species overall. **Over half (58%) of monitored sites important for CMS species are experiencing 'unfavourable' or 'very unfavourable' levels of pressure** (Figure 3.9). This means that one or more of their trigger species is highly impacted by threats.

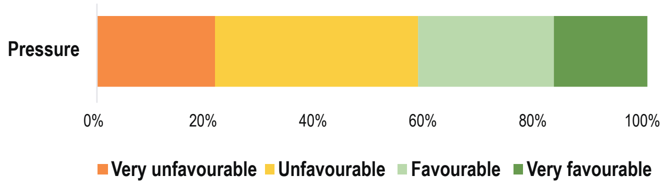

***Figure 3.9:* Pressure assessments of KBAs that are triggered by CMS-listed species and for which monitoring data are available (n=3,096).**

While recognizing the limitations of the data, which include incomplete coverage of CMS-listed species and the lack of recent threat monitoring[s], the four threats most frequently recorded at sites triggered by CMS species are **'hunting and collecting terrestrial animals'**, **'recreational activities'**, **'livestock farming and ranching'**, and **'non-timber crop production'** (Figure 3.10). These threats are reportedly having a high or very high impact at 198 (6%), 151 (5%), 133 (4%) and 191 (6%) of the 3,096 monitored sites, for the pressures listed above respectively. Collectively, as seen with threats to the species themselves (Figure 3.1), pressures to sites are mainly driven by both 'habitat loss, degradation and fragmentation' and 'overexploitation'.

Other sources of threat data, particularly for birds, include data being collated by Ramsar and presented in its Global Wetland Outlook series[16], and through flyway assessments such as the East Atlantic Flyway Assessment 2020[17]. These data overlap with sites with IBA monitoring data presented in Figure 3.10, but provide a more detailed regional or taxon group assessment.

Another source of threat data is from protected area monitoring, collated for example on World Heritage Sites by UNESCO and the European Union for its Natura 2000 network. Remote-sensing data are also being used to identify and monitor threats to sites in some contexts[18]. Global remote sensing datasets can also detect other relevant changes such as changes in surface water and intertidal habitats.

Many data gaps remain on threats to key sites

Substantial data gaps remain in relation to understanding the threats to sites important for CMS species, as recognized in CMS Resolution 12.7 (Rev.COP13)[19], which, among other recommendations, urges CMS Parties to identify critical sites and to undertake monitoring of threats. CMS Resolution 12.7 (Rev.COP13) also recognizes the crucial importance of maintaining coherent ecological networks encompassing core sites, migration corridors and wider landscape/seascape in enabling the survival and the unimpeded movement of migratory species[20].

To support this, a review of the currently-recognized important sites (KBAs and others), together with their connectivity, would help assess the adequacy of the current site network, and provide a baseline for future progress towards relevant targets under the new CMS strategy. Site-based threat data could be supplemented by national, regional or global analyses of remote sensing data to aid with data gap filling, though this will require the further development and testing of approaches.

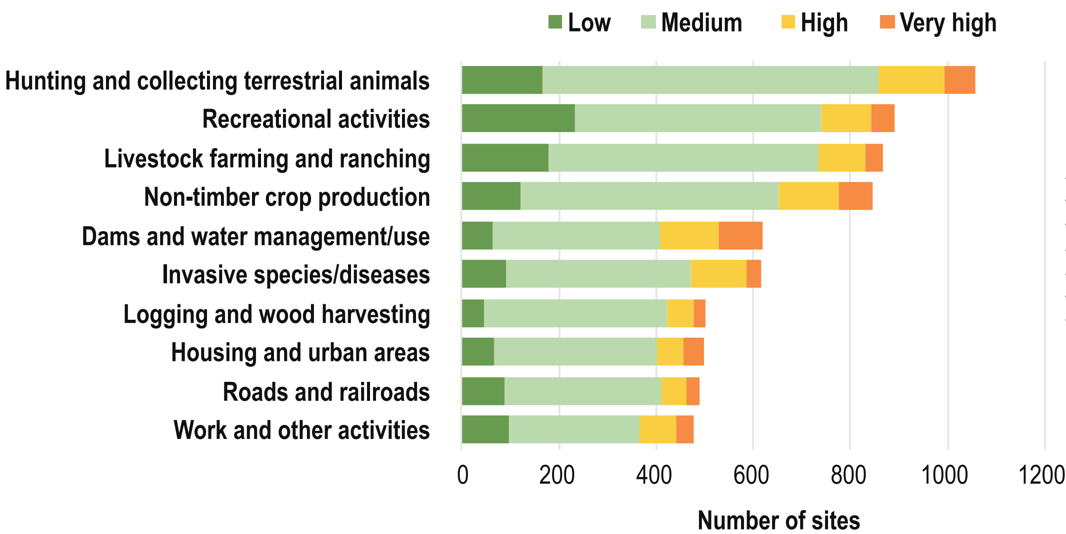

***Figure 3.10:* Top 10 threats to sites supporting CMS-listed species identified during IBA monitoring at 3,096 sites, based on the IUCN threat sub-categories and an assessment of impact.**

[r] The IBA monitoring protocol also enables the state (condition) and response (conservation actions taken at the site) to be assessed and tracked.

[s] A large proportion of the sites (47%) were last monitored more than 12 years ago. A weakest-link approach is also taken for assessing the status of sites, and this has led in some cases to the assessor reporting only on the highest impact threat to the trigger species, rather than reporting a complete site threat assessment.

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IV. RESPONSE – Actions to conserve migratory species and their habitats

As highlighted in the previous chapter, migratory species, and their habitats and migratory routes, are facing a myriad of threats. This chapter provides illustrative examples of responses that the world's governments, as well as wider stakeholders such as civil society and the private sector, are taking to address key threats and to conserve migratory species and their habitats, and identifies where more work needs to be done.

Implementation of legally binding obligations under CMS

The Convention text sets out the general principles agreed upon by Parties for the protection and conservation of species listed in the CMS Appendices.

For **species included in Appendix I**, CMS Parties are obliged to prohibit the 'taking' of these species, defined as taking, hunting, fishing, capturing, harassing or deliberate killing, with a narrow set of exceptions to this obligation (Article III.5); Parties should, as soon as possible, inform the Secretariat of any exceptions made (Article III.7).

CMS Parties that are Range States of Appendix I species are additionally directed *"to endeavour to conserve and, where feasible and appropriate, restore those habitats of the species which are of importance in removing the species from danger of extinction; to prevent, remove, compensate for or minimize, as appropriate, the adverse effects of activities or obstacles that seriously impede or prevent the migration of the species; and to the extent feasible and appropriate, to prevent, reduce or control factors that are endangering or are likely to further endanger the species"* (Article III.4).

CMS Parties are additionally required to *"keep the Secretariat informed in regard to which of the migratory species listed in Appendices I and II they consider themselves to be Range States, including provision of information on their flag vessels engaged outside national jurisdictional limits in taking the migratory species concerned and, where possible, future plans in respect of such taking"* (Article VI.2).

At COP12 Parties adopted Resolution 12.09 to establish a Review Mechanism and a National Legislation Programme to facilitate the implementation of the Convention and promote its effectiveness. The Review Mechanism aims to ensure compliance with Articles III.4, III.5, III.7 and VI.2 of the Convention by reviewing specific implementation matters[a]. The National Legislation Programme provides assistance to Parties, if needed, in developing or improving relevant national legislation to ensure long-term compliance with Articles III.4 a) and b) and III.5.

In accordance with Resolution 12.9 and COP Decision 13.23, information on Parties' national legislation to implement Article III.5 and III.4 a) and b) was obtained through a questionnaire. A National Legislation Profile, comprising the findings and a set of recommendations, has been prepared for each of the 58 Parties participating in the Programme. The preliminary review of national legislation revealed varying levels of implementation and differences in interpretations of key concepts, such as the definition of 'taking' and the exceptions to the take prohibition. The review also found that while most laws cover the actions included in the definition of 'taking', such as hunting, fishing, capturing and deliberate killing, in some cases 'harassment' and 'attempt' are not expressly prohibited. Additionally, it was revealed that domestic legislation tends to have a broader scope when incorporating the requirements to exceptionally allow the taking of Appendix I species. For example, most Parties provide a general exception for the taking of Appendix I species for scientific purposes, but few define the circumstances in which this exception is reasonable and appropriate.

Certain Cheetah (*Acinonyx jubatus*) **populations are listed in CMS Appendix I.**

[a] **Article III paragraph 4:** Parties to conserve and restore habitats of, address obstacles to migration of, and address factors endangering Appendix I species; **Article III paragraph 5:** Parties to prohibit taking of Appendix I species; **Article III paragraph 7**: Parties to notify exceptions to Article III paragraph 5; and **Article VI paragraph 2**: Parties to notify which Appendix I and II migratory species they consider themselves to be Range States and inform about flag vessels engaged outside national jurisdictional limits in taking of migratory species concerned.

Reducing overexploitation, including mitigating incidental catch of non-target species

Pressure from overexploitation, including the incidental catch of non-target species, represents one of the foremost threats facing CMS-listed species (see *Chapter II*). Tackling this complex threat is challenging, due to the diverse motivations of harvesters, the varied rules and regulations that are in place in different countries and environments (marine, terrestrial, freshwater), and the many connections between the drivers of overexploitation and the wider economy. For example, the intentional harvest, use and trade of wildlife occurs in many different socio-economic contexts, may be legal or illegal depending on the region or species, and can be driven by subsistence use, domestic demand and major international market forces[1-4]. Similarly, incidental catch of non-target species can occur in both large- and small-scale fisheries, with species-specific impacts that vary widely between gear types[5]. Responses to overexploitation and incidental catch are therefore just as varied, ranging from community awareness-raising projects to national legislation and coordinated international action.

Tackling the illegal or unsustainable killing, taking and trade of migratory birds

The illegal killing, taking and trade of migratory birds (IKB) is an increasing risk to many species[6]. Following the mandate set out by CMS Resolution 11.16 (Rev. COP13) on The Prevention of Illegal Killing, Taking and Trade of Migratory Birds, two CMS intergovernmental task forces have been established so far to respond to IKB, including the Inter-governmental Task Force on Illegal Killing, Taking and Trade of Migratory Birds in the Mediterranean Region (MIKT), while others have been proposed and are being considered.

MIKT member countries have adopted a zero-tolerance approach to IKB that contravenes national laws, multilateral environmental agreements and international commitments[7]. MIKT operates in tandem with the Bern Convention Network of Special Focal Points on IKB, using the common strategic framework of the Rome Strategic Plan 2020-2030. Under the framework, countries aim to halve IKB within their national territories by 2030, compared to the 2020 baseline[8]. Member countries are encouraged to evaluate their progress through a voluntary scoreboard assessment[9]. The most recent assessment, in 2021, concluded that current legislation was in general "adequate to address IKB", but highlighted the ongoing need for heightened enforcement, including enhanced judicial awareness in order to improve prosecution success[9]. Numerous projects at the national level also feed into IKB solutions in the Mediterranean; for example, in Cyprus, surveillance of known bird trapping hotspots by BirdLife Cyprus and the RSPB working with the competent authorities resulted in a significant decline in illegal mist netting in these areas since 2002[10].

IKB is also significant in other regions, notably the East Asian-Australasian Flyway (EAAF) migration route[3,11,12], where illegal trapping for consumption has caused a population decline of 84-95% in the previously "superabundant" Yellow-breasted Bunting (*Emberiza aureola*) that is now considered Critically Endangered[11]. A task force for the region, modelled on the MIKT, and in cooperation with the EAAF Partnership on protection of migratory waterbirds, facilitates regional cooperation and knowledge sharing[13]. A third regional IKB task force has also been proposed for the Arabian Peninsula, Iran and Iraq[6].

Yellow-breasted Bunting (*Emberiza aureola*), once widespread, has experienced substantial declines due to illegal hunting and is now Critically Endangered.

Other priority actions to tackle the unsustainable legal taking of birds under CMS include, for example, adaptive harvest management programmes. These can support population recovery and sustainable use and have been established for certain species under the Agreement on the Conservation of African-Eurasian Waterbirds (AEWA), including for the Taiga Bean Goose (*Anser fabalis fabalis*), which is declining due to hunting pressure in Denmark, the Russian Federation, and Sweden[14].

Advances in tracking technology[16,17], combined with the growing availability of remotely sensed data[4], are increasingly enabling researchers to assess the impact of threats at the flyway scale. That said, as highlighted in *Chapter II*, data on legal and illegal taking are still lacking for many bird species in some regions. Systematically collected data on illegal killing would help to better target on-the-ground conservation action, including collaborative international efforts designed to tackle illegal killing, towards the species most at risk and the areas that are hotspots for illegal activity.

Mitigating incidental catch of non-target species

Bycatch[b], referred to by CMS as the incidental catch of non-target species in fishing gear, is a major conservation issue affecting a wide range of aquatic taxa including mammals, seabirds, turtles, sharks and other non-target fish species[18-20].

Tackling incidental catch of non-target species is a key priority for CMS. In 2017, several CMS recommendations and Resolutions were consolidated into CMS Resolution 12.22, which calls on Parties, as a matter of urgency, to continue and strengthen measures within fisheries under their control to minimize the incidental catch of migratory species.

CMS Resolution 12.22 encourages Parties to implement best practice approaches as outlined in International Plans of Action (IPOAs) and Technical Guidelines[c] developed by the Food and Agriculture Organization (FAO). IPOAs were created as voluntary instruments, following the adoption in 1995 of the (non-binding) FAO Code of Conduct for Responsible Fisheries, to aid the implementation of bycatch mitigation measures[21]. As well as urging Parties to develop country-level measures such as National Plans of Action, IPOAs highlight opportunities for bycatch mitigation through the work of Regional Fisheries Management Organizations.

Through Resolution 12.22, CMS calls on its Parties to cooperate closely with other programmes such as the Bycatch Mitigation Initiative (BMI) established by the International Whaling Commission (IWC). The BMI aims to develop, assess and promote effective measures to mitigate incidental catch in cetaceans, with a focus on small-scale fisheries employing gillnets, due to their wide use and non-selective nature[22,23].

Net illumination has emerged as a promising mitigation tool in gillnet fisheries to reduce the incidental catch of small cetaceans[24], birds[24,25] and turtles[26-28] without affecting target catch or value. Recent trials in Mexico found that attaching green LED lights to gillnets reduces the incidental capture of elasmobranchs, squid and finfish[29]. Research suggests that net illumination enables non-target species to avoid entanglement by deterring them or alerting them to the presence of nets[25,26]. Since the success of such sensory deterrents is often highly dependent on the local context and the species involved, additional trials are needed to determine the efficacy of this developing tool in varying light and turbidity conditions[30], and to assess the effect of lights on different taxa[31]. Wider implementation also depends on overcoming challenges surrounding the cost and availability of this technology[27,32].

While emerging mitigation tools such as net illumination represent a promising solution to the problem of incidental catch for some species[33], there is still an urgent need to expand collaborative international efforts designed to tackle this threat. Given the dire conservation status of CMS-listed fish and sharks and rays in particular[d], as well as the inherent susceptibility of many long-lived marine mammals and seabirds to additional mortality, further action is needed to accelerate the effective implementation of successful mitigation measures, and promote widespread take-up in key fisheries.

Manta Rays (*Mobula* spp.) are particularly susceptible to incidental catch by fisheries and suffer from high rates of post-release mortality.

[b] The definition of bycatch used by different stakeholders can vary. This can result in inconsistencies in reporting and the implementation of mitigation strategies, particularly for species that are commercially used, but are not directly managed as the official target of a fishery.

[c] Key documents include the 1999 FAO International Plan of Action for Reducing Incidental Catch of Seabirds in Longline Fisheries (IPOA-Seabirds) and its related Best Practices Technical Guidelines, the 1999 FAO International Plan of Action for the Conservation and Management of Sharks (IPOA-Sharks), the 2009 FAO Guidelines to Reduce Sea Turtle Mortality in Fishing Operations, and the 2011 FAO International Guidelines on Bycatch Management and Reduction of Discards, and the 2021 FAO Guidelines to Prevent and Reduce Bycatch of Marine Mammals in Capture Fisheries.

[d] 27 out of 37 CMS-listed sharks and rays are categorized as Endangered or Critically Endangered.

Protecting and conserving key habitats for migratory species

Protected areas and other effective area-based conservation measures (OECMs), collectively known as protected and conserved areas, are essential for the conservation of migratory species. These areas, if effectively managed, provide some of the best mechanisms to combat many of the key threats by protecting habitat, regulating natural resource use and preserving refuges that can provide resilience to climate change.

Migratory species can travel vast distances, meaning the protection of their migration routes requires careful planning. Before sites can be protected, the most important habitats for migratory species first need to be identified: to reflect this urgent need, the Strategic Plan for Migratory Species 2015-2023 calls for the identification of all critical habitats and sites for migratory species (Target 10; *see Chapter II*). Once these critical sites have been identified, well-placed, well-designed, well-connected, and well-managed networks of protected areas and OECMs can be established to prevent the degradation of vital habitat within seasonal ranges and migratory routes, including feeding, breeding, non-breeding and stopover sites[1]. While protected and conserved areas have great potential to improve the conservation status of migratory species, as of 2019, 78% of known threatened species lack adequate protected area coverage[2]. Furthermore, an analysis of protected area coverage for 1,451 migratory birds found that just 9% are sufficiently protected across all stages of their annual cycle, compared to 44.8% of non-migratory birds[3].

Protected areas can be designated under a variety of management types, ranging from strict protection to the sustainable use of some natural resources[4]. OECMs are areas governed and managed in ways that achieve biodiversity conservation regardless of management objectives; they represent a diverse range of management and governance regimes, implemented by a range of actors from the private sector to Indigenous Peoples and/or local communities[5]. OECMs can create ecological linkages between protected areas and therefore play an important role in building connectivity.

Atlantic Forest in Guapiaçu Ecological Reserve, Brazil.

KBA coverage by protected and conserved areas

Key Biodiversity Areas (KBAs)[e] represent the network of sites identified as being important for biodiversity. Globally, nearly half (49%) of the area of KBAs triggered[f] by CMS-listed migratory species was covered by protected and conserved areas[g] in 2022[6].

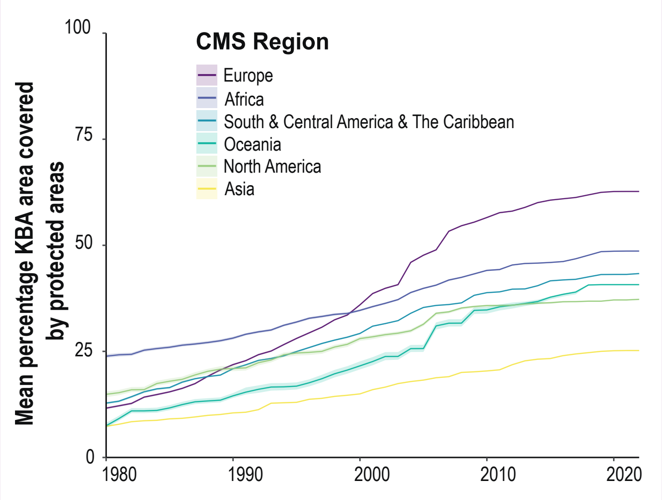

Figure 4.1: ***Trends in protected area coverage of Key Biodiversity Areas identified for CMS-listed species in each region.*** *n = 1,106 KBAs in Africa, 2,100 KBAs in Asia, 4,490 KBAs in Europe, 477 KBAs in North America, 369 KBAs in Oceania and 710 KBAs in South & Central America and The Caribbean. Shading shows confidence intervals. Data source: BirdLife International (2023).*

Europe currently has the highest percentage of areas of KBAs triggered by CMS-listed species that is covered by protected and conserved areas (63%) and Asia the lowest (25%) (Figure 4.1). This means many areas already identified as being important for migratory species are not yet fully protected or conserved at the national or international level. For example, the Salar De Huasco salt flats of Chile are designated as a KBA on the basis of their importance to the Andean Flamingo (*Phoenicoparrus andinus*), Puna Flamingo (*Phoenicoparrus jamesi*), and Chilean Flamingo (*Phoenicopterus chilensis*). While the Salar De Huasco KBA overlaps with a designated protected area, only an estimated 7% of the KBA is covered by the national park[7].

Increased efforts are needed to protect and conserve more of these important sites for migratory species. Even sites that are fully covered by protected or conserved areas, if not appropriately managed, may not be effectively conserved on the ground. It is also important that such areas are well-connected, to ensure that migratory species are sufficiently protected and conserved along their migratory routes.

[e] Key Biodiversity Areas (KBAs) are "sites that contribute to the global persistence of biodiversity" identified based on a set of 11 global criteria including threatened, irreplaceable, and restricted biodiversity, ecological integrity, and biological processes. For example, sites may be designated due to the presence of a significant proportion of a globally threatened species.

[f] KBAs identified as having one or more CMS-listed species at qualifying levels for at least one KBA criterion.

[g] The protected area coverage of KBAs identified for CMS-listed species was determined by overlapping boundary data for KBAs from the World Database of KBAs, protected areas from the World Database on Protected Areas, and OECMs from the World Database on OECMs (September 2022 release). While this illustrates the global protected and conserved area coverage for migratory species, it does not capture important sites for non-CMS-listed migratory species or species that have not yet been identified as KBA triggers. Moreover, migratory species are likely reliant on many more sites beyond those currently identified.

Additional measures, designed to ensure that wider areas of habitat are appropriately managed, are also required for the many migratory species that occur at low densities over a very large geographic area during all or part of their annual cycle (e.g. passerine birds)[8]. Similar measures may be needed for wide-ranging nomadic species, such as the Mongolian Gazelle (*Procapra gutturosa*), which exhibits considerable year-to-year variation in its movement patterns[9].

Coherent, well-connected ecological networks are crucial for migratory species

While migratory routes can rarely be entirely protected, ecological networks of protected areas and OECMs can be designed to meet the habitat needs of migratory species at the land- and seascape level[10,11]. Ecologically connected networks can facilitate the movements of migratory species between habitat patches and geographically link individuals and populations throughout their migratory cycles[12,13]. Connectivity between sites is therefore crucial for the persistence of populations and species. Despite the importance of ecological networks, connectivity has seldom been prioritized in the identification and design of protected area networks[14,15], and there has been no global-scale assessment of the connectedness of current marine and freshwater protected area networks[2,15]. In the terrestrial realm, protected and connected land was estimated to have increased from 6.5% to just 7.7% between 2010 and 2018[16], and to 7.84% in 2020[17]. Promoting ecological corridors must therefore be prioritized in the future creation and expansion of protected and conserved areas.

Political boundaries and ecological boundaries often do not align[18,19]. Transboundary protected areas are therefore important to facilitate migratory species' movements across jurisdictional borders. At the UN Climate Change Conference COP26 in 2021, Ecuador, Costa Rica, Panama and Colombia committed to the creation of a 500,000 km^2 fishing-free corridor. The Eastern Tropical Pacific Marine Corridor ('CMAR') would be the world's largest transboundary marine protected area and could provide vital protection to the migratory routes of whales, sharks, sea turtles and manta rays[20].

On land, the Kavango-Zambezi (KAZA) Transfrontier Conservation Area in Southern Africa is one of the world's largest transboundary ecological networks, spanning five countries and facilitating the migrations of CMS-listed species, including African Elephants (*Loxodonta africana*), African Wild Dogs (*Lycaon pictus*), and several migratory bird species[3]. In collaboration with CITES, CMS is promoting ecological corridors for Lions, Wild Dogs and other species through its African Carnivores Initiative[21]. Elsewhere, the Asian continent has been identified as having strong potential for transboundary protected areas, but protected area connectivity in this region was estimated to have decreased between 2010 and 2018 (from 6.2% to 5.1%)[16,22]. Under the Central Asian Mammals Initiative[23], CMS is driving forwards work to maintain connectivity in the largely intact ecosystems of Central Asia, which are home to wide-ranging species such as the Asiatic Wild Ass (*Equus hemionus hemionus*).

Effective stakeholder and rights-holder participation is key for migratory route protection

Migratory routes can cover large areas under diverse governance and tenure systems, across a mosaic of protected and unprotected lands and waters. Governance of migratory routes therefore requires collaboration, effective and equitable participation and consent of all relevant stakeholders and rights-holders, including the free, prior and informed consent of Indigenous Peoples and local communities (IPs and LCs)[24]. IPs and LCs own or govern at least a third of the world's terrestrial surface and play a significant role in the conservation of migratory species and in maintaining connectivity[25]. Examples of successful community-led conservation exist across the world and include Kawawana, Senegal, where embedded traditional systems of governance supporting local efforts to restore coastal habitats have seen the return of manatees, dolphins and many migratory birds[26].

The next two sections will explore two concepts that are integral to the design and maintenance of effective protected area networks for migratory species: minimizing barriers to connectivity and promoting the restoration of degraded ecosystems.

Andean Flamingos (*Phoenicoparrus andinus*) feeding in the salt flats of Chile

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Promoting ecological connectivity by removing barriers to migration

Migratory species depend on connectivity throughout their lifecycle. As highlighted in the preceding section, protected and conserved areas are important aspects of promoting ecological connectivity, but the removal of physical barriers and infrastructure that impedes their movement is also key. Given the range of threats posed to migratory species, designing appropriate conservation and management measures that promote connectivity and minimize human disruption to movement is critical to the long-term survival of migratory species[1].

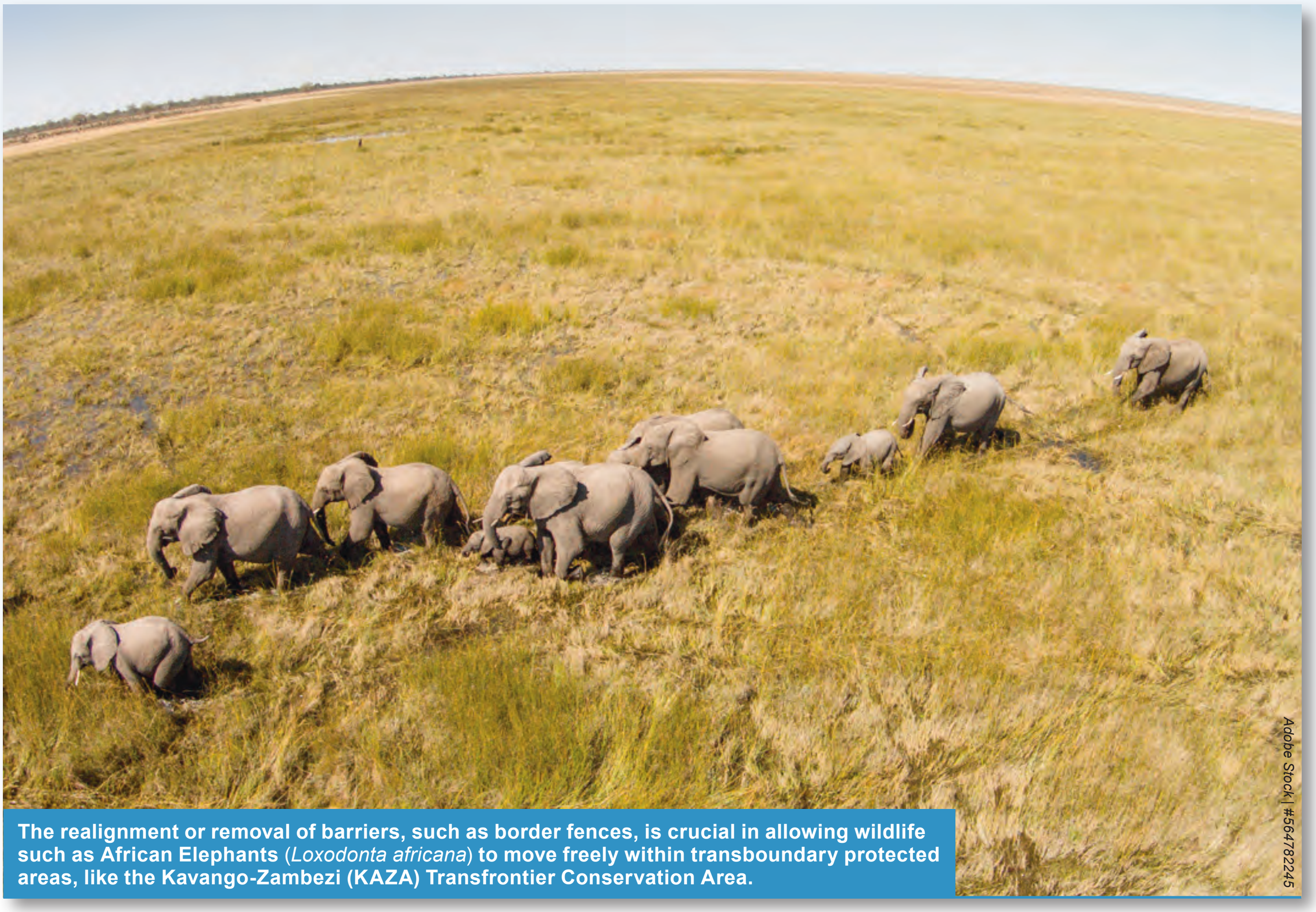
Development projects should endeavour to preserve ecological connectivity wherever possible. This often requires collaboration between multiple stakeholders, including national governments, the private sector and civil society. Formal initiatives that bring these stakeholders together can be beneficial in facilitating dialogue. For example, the CMS Energy Task Force is a global forum for relevant stakeholders to establish best practice in relation to renewable energy expansion and migratory species. This multi-stakeholder initiative has developed guidance and technical standards for renewable energy projects to avoid and minimize activities that could negatively impact migratory species.

This section focusses on measures being taken to mitigate barriers to connectivity caused specifically by infrastructure development. This can be achieved through targeted activities focussed on **avoidance**, **minimization** and **restoration**.

Avoidance

Avoidance is the most important and most cost-effective mechanism for reducing impacts on species[2,3]. Awareness of the potential effects of infrastructure developments prior to project implementation can avoid severe impacts on migratory species if acted upon. For example, a critical step prior to the construction of new energy infrastructure is ensuring that projects are not located in the most sensitive areas for migratory species. To assist stakeholders involved in energy development, the CMS Energy Task Force has compiled a range of resources on this topic, including guidance on how to integrate migratory species considerations into spatial planning processes (ETF6/Doc.6). Additionally, specific online tools have also been created to support planning for energy developments: for example, BirdLife International, the coordinator of the CMS Energy Task Force, has developed the Avian Sensitivity Tool for Energy Planning ('AVISTEP') (see Box 3).

Identifying alternative development sites or rerouting planned pipelines, roads and railways can also help to avoid negative impacts on migratory species[3]. For example, in 2011, a development proposal for a road that would bisect Serengeti National Park, "the largest remaining migratory system on Earth"[4], was withdrawn by the United Republic of Tanzania following widespread concern over its expected impacts, including potential disruptions to the mass migrations of wildebeest[5].



The realignment or removal of barriers, such as border fences, is crucial in allowing wildlife such as African Elephants (*Loxodonta africana*) to move freely within transboundary protected areas, like the Kavango-Zambezi (KAZA) Transfrontier Conservation Area.

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Asiatic Wild Ass (*Equus hemionus hemionus*) observed crossing the eastern steppe in Mongolia for the first time in 65 years following work to remove barriers to migration.

Environmental Impact Assessments (EIAs) identify risks and potential biodiversity impacts at the planning stage of a development project[6] and are applied in almost 200 countries[7]. EIAs can be complemented by Strategic Environmental Assessments (SEAs), which consider the cumulative impacts of several projects and tend to be applied at the sector or country level. To understand the true potential impact on migratory species, cumulative impacts should be modelled at the population scale, taking into account existing and planned development across multiple countries. SEAs are recognized by a number of international conventions and treaties[h], and are expected to become more prevalent following the adoption of the Kunming-Montreal Global Biodiversity Framework under the Convention on Biological Diversity (Target 14[i]). SEAs are already being used in landscape planning for large-scale infrastructure projects: for example, the inter-governmental Mekong River Commission (MRC) of Cambodia, Lao PDR, Thailand and Viet Nam commissioned an SEA to assess development proposals for twelve hydropower dams in the lower Mekong[8]. The final report recommended that decisions on the construction of the dams should be deferred for ten years to allow time to consider alternative and less destructive power generation systems[9]. While the role of the SEA in influencing decision-making is unclear, Cambodia recently established a 10-year moratorium on dam-building in the Mekong[10]. However, pressure to push forward on the construction of dams in the lower Mekong is growing[8].

Minimization

If the creation of infrastructure barriers is unavoidable, the incorporation of biodiversity-friendly designs to **prevent or minimize** their impacts on migratory species should be considered[11]. Infrastructure that is critical to the functioning of society, such as roads, railways, and energy infrastructure, can be modified to facilitate movements and reduce mortality of migratory species. Based on 55 studies on the effect of underpasses and fencing on terrestrial mammals, Conservation Evidence determined that such interventions are overall beneficial, with underpasses being utilized by a range of species and most studies finding a reduction in vehicle collisions[12]. The Center for Large Landscape Conservation collates resources for policy makers and practitioners, including best practice manuals for conserving ecological connectivity and implementing effective wildlife crossings projects that are tailored to a range of species, habitats, and socioeconomic contexts.

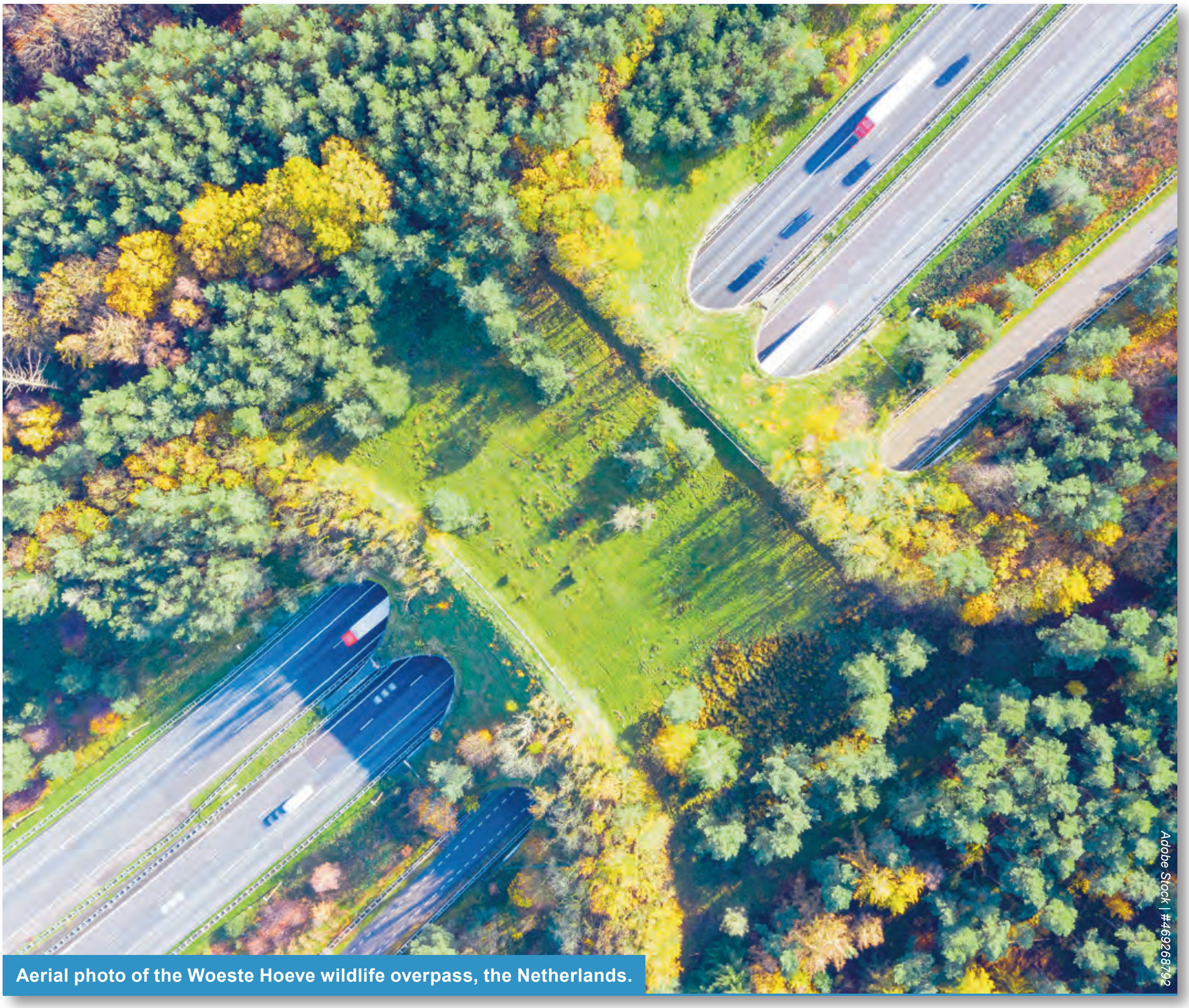
Nationally, through the implementation of the CMS guidelines for reducing the impact of linear infrastructure on mammal migratory species in Central Asia (UNEP/CMS/COP11/Doc 23.3.2), the government of Mongolia developed national standards ensuring that wildlife-friendly measures are considered during development projects. As part of this, the government of Mongolia made modifications to the previously impenetrable fence along the Trans-Mongolian Railway to allow migratory ungulate movement. As a result, in 2020, the first known crossing in 65 years of the CMS-listed Asiatic Wild Ass (*Equus hemionus hemionus*) was observed into the eastern steppe[13].

Restoration

If suitable habitat has been fragmented but remains viable, **restoring** habitat connectivity by removing barriers may be sufficient for migratory behaviour to return, even if migratory movements have been disrupted for decades. Following the removal of fences surrounding the Okavango Delta, Botswana, Burchell's Zebra (*Equus burchelli*) resumed their historically documented migrations, despite movement out of the Delta being prevented for over 30 years[14].

[h] In addition to CMS, which has a number of Resolutions of relevance to SEAs (e.g. Resolution 7.2 (Rev.COP12)), the African-Eurasian Migratory Waterbird Agreement (AEWA), the Convention on Biological Diversity (CBD), the Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention), and the Convention on Wetlands (Ramsar Convention) are a few conventions that have incorporated SEA and EIA guidelines.

[i] Target 14: Ensure the full integration of biodiversity and its multiple values into policies, regulations, planning and development processes, poverty eradication strategies, strategic environmental assessments, environmental impact assessments and, as appropriate, national accounting, within and across all levels of government and across all sectors, in particular those with significant impacts on biodiversity, progressively aligning all relevant public and private activities, fiscal and financial flows with the goals and targets of this framework.



Aerial photo of the Woeste Hoeve wildlife overpass, the Netherlands.

Box 3. Online tools to avoid and mitigate barriers to connectivity

To conserve the long-distance movements of migratory species across multi-use landscapes, it is necessary to carry out research and mapping of these movements in order to guide spatial and developmental planning and policies[15]. The Integrated Biodiversity Assessment Tool (IBAT) facilitates the consideration of biodiversity (including migratory species) in planning decisions by providing access to information from three global biodiversity datasets: the World Database on Protected Areas (WDPA), Key Biodiversity Areas (KBAs), and the IUCN Red List of Threatened Species.

Mapping long-distance migrations and corridors is now possible in ever finer detail due to advances in tracking technology[15]. The Global Initiative on Ungulate Migration (GIUM), for example, under the auspices of CMS, aims to develop a global atlas of ungulate migrations using knowledge, data and analytical tools and catalyse new conservation actions and policies for infrastructure development. Additionally, the Eurasian African Bird Migration Atlas, produced in collaboration with CMS, integrates information on ringing recoveries with detailed tracking data on avian migration patterns. These data are beginning to shed light on a range of topics relevant to the flyway-scale conservation of migratory birds, including the degree of linkage between different parts of a species' migratory range[16]. Similar tools and datasets have been created for marine species, such as the Migratory Connectivity in the Ocean (MiCO) system and the Seabird Tracking Database. The Avian Sensitivity Tool for Energy Planning (AVISTEP) provides detailed spatial assessments of avian sensitivity to steer renewable energy infrastructure planning and development.

The Global Infrastructure Impact Viewer displays the first global database of planned road and railway infrastructure and identifies the risks and benefits it may pose to people and nature. Initiatives like Linear Infrastructure Safeguards in Asia (LISA) and BISON Project in Europe aim to support improved planning, implementation and monitoring of sustainable, biodiversity-friendly infrastructure through knowledge and research, as well as the recent IUCN WCPA Technical Report 'Addressing ecological connectivity in the development of roads, railways and canals'[17].

Ecosystem restoration

While work must continue to protect and conserve the remaining habitats that migratory species rely upon, there is now also an urgent need to recover what has already been degraded, damaged, or destroyed. Ecosystem restoration, when planned with connectivity in mind, can reverse declines in migratory species, allow them to migrate safely, and can bring additional benefits - ranging from climate change mitigation to improvements in the socioeconomic health of communities. At the same time, migratory species can support restoration by, in some cases, re-establishing their unique ecological functions[1].

UN World Restoration flagship initiatives showcase the benefits of restoration for migratory species and for people

The global momentum to restore nature is growing with the UN declaring 2021-2030 the Decade for Ecosystem Restoration and governments committing to the new global target to restore 30% of degraded ecosystems by 2030[j,2,3]. Intensifying restoration efforts in key areas provides a unique opportunity to help migratory species recover.

Restoration encompasses a continuum of activities from reducing ecosystem pressures to active management interventions, with outcomes ranging from partial recovery to full recovery of native systems[k]. Under the banner of the UN Decade on Ecosystem Restoration, ten restoration projects across a range of ecosystem types[l] have been declared World Restoration Flagships, which represent the best examples of large-scale and long-term ecosystem restoration[4]. Three of these are highlighted below.

Grasslands, shrublands, and savannahs

The **Altyn Dala Conservation Initiative** in Central Asia has played a crucial role in creating a refuge for the Saiga Antelope (*Saiga tatarica*), helping to bring this migratory species back from the brink of extinction. Through a range of restorative activities, including the revival of Kazakhstan's steppe and wetland habitats, and working with local communities, the initiative is addressing overexploitation, landscape connectivity and re-introducing native species[5]. This has facilitated the spectacular recovery of the Saiga Antelope in Kazakhstan from 50,000 individuals in 2006 to over 1.3 million individuals in 2022 and has partially restored their migrations into Uzbekistan[4].

Saiga Antelope (*Saiga tatarica*)

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Oceans and coasts

In the marine realm, the **Abu Dhabi Marine Restoration initiative** is restoring critical coastal ecosystems for migratory species including coral, seagrass, and mangrove habitats[4]. This will provide feeding and breeding sites for CMS-listed species including 3,000 Dugongs (*Dugong dugon*), 4,000 Green Turtles (*Chelonia mydas*) and several seabird species, while also building climate resilience through carbon sequestration in mangrove trees.

Dugong (*Dugong dugon*)

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Forests

The **Trinational Atlantic Forest Pact**, a coalition formed by Brazil, Argentina, and Paraguay, is a shared goal to restore 15 million hectares of the Atlantic Forest by 2050[6]. The initiative brings together public and private institutions, the scientific community and landowners. To date, the restoration work has benefitted approximately 154 million people in the region through increased job opportunities, improved food and water security, and improved climate resilience. The Atlantic Forest, which has been significantly degraded due to centuries of logging and agricultural expansion, is home to the Jaguar (*Panthera onca*), a CMS-listed species which historically ranged throughout the Atlantic Forest. However, most recent estimates suggest the species occupies just 2.8% of the remaining forest[7]. In addition to this initiative, the Jaguar 2030 Roadmap[8] aims to strengthen the 'Jaguar Corridor' from Mexico to Argentina, with the goal of securing 30 landscapes which are a conservation priority for the Jaguar by 2030.

[j] Target 2 of the Kunming-Montreal Global Biodiversity Framework.

[k] Ecological restoration aims for the full recovery of an ecosystem to a state that closely resembles its condition in the absence of degradation.

[l] The 10 UN World Restoration Flagship projects focus on a range of habitats, from forests, coastal habitats such as coral reefs and mangroves, savannahs and grasslands, rivers, mountains, and agricultural landscapes.

Restoration requires investment and participation from all stakeholders

Several prioritization exercises have been conducted to identify areas that may benefit from ecosystem restoration[9,10,11]. While these global-scale analyses can provide the first step towards implementation of restoration projects at national and subnational scales, restoration also requires consideration of the local context[12]. Furthermore, the effectiveness of these projects depends on meaningful consultation and engagement with local communities, including indigenous peoples, women, and marginalized groups[13].

Successful restoration projects often hinge on community engagement from the outset: low success rates are frequently reported for mangrove restoration projects, with key reasons for project failure including a lack of long-term incentives for local communities to protect restored sites[14]. The community-led project Mikoko Pamoja in Kenya has conserved 117 hectares of mangrove and aims to restore an additional 0.4 hectares per year[15], and is widely considered an effective restoration project that has delivered benefits for the local community, the climate, and for biodiversity[16]. With mangroves being valuable nursery habitats for migratory marine fish and key stopover sites for many migratory birds, inclusive restoration projects such as this are of importance for the future conservation of migratory species.

In summary, the restoration of important sites for migratory species has great potential to revive migratory populations and promote ecological connectivity. Specifically, ecosystem restoration can play a vital role in halting and reversing the range contractions that have accompanied serious declines in the populations of many migratory species. Restoring migratory species to their former range will depend upon focussed efforts by CMS Parties at the national level, including comprehensive assessments of the scale of restoration needed to facilitate species recovery. As well as an ambitious national approach to ecosystem restoration, meaningful consultation and engagement with Indigenous Peoples and local communities is critical for achieving the success of individual restoration projects, in alignment with Target 11 of the Strategic Plan for Migratory Species 2015-2023[m].

Rob Barnes/GRID-Arendal

Community-led projects, such as Mikoko Pamoja in Gazi Bay, Kenya (pictured) have been successful in restoring degraded mangrove ecosystems.

[m] Target 11: Migratory species and their habitats which provide important ecosystem services are maintained at or restored to favourable conservation status, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable.

Mitigating light pollution

Light pollution, particularly artificial light at night, is a pervasive and increasing issue globally[1-3], but one where clear solutions exist. The availability of a range of mitigation measures means that there are significant opportunities for Parties to take action to combat this threat.

CMS guidelines for addressing light pollution

Due to concerns about the impact of light pollution, in 2020, CMS Parties adopted Resolution 13.5 on Light Pollution Guidelines for Wildlife. This Resolution requested Parties to "*manage artificial light so that migratory species are not disrupted within, nor displaced from, important habitat, and are able to undertake critical behaviours such as foraging, reproduction and migration*"[6]. The Resolution also endorsed National Light Pollution Guidelines for Wildlife including marine turtles, seabirds and migratory shorebirds (Annex to CMS Resolution 13.5) as a useful and practical framework for assessing and managing the impact of artificial light on susceptible wildlife.

The Guidelines provide a wealth of information on the theoretical, technical and practical aspects to light management for wildlife, relevant at a range of scales, from individual households to large-scale industrial developments. Key recommendations include the use of *Best Practice Lighting Design* (a set of principles that can be applied in all lighting circumstances) and to conduct an Environmental Impact Assessment for the effects of artificial light on CMS-listed species where there is evidence for the likely impact of light pollution on crucial behaviours or survival. Additionally, the Guidelines include Light Mitigation Toolboxes, which provide practical solutions for reducing the impact of artificial light on specific taxa, including birds, bats and marine turtles.

Other measures to reduce light pollution

Light pollution-reducing measures can be very effective. Across the world, citizen-driven campaigns, including Lights Out programmes, which encourage the public to extinguish outdoor lighting to protect migratory birds, are growing in popularity and help to reduce fatal collisions[7-9].

Passerine birds are particularly vulnerable as they migrate at night to avoid detection by predators[10]. Lowering light levels emanating from within buildings significantly reduces collisions, particularly during key nocturnal migration events[11].

Recently developed analytical tools, such as ecological forecasting techniques based on observations of migrating birds derived from weather radar networks, may also offer a way for cities to target Lights Out programmes more strategically[12]. These tools enable forecasters to predict when nocturnal bird migration is at its peak, allowing mitigation efforts to be rolled out when the threat is most severe[12]. Although weather radar-based monitoring of migrating birds has mostly been applied within North America and Europe, these techniques could feasibly be extended to other regions, such as the East Asian-Australian Flyway[13].

In summary, a wealth of knowledge exists on the tools and strategies needed to reduce the negative impacts of light pollution on migratory species. CMS Parties should make efforts to promote the widespread adoption of these measures, concentrating on areas close to key sites used by migratory species, or along critical migration routes.

Green Turtle (*Chelonia mydas*) nesting on a beach in Costa Rica. Red LEDs are less likely to disturb nesting turtles or disorient hatchlings making their journey to sea.

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European Bee-eaters (*Merops apiaster*)

Conclusion

State of the World's Migratory Species provides a comprehensive overview and analysis of the conservation status of migratory species. It summarizes their current status and trends, identifies the key pressures they face, and highlights illustrative examples of efforts underway to reverse population declines and conserve their habitats.

According to the IUCN Red List, one in five CMS-listed species are threatened with extinction and many are undergoing population declines. Extinction risk is rising for CMS-listed species, with considerably more species deteriorating than improving between 1988 and 2020. Across the wider group of all migratory species, levels of extinction risk are also escalating. This report further indicates there are at least 399 globally threatened or Near Threatened migratory species that are not yet benefitting from the international protection afforded by the Convention.

Migratory species are exposed to a diverse range of anthropogenic pressures that are driving population declines. Habitat loss, degradation and fragmentation (primarily driven by agricultural expansion), and overexploitation (hunting and fishing, both targeted and incidental), emerge as the two most pervasive threats to CMS-listed species and migratory species as a whole. Similarly, when analyzing threats to key sites for migratory species, including pressures on habitats as well as direct pressures on populations for which the sites were designated, most are adversely affected by agriculture and overexploitation. Climate change and pollution represent additional key sources of pressure facing many migratory species.

This report highlights the urgent need for action. Action to reverse declines in migratory species populations. Action to protect their key sites. Action to preserve the phenomenon of migration itself. Protecting migratory species requires international cooperation. Under CMS a wealth of collaborative projects are already underway, examples of which include two intergovernmental task forces to tackle the illegal killing, taking and trade of migratory birds, as well as multilateral initiatives to ensure the long-term survival of migratory mammals in Central Asia and carnivores in Africa.

However, these efforts need to be strengthened and expanded in order to halt population declines and to promote the recovery of migratory species and their habitats. This should include actions to identify additional key sites for migratory species and to further understand the threats to them; to ensure these sites are recognized internationally and effectively protected and conserved; and that they are well-connected and, where necessary, restored, to realize their full ecological potential. All of which will be crucial for helping migratory species adapt to climate change. Tackling overexploitation also requires further action – from ensuring that national legislation fully and effectively protects CMS Appendix I species from taking, to improving how legal take is monitored and reported at the national level, as well as strengthening and expanding international efforts to tackle illegal take.

The good news is that, although some important data gaps remain, the main drivers of population declines and species loss are known, and so too are the solutions. CMS provides a global platform for international cooperation, and active engagement across governments, communities and all other stakeholders is critical for addressing the myriad of challenges that migratory species face. Actions taken under CMS will not only be crucial for migratory species, but will also make a vital contribution towards fulfilling global commitments outlined in the Kunming-Montreal Global Biodiversity Framework. To effectively confront the biodiversity crisis, the international community urgently needs to accelerate collective efforts to conserve migratory species and promote the recovery of their populations and their habitats worldwide.

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Spinner Dolphins (*Stenella longirostris*)

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IV. Response
- Actions to conserve migratory species and their habitats

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Annex A: Additional notes on the methods

Defining CMS-listed taxa

Species+ and the CMS Appendices were used as the sources of information for the list of CMS species[a]. The number of bird species included under higher-level listings was based on a disaggregation following the CMS standard taxonomic reference. Only those birds assessed by the CMS COP-appointed co-Councillor for Birds as meeting the CMS movement criteria regardless of conservation status were included. As work is ongoing to agree the list of species covered under the higher-level listings for birds, the numbers in this report are approximate.

Matching CMS-listed taxa to IUCN Red List assessments

IUCN Red List version 2022-2 was used throughout the report as a source of data on conservation status (Chapter II), threats (Chapter III) and migratory behaviour (Chapters II, III and IV). CMS-listed taxa were matched to IUCN Red List assessments based on accepted names and synonyms recorded in Species+ and the IUCN Red List. Only matches based on accepted names and accepted name-to-synonym matches were retained. Where only a subspecies or population of a species is listed in the CMS Appendices, this was matched to the corresponding regional, subspecies or subpopulation level IUCN assessment where available, excluding any assessments annotated as 'needs updating' and where a more recent species-level assessment was available[b]. In cases where multiple CMS-listed species correspond to a single IUCN species, the IUCN assessment was repeated in the analysis for each of the CMS-listed species[c]. For example, *Mobula mobular* and *Mobula japanica* (as listed in the CMS Appendices) is considered by IUCN to be a single species (*Mobula mobular*); its assessment was counted twice in the analysis, once for each of the two species listed in the CMS Appendices. Only one CMS-listed species, *Gazella erlangeri*, has not been assessed for the IUCN Red List.

Chapter II: Trends in the conservation status and population abundance of migratory species

The analyses of the Red List Index (RLI) and Living Planet Index (LPI) included within Chapter II were conducted in March 2023 and January 2023 respectively. Further details of the RLI and LPI methodologies are available online. The LPI uses data on monitored populations from the Living Planet Database to calculate average trends for individual species. Unlike the global-level LPI, the indices included in this report are not calculated using a proportional weighting system in which data from regions containing higher levels of biodiversity are given greater weight, as this approach is not directly applicable to migratory species. Non-CMS-listed migratory species were identified using two data sources: the IUCN Red List (taxa with a movement pattern described as 'Full Migrant') and the Global Register of Migratory Species (GROMS)[d].

Chapter III: Analysis of threats to migratory species and threats to important sites

This analysis was restricted to CMS-listed taxa and migratory species which had one or more threats documented in their Red List assessment. As the focus was on current and future threats, historic threats classified as 'Past, Unlikely to Return' were excluded. To be precautionary, threats with unknown or unspecified timing were retained. Non-CMS-listed migratory species were identified using two data sources: the IUCN Red List and GROMS. The analysis of threats to Key Biodiversity Areas (KBAs) triggered by CMS-listed species was conducted in February 2023 and based on monitoring assessments available at the time.

[a] The CMS Appendices can be accessed at: https://www.cms.int/en/species/appendix-i-ii-cms. CMS-listed subspecies where the parent species is also CMS-listed were excluded from the analysis, to avoid double-counting. Two CMS-listed subspecies (*Calidris canutus rufa* and *Tursiops truncatus ponticus*) were excluded in this way.

[b] Data from regional, subspecies and subpopulation IUCN Red List assessments were used for the following taxa: *Acipenser ruthenus* (Europe), *Equus ferus przewalskii* (subspecies), *Gavia immer* (Europe), *Halichoerus grypus* (Baltic Sea subpopulation), *Kobus kob leucotis* (subspecies assessment), *Lanius minor* (Europe), *Plecotus kolombatovici* (Europe) and *Ziphius cavirostris* (Mediterranean sub-population). The Red List category for *Ursus arctos isabellinus* was obtained from the supplementary information of the species-level global assessment.

[c] There were no cases where the CMS taxonomy recognized a single species and the IUCN recognized it as two or more species.

[d] Riede, K. (2001). Global Register of Migratory Species: species were considered to be migratory if they were classified as 'GROMS migrants', 'amphidromous', 'anadromous', 'catadromous', 'diadromous', 'intercontinental', 'interoceanic', 'intracontinental', 'Intraoceanic', 'oceanodromous', 'oceano-estuarine' or 'potamodromous'.

Chapter III: Analysis of additional areas of potential significance for CMS-listed taxa

Terrestrial areas of potential significance for CMS-listed taxa were identified using IUCN Red List range maps refined to the Area of Habitat (AOH). This approach uses known habitat preferences and elevation limits in combination with the habitat map outlined in Jung *et al*. 2021[e], to delimit the AOH available to each CMS-listed taxon within its wider range. To produce the index of rarity-weighted richness, which highlights terrestrial areas where range-restricted CMS-listed taxa are concentrated, these AOH maps were then summed together. During the summing process, smaller ranges were given a larger weighting, based on the rationale that a given area of habitat is typically of more significance to the survival of a species, if there is not much habitat left to lose. Different components of a species range were weighted separately, following Hill *et al*. 2019[f].

Chapter IV: Trends in protected area coverage of Key Biodiversity Areas triggered by CMS-listed taxa

Figure 4.1: ('Trends in protected area coverage of Key Biodiversity Areas identified for CMS-listed species in each region') shows trends in the degree to which Key Biodiversity Areas (KBAs) triggered by CMS-listed taxa are covered by protected areas (PAs) and other effective area-based conservation measures (OECMs). Digital boundaries of KBAs from the World Database of KBAs were overlayed with digital boundaries of PAs from the World Database on Protected Areas and World Database on OECMs[g]. All data on KBAs, PAs and OECMs were obtained from the September 2022 releases of their respective databases.

[e] Jung *et al*. 2021. Areas of global importance for conserving terrestrial biodiversity, carbon and water. Nature Ecology & Evolution, 5: 1-11.

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[g] Full details of the methods are available at: https://unstats.un.org/sdgs/metadata/files/Metadata-15-01-02.pdf.

Annex B: Globally threatened or Near Threatened migratory species not yet listed in the CMS Appendices

Table B1: *Migratory[a] species that are globally threatened or Near Threatened and not yet listed in the CMS Appendices (n=399). [IUCN Red List category: CR = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Near Threatened; population trend: ↗ = increasing, - = stable, ↘ = decreasing, ? = unknown, uns. = unspecified]. **Note:** This is a **preliminary list** and **further consideration is required to determine if individual species meet the criteria for listing**, particularly in relation to the CMS definition of migration for all groups other than birds (for which a comprehensive assessment has already been undertaken).*

Order	Family	*Scientific name* (Common name)	IUCN Red List category (Population trend)	Year of IUCN Red List assessment
Terrestrial mammals				
Cetartiodactyla	Bovidae	*Bison bison* (American Bison)	NT (-)	2016
Cetartiodactyla	Bovidae	*Bison bonasus* (European Bison)	NT (↗)	2020
Cetartiodactyla	Bovidae	*Capra caucasica* (Western Tur)	EN (↘)	2019
Cetartiodactyla	Bovidae	*Pantholops hodgsonii* (Chiru)	NT (↗)	2016
Cetartiodactyla	Cervidae	*Rangifer tarandus* (Reindeer)	VU (↘)	2015
Chiroptera	Hipposideridae	*Macronycteris vittatus* (Striped Leaf-nosed Bat)	NT (↘)	2019
Chiroptera	Phyllostomidae	*Choeronycteris mexicana* (Mexican Long-tongued Bat)	NT (?)	2018
Chiroptera	Phyllostomidae	*Leptonycteris curasoae* (Southern Long-nosed Bat)	VU (↘)	2015
Chiroptera	Pteropodidae	*Pteropus vampyrus* (Large Flying-fox)	EN (↘)	2021
Chiroptera	Vespertilionidae	*Myotis lucifugus* (Little Brown Bat)	EN (↘)	2018
Chiroptera	Vespertilionidae	*Myotis septentrionalis* (Northern Myotis)	NT (↘)	2018
Chiroptera	Vespertilionidae	*Perimyotis subflavus* (Eastern Pipistrelle)	VU (↘)	2018
Perissodactyla	Equidae	*Equus quagga* (Plains Zebra)	NT (↘)	2016
Perissodactyla	Equidae	*Equus zebra* (Mountain Zebra)	VU (↗)	2018
Aquatic mammals				
Carnivora	Odobenidae	*Odobenus rosmarus* (Walrus)	VU (?)	2016
Carnivora	Otariidae	*Callorhinus ursinus* (Northern Fur Seal)	VU (↘)	2015
Carnivora	Otariidae	*Phocarctos hookeri* (New Zealand Sea Lion)	EN (↘)	2014
Carnivora	Phocidae	*Cystophora cristata* (Hooded Seal)	VU (?)	2015
Cetartiodactyla	Platanistidae	*Platanista minor* (Indus River Dolphin)	EN (↗)	2021
Birds				
Bucerotiformes	Bucerotidae	*Bycanistes cylindricus* (Brown-cheeked Hornbill)	VU (↘)	2018
Bucerotiformes	Bucerotidae	*Ceratogymna elata* (Yellow-casqued Hornbill)	VU (↘)	2016
Caprimulgiformes	Apodidae	*Apus acuticauda* (Dark-rumped Swift)	VU (-)	2016
Caprimulgiformes	Apodidae	*Chaetura pelagica* (Chimney Swift)	VU (↘)	2018
Caprimulgiformes	Apodidae	*Cypseloides niger* (Black Swift)	VU (↘)	2020
Caprimulgiformes	Apodidae	*Cypseloides rothschildi* (Rothschild's Swift)	NT (-)	2016
Caprimulgiformes	Caprimulgidae	*Antrostomus carolinensis* (Chuck-will's-widow)	NT (↘)	2020

[a] For avian taxa, these species were assessed by the CoP-appointed co-Councillor for Birds to determine whether these species met the CMS definition of migration; for the other taxa, the evidence for migratory behaviour was based on a range of sources (including the IUCN Red List and GROMS), but whether or not these species meet the CMS movement criteria has not been verified.

Order	Family	*Scientific name* (Common name)	IUCN Red List category (Population trend)	Year of IUCN Red List assessment
Caprimulgiformes	Caprimulgidae	*Antrostomus vociferus* (Eastern Whip-poor-will)	NT (-)	2019
Caprimulgiformes	Caprimulgidae	*Caprimulgus ruficollis* (Red-necked Nightjar)	NT (↘)	2022
Caprimulgiformes	Caprimulgidae	*Eleothreptus anomalus* (Sickle-winged Nightjar)	VU (↘)	2021
Caprimulgiformes	Trochilidae	*Selasphorus rufus* (Rufous Hummingbird)	NT (↘)	2020
Charadriiformes	Alcidae	*Brachyramphus brevirostris* (Kittlitz's Murrelet)	NT (↘)	2018
Charadriiformes	Alcidae	*Brachyramphus marmoratus* (Marbled Murrelet)	EN (↘)	2020
Charadriiformes	Alcidae	*Brachyramphus perdix* (Long-billed Murrelet)	NT (↘)	2018
Charadriiformes	Alcidae	*Fratercula arctica* (Atlantic Puffin)	VU (↘)	2018
Charadriiformes	Alcidae	*Ptychoramphus aleuticus* (Cassin's Auklet)	NT (↘)	2020
Charadriiformes	Alcidae	*Synthliboramphus craveri* (Craveri's Murrelet)	VU (↘)	2020
Charadriiformes	Alcidae	*Synthliboramphus hypoleucus* (Guadalupe Murrelet)	EN (↘)	2018
Charadriiformes	Alcidae	*Synthliboramphus scrippsi* (Scripps's Murrelet)	VU (↘)	2020
Charadriiformes	Glareolidae	*Glareola ocularis* (Madagascar Pratincole)	NT (↘)	2020
Charadriiformes	Laridae	*Larus heermanni* (Heermann's Gull)	NT (?)	2020
Charadriiformes	Laridae	*Onychoprion aleuticus* (Aleutian Tern)	VU (↘)	2020
Charadriiformes	Laridae	*Pagophila eburnea* (Ivory Gull)	NT (↘)	2018
Charadriiformes	Laridae	*Rissa brevirostris* (Red-legged Kittiwake)	VU (↘)	2018
Charadriiformes	Laridae	*Rissa tridactyla* (Black-legged Kittiwake)	VU (↘)	2018
Charadriiformes	Laridae	*Rynchops albicollis* (Indian Skimmer)	EN (↘)	2020
Charadriiformes	Laridae	*Sterna striata* (White-fronted Tern)	NT (↘)	2018
Charadriiformes	Laridae	*Thalasseus elegans* (Elegant Tern)	NT (-)	2020
Ciconiiformes	Ciconiidae	*Ephippiorhynchus asiaticus* (Black-necked Stork)	NT (↘)	2016
Ciconiiformes	Ciconiidae	*Leptoptilos dubius* (Greater Adjutant)	EN (↘)	2016
Ciconiiformes	Ciconiidae	*Leptoptilos javanicus* (Lesser Adjutant)	VU (↘)	2016
Ciconiiformes	Ciconiidae	*Mycteria cinerea* (Milky Stork)	EN (↘)	2016
Ciconiiformes	Ciconiidae	*Mycteria leucocephala* (Painted Stork)	NT (↘)	2016
Columbiformes	Columbidae	*Caloenas nicobarica* (Nicobar Pigeon)	NT (↘)	2020
Columbiformes	Columbidae	*Columba eversmanni* (Yellow-eyed Pigeon)	VU (↘)	2022
Columbiformes	Columbidae	*Leptotila ochraceiventris* (Ochre-bellied Dove)	VU (↘)	2020
Columbiformes	Columbidae	*Ramphiculus jambu* (Jambu Fruit-dove)	NT (↘)	2016
Coraciiformes	Alcedinidae	*Halcyon pileata* (Black-capped Kingfisher)	VU (↘)	2022
Cuculiformes	Cuculidae	*Hierococcyx vagans* (Moustached Hawk-cuckoo)	NT (↘)	2022
Galliformes	Phasianidae	*Coturnix japonica* (Japanese Quail)	NT (↘)	2016
Gruiformes	Gruidae	*Balearica pavonina* (Black Crowned Crane)	VU (↘)	2016
Gruiformes	Rallidae	*Coturnicops exquisitus* (Swinhoe's Rail)	VU (↘)	2016
Gruiformes	Rallidae	*Laterallus jamaicensis* (Black Rail)	EN (↘)	2020
Gruiformes	Rallidae	*Rallus antarcticus* (Austral Rail)	VU (↘)	2021
Gruiformes	Rallidae	*Rallus elegans* (King Rail)	NT (↘)	2021
Gruiformes	Rallidae	*Zapornia paykullii* (Band-bellied Crake)	NT (↘)	2016
Otidiformes	Otididae	*Ardeotis arabs* (Arabian Bustard)	NT (↘)	2018
Otidiformes	Otididae	*Neotis denhami* (Denham's Bustard)	NT (↘)	2016
Otidiformes	Otididae	*Neotis ludwigii* (Ludwig's Bustard)	EN (↘)	2016
Otidiformes	Otididae	*Neotis nuba* (Nubian Bustard)	NT (↘)	2016
Otidiformes	Otididae	*Sypheotides indicus* (Lesser Florican)	CR (↘)	2021
Passeriformes	Alaudidae	*Chersophilus duponti* (Dupont's Lark)	VU (↘)	2020
Passeriformes	Bombycillidae	*Bombycilla japonica* (Japanese Waxwing)	NT (↘)	2018
Passeriformes	Calcariidae	*Calcarius ornatus* (Chestnut-collared Longspur)	VU (↘)	2020

Order	Family	*Scientific name* (Common name)	IUCN Red List category (Population trend)	Year of IUCN Red List assessment
Passeriformes	Corvidae	*Corvus pectoralis* (Collared Crow)	VU (↘)	2018
Passeriformes	Cotingidae	*Cephalopterus glabricollis* (Bare-necked Umbrellabird)	EN (↘)	2020
Passeriformes	Cotingidae	*Procnias nudicollis* (Bare-throated Bellbird)	NT (↘)	2020
Passeriformes	Cotingidae	*Procnias tricarunculatus* (Three-wattled Bellbird)	VU (↘)	2020
Passeriformes	Emberizidae	*Emberiza cineracea* (Cinereous Bunting)	NT (↘)	2021
Passeriformes	Emberizidae	*Emberiza jankowskii* (Jankowski's Bunting)	EN (↘)	2018
Passeriformes	Emberizidae	*Emberiza rustica* (Rustic Bunting)	VU (↘)	2016
Passeriformes	Emberizidae	*Emberiza yessoensis* (Ochre-rumped Bunting)	NT (↘)	2020
Passeriformes	Fringillidae	*Hesperiphona vespertina* (Evening Grosbeak)	VU (↘)	2018
Passeriformes	Fringillidae	*Rhynchostruthus percivali* (Arabian Grosbeak)	NT (↘)	2022
Passeriformes	Hirundinidae	*Progne sinaloae* (Sinaloa Martin)	VU (↘)	2020
Passeriformes	Hirundinidae	*Tachycineta cyaneoviridis* (Bahama Swallow)	EN (↘)	2020
Passeriformes	Icteridae	*Agelaius tricolor* (Tricolored Blackbird)	EN (↘)	2020
Passeriformes	Icteridae	*Euphagus carolinus* (Rusty Blackbird)	VU (↘)	2020
Passeriformes	Icteridae	*Quiscalus quiscula* (Common Grackle)	NT (↘)	2018
Passeriformes	Icteridae	*Sturnella magna* (Eastern Meadowlark)	NT (↘)	2020
Passeriformes	Laniidae	*Lanius ludovicianus* (Loggerhead Shrike)	NT (↘)	2020
Passeriformes	Laniidae	*Lanius meridionalis* (Iberian Grey Shrike)	VU (↘)	2017
Passeriformes	Laniidae	*Lanius senator* (Woodchat Shrike)	NT (↘)	2021
Passeriformes	Mimidae	*Toxostoma bendirei* (Bendire's Thrasher)	VU (↘)	2020
Passeriformes	Nectariniidae	*Cinnyris neergaardi* (Neergaard's Sunbird)	NT (↘)	2018
Passeriformes	Parulidae	*Setophaga chrysoparia* (Golden-cheeked Warbler)	EN (↘)	2020
Passeriformes	Parulidae	*Setophaga striata* (Blackpoll Warbler)	NT (↘)	2018
Passeriformes	Parulidae	*Vermivora bachmanii* (Bachman's Warbler)	CR (?)	2020
Passeriformes	Parulidae	*Vermivora chrysoptera* (Golden-winged Warbler)	NT (↘)	2018
Passeriformes	Passerellidae	*Zonotrichia querula* (Harris's Sparrow)	NT (↘)	2020
Passeriformes	Pittidae	*Pitta nympha* (Fairy Pitta)	VU (↘)	2016
Passeriformes	Ploceidae	*Ploceus megarhynchus* (Finn's Weaver)	EN (↘)	2021
Passeriformes	Thraupidae	*Sporophila iberaensis* (Ibera Seedeater)	EN (↘)	2016
Passeriformes	Thraupidae	*Sporophila nigrorufa* (Black-and-tawny Seedeater)	VU (↘)	2020
Passeriformes	Tyrannidae	*Contopus cooperi* (Olive-sided Flycatcher)	NT (↘)	2016
Pelecaniformes	Ardeidae	*Agamia agami* (Agami Heron)	VU (?)	2016
Pelecaniformes	Ardeidae	*Ardea occidentalis* (Great White Heron)	EN (↘)	2020
Pelecaniformes	Ardeidae	*Egretta rufescens* (Reddish Egret)	NT (↘)	2020
Pelecaniformes	Ardeidae	*Oroanassa magnifica* (White-eared Night-heron)	EN (↘)	2016
Pelecaniformes	Pelecanidae	*Pelecanus philippensis* (Spot-billed Pelican)	NT (↘)	2017
Pelecaniformes	Threskiornithidae	*Threskiornis melanocephalus* (Black-headed Ibis)	NT (↘)	2016
Procellariiformes	Hydrobatidae	*Hydrobates cheimomnestes* (Ainley's Storm-petrel)	VU (-)	2018
Procellariiformes	Hydrobatidae	*Hydrobates homochroa* (Ashy Storm-petrel)	EN (↘)	2018
Procellariiformes	Hydrobatidae	*Hydrobates hornbyi* (Ringed Storm-petrel)	NT (↘)	2019
Procellariiformes	Hydrobatidae	*Hydrobates leucorhous* (Leach's Storm-petrel)	VU (↘)	2018
Procellariiformes	Hydrobatidae	*Hydrobates macrodactylus* (Guadalupe Storm-petrel)	CR (?)	2018
Procellariiformes	Hydrobatidae	*Hydrobates markhami* (Markham's Storm-petrel)	NT (↘)	2019
Procellariiformes	Hydrobatidae	*Hydrobates matsudairae* (Matsudaira's Storm-petrel)	VU (?)	2018
Procellariiformes	Hydrobatidae	*Hydrobates monorhis* (Swinhoe's Storm-petrel)	NT (-)	2018
Procellariiformes	Hydrobatidae	*Hydrobates socorroensis* (Townsend's Storm-petrel)	EN (↘)	2018
Procellariiformes	Oceanitidae	*Fregetta maoriana* (New Zealand Storm-petrel)	CR (?)	2018

Order	Family	*Scientific name* (Common name)	IUCN Red List category (Population trend)	Year of IUCN Red List assessment
Procellariiformes	Oceanitidae	*Nesofregetta fuliginosa* (Polynesian Storm-petrel)	EN (↘)	2018
Procellariiformes	Procellariidae	*Ardenna bulleri* (Buller's Shearwater)	VU (-)	2018
Procellariiformes	Procellariidae	*Ardenna carneipes* (Flesh-footed Shearwater)	NT (↘)	2018
Procellariiformes	Procellariidae	*Ardenna grisea* (Sooty Shearwater)	NT (↘)	2019
Procellariiformes	Procellariidae	*Bulweria fallax* (Jouanin's Petrel)	NT (?)	2018
Procellariiformes	Procellariidae	*Calonectris edwardsii* (Cape Verde Shearwater)	NT (↘)	2018
Procellariiformes	Procellariidae	*Calonectris leucomelas* (Streaked Shearwater)	NT (↘)	2018
Procellariiformes	Procellariidae	*Pachyptila macgillivrayi* (MacGillivray's Prion)	CR (↘)	2021
Procellariiformes	Procellariidae	*Pelecanoides whenuahouensis* (Whenua Hou Diving-petrel)	CR (↗)	2019
Procellariiformes	Procellariidae	*Pseudobulweria becki* (Beck's Petrel)	CR (↘)	2018
Procellariiformes	Procellariidae	*Pseudobulweria macgillivrayi* (Fiji Petrel)	CR (↘)	2018
Procellariiformes	Procellariidae	*Pseudobulweria rostrata* (Tahiti Petrel)	NT (↘)	2018
Procellariiformes	Procellariidae	*Pterodroma alba* (Phoenix Petrel)	VU (↘)	2020
Procellariiformes	Procellariidae	*Pterodroma arminjoniana* (Trindade Petrel)	VU (-)	2018
Procellariiformes	Procellariidae	*Pterodroma axillaris* (Chatham Petrel)	VU (↗)	2018
Procellariiformes	Procellariidae	*Pterodroma baraui* (Barau's Petrel)	EN (↘)	2018
Procellariiformes	Procellariidae	*Pterodroma brevipes* (Collared Petrel)	VU (↘)	2018
Procellariiformes	Procellariidae	*Pterodroma caribbaea* (Jamaican Petrel)	CR (?)	2018
Procellariiformes	Procellariidae	*Pterodroma cervicalis* (White-necked Petrel)	VU (↗)	2018
Procellariiformes	Procellariidae	*Pterodroma cookii* (Cook's Petrel)	VU (↗)	2018
Procellariiformes	Procellariidae	*Pterodroma defilippiana* (Masatierra Petrel)	VU (-)	2018
Procellariiformes	Procellariidae	*Pterodroma deserta* (Desertas Petrel)	VU (-)	2018
Procellariiformes	Procellariidae	*Pterodroma externa* (Juan Fernandez Petrel)	VU (-)	2018
Procellariiformes	Procellariidae	*Pterodroma feae* (Cape Verde Petrel)	NT (?)	2018
Procellariiformes	Procellariidae	*Pterodroma hasitata* (Black-capped Petrel)	EN (↘)	2018
Procellariiformes	Procellariidae	*Pterodroma incerta* (Atlantic Petrel)	EN (↘)	2019
Procellariiformes	Procellariidae	*Pterodroma inexpectata* (Mottled Petrel)	NT (↘)	2018
Procellariiformes	Procellariidae	*Pterodroma leucoptera* (White-winged Petrel)	VU (↘)	2018
Procellariiformes	Procellariidae	*Pterodroma longirostris* (Stejneger's Petrel)	VU (↘)	2019
Procellariiformes	Procellariidae	*Pterodroma madeira* (Zino's Petrel)	EN (−)	2018
Procellariiformes	Procellariidae	*Pterodroma magentae* (Magenta Petrel)	CR (↗)	2018
Procellariiformes	Procellariidae	*Pterodroma pycrofti* (Pycroft's Petrel)	VU (↗)	2018
Procellariiformes	Procellariidae	*Puffinus auricularis* (Townsend's Shearwater)	CR (↘)	2018
Procellariiformes	Procellariidae	*Puffinus bryani* (Bryan's Shearwater)	CR (↘)	2018
Procellariiformes	Procellariidae	*Puffinus heinrothi* (Heinroth's Shearwater)	VU (-)	2018
Procellariiformes	Procellariidae	*Puffinus huttoni* (Hutton's Shearwater)	EN (−)	2019
Procellariiformes	Procellariidae	*Puffinus newelli* (Newell's Shearwater)	CR (↘)	2019
Procellariiformes	Procellariidae	*Puffinus opisthomelas* (Black-vented Shearwater)	NT (-)	2021
Procellariiformes	Procellariidae	*Puffinus yelkouan* (Yelkouan Shearwater)	VU (↘)	2018
Psittaciformes	Psittacidae	*Amazona aestiva* (Turquoise-fronted Amazon)	NT (↘)	2019
Psittaciformes	Psittacidae	*Amazona vinacea* (Vinaceous-breasted Amazon)	EN (↘)	2017
Psittaciformes	Psittacidae	*Belocercus longicaudus* (Long-tailed Parakeet)	VU (↘)	2018
Psittaciformes	Psittacidae	*Psittacara erythrogenys* (Red-masked Parakeet)	NT (↘)	2021
Psittaciformes	Psittacidae	*Psittacula derbiana* (Lord Derby's Parakeet)	NT (↘)	2016
Psittaciformes	Psittacidae	*Psittacus timneh* (Timneh Parrot)	EN (↘)	2020
Psittaciformes	Psittacidae	*Rhynchopsitta pachyrhyncha* (Thick-billed Parrot)	EN (↘)	2020
Sphenisciformes	Spheniscidae	*Aptenodytes forsteri* (Emperor Penguin)	NT (↘)	2019

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Sphenisciformes	Spheniscidae	*Eudyptes chrysocome* (Southern Rockhopper Penguin)	VU (↘)	2020
Sphenisciformes	Spheniscidae	*Eudyptes chrysolophus* (Macaroni Penguin)	VU (↘)	2020
Sphenisciformes	Spheniscidae	*Eudyptes moseleyi* (Northern Rockhopper Penguin)	EN (↘)	2020
Sphenisciformes	Spheniscidae	*Eudyptes pachyrhynchus* (Fiordland Penguin)	NT (↘)	2020
Strigiformes	Strigidae	*Bubo scandiacus* (Snowy Owl)	VU (↘)	2021
Suliformes	Phalacrocoracidae	*Leucocarbo bougainvilliorum* (Guanay Cormorant)	NT (↘)	2018
Suliformes	Phalacrocoracidae	*Phalacrocorax capensis* (Cape Cormorant)	EN (↘)	2018
Suliformes	Phalacrocoracidae	*Phalacrocorax neglectus* (Bank Cormorant)	EN (↘)	2018
Suliformes	Sulidae	*Morus capensis* (Cape Gannet)	EN (↘)	2018
Suliformes	Sulidae	*Papasula abbotti* (Abbott's Booby)	EN (−)	2019
Reptiles				
Testudines	Testudines	*Carettochelys insculpta* (Pig-nosed Turtle)	EN (↘)	2017
Fish				
Acipenseriformes	Acipenseridae	*Acipenser brevirostrum* (Shortnose Sturgeon)	VU (-)	2016
Acipenseriformes	Acipenseridae	*Acipenser oxyrinchus* (Atlantic Sturgeon)	VU (↗)	2019
Acipenseriformes	Acipenseridae	*Acipenser transmontanus* (White Sturgeon)	VU (-)	2020
Albuliformes	Albulidae	*Albula glossodonta* (Shortjaw Bonefish)	VU (↘)	2011
Albuliformes	Albulidae	*Albula vulpes* (Bonefish)	NT (↘)	2011
Anguilliformes	Anguillidae	*Anguilla australis* (Shortfin Eel)	NT (?)	2018
Anguilliformes	Anguillidae	*Anguilla bengalensis* (Indian Mottled Eel)	NT (?)	2019
Anguilliformes	Anguillidae	*Anguilla bicolor* (Shortfin Eel)	NT (?)	2019
Anguilliformes	Anguillidae	*Anguilla borneensis* (Indonesian Longfinned Eel)	VU (?)	2018
Anguilliformes	Anguillidae	*Anguilla japonica* (Japanese Eel)	EN (↘)	2018
Anguilliformes	Anguillidae	*Anguilla luzonensis* (Philippine Mottled Eel)	VU (?)	2018
Anguilliformes	Anguillidae	*Anguilla mossambica* (African Longfin Eel)	NT (?)	2018
Anguilliformes	Anguillidae	*Anguilla rostrata* (American Eel)	EN (↘)	2013
Aulopiformes	Synodontidae	*Harpadon nehereus* (Bombay Duck Lizardfish)	NT (↘)	2018
Carcharhiniformes	Carcharhinidae	*Carcharhinus acronotus* (Blacknose Shark)	EN (↘)	2019
Carcharhiniformes	Carcharhinidae	*Carcharhinus amblyrhynchoides* (Graceful Shark)	VU (↘)	2020
Carcharhiniformes	Carcharhinidae	*Carcharhinus amblyrhynchos* (Gray Reef Shark)	EN (↘)	2020
Carcharhiniformes	Carcharhinidae	*Carcharhinus brachyurus* (Copper Shark)	VU (↘)	2020
Carcharhiniformes	Carcharhinidae	*Carcharhinus brevipinna* (Spinner Shark)	VU (↘)	2020
Carcharhiniformes	Carcharhinidae	*Carcharhinus hemiodon* (Pondicherry Shark)	CR (?)	2020
Carcharhiniformes	Carcharhinidae	*Carcharhinus isodon* (Finetooth Shark)	NT (-)	2019
Carcharhiniformes	Carcharhinidae	*Carcharhinus leucas* (Bull Shark)	VU (↘)	2020
Carcharhiniformes	Carcharhinidae	*Carcharhinus limbatus* (Blacktip Shark)	VU (↘)	2020
Carcharhiniformes	Carcharhinidae	*Carcharhinus macloti* (Hardnose Shark)	NT (↘)	2020
Carcharhiniformes	Carcharhinidae	*Carcharhinus melanopterus* (Blacktip Reef Shark)	VU (↘)	2020
Carcharhiniformes	Carcharhinidae	*Carcharhinus plumbeus* (Sandbar Shark)	EN (↘)	2020
Carcharhiniformes	Carcharhinidae	*Galeocerdo cuvier* (Tiger Shark)	NT (↘)	2018
Carcharhiniformes	Carcharhinidae	*Glyphis gangeticus* (Ganges Shark)	CR (↘)	2021
Carcharhiniformes	Carcharhinidae	*Isogomphodon oxyrhynchus* (Daggernose Shark)	CR (↘)	2019
Carcharhiniformes	Carcharhinidae	*Lamiopsis temminckii* (Broadfin Shark)	EN (↘)	2020
Carcharhiniformes	Carcharhinidae	*Negaprion acutidens* (Sharptooth Lemon Shark)	EN (↘)	2020
Carcharhiniformes	Carcharhinidae	*Negaprion brevirostris* (Lemon Shark)	VU (↘)	2020
Carcharhiniformes	Carcharhinidae	*Rhizoprionodon acutus* (Milk Shark)	VU (↘)	2020
Carcharhiniformes	Carcharhinidae	*Scoliodon laticaudus* (Spadenose Shark)	NT (↘)	2020

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Carcharhiniformes	Sphyrnidae	*Eusphyra blochii* (Winghead Shark)	EN (↘)	2015
Carcharhiniformes	Sphyrnidae	*Sphyrna tiburo* (Bonnethead Shark)	EN (↘)	2019
Carcharhiniformes	Sphyrnidae	*Sphyrna tudes* (Smalleye Hammerhead)	CR (↘)	2019
Carcharhiniformes	Triakidae	*Mustelus asterias* (Starry Smoothhound)	NT (↘)	2020
Carcharhiniformes	Triakidae	*Mustelus canis* (Dusky Smoothhound)	NT (↘)	2019
Carcharhiniformes	Triakidae	*Mustelus mustelus* (Common Smoothhound)	EN (↘)	2020
Carcharhiniformes	Triakidae	*Mustelus schmitti* (Narrownose Smoothhound)	CR (↘)	2019
Characiformes	Alestidae	*Brycinus brevis*	EN (?)	2019
Characiformes	Alestidae	*Micralestes comoensis*	EN (?)	2019
Characiformes	Bryconidae	*Chilobrycon deuterodon*	NT (?)	2020
Characiformes	Serrasalmidae	*Myleus pacu* (Pacu)	NT (↘)	2021
Characiformes	Serrasalmidae	*Myloplus planquettei* (Pacu)	VU (↘)	2021
Chimaeriformes	Chimaeridae	*Chimaera monstrosa* (Rabbitfish)	VU (↘)	2019
Clupeiformes	Clupeidae	*Alosa aestivalis* (Blueback Herring)	VU (↘)	2011
Clupeiformes	Clupeidae	*Alosa algeriensis* (North African Shad)	EN (↘)	2021
Clupeiformes	Clupeidae	*Alosa immaculata* (Pontic Shad)	VU (↘)	2008
Clupeiformes	Clupeidae	*Alosa volgensis* (Volga Shad)	EN (?)	2008
Clupeiformes	Clupeidae	*Clupeonella engrauliformis* (Anchovy Sprat)	EN (↘)	2018
Clupeiformes	Clupeidae	*Clupeonella grimmi* (Southern Caspian Sprat)	EN (↘)	2017
Clupeiformes	Clupeidae	*Sardinella lemuru* (Bali Sardinella)	NT (↘)	2017
Clupeiformes	Clupeidae	*Sardinella maderensis* (Madeiran Sardinella)	VU (?)	2014
Clupeiformes	Clupeidae	*Tenualosa macrura* (Longtail Shad)	NT (↘)	2017
Clupeiformes	Clupeidae	*Tenualosa thibaudeaui* (Mekong Herring)	VU (↘)	2011
Clupeiformes	Engraulidae	*Coilia mystus* (Osbeck's Grenadier Anchovy)	EN (↘)	2017
Clupeiformes	Engraulidae	*Coilia nasus* (Japanese Grenadier Anchovy)	EN (↘)	2017
Cypriniformes	Cyprinidae	*Aaptosyax grypus* (Mekong Giant Salmon Carp)	CR (↘)	2011
Cypriniformes	Cyprinidae	*Capoeta barroisi* (Orontes Scraper)	EN (↘)	2013
Cypriniformes	Cyprinidae	*Catlocarpio siamensis* (Giant Carp)	CR (↘)	2011
Cypriniformes	Cyprinidae	*Cirrhinus microlepis* (Small Scaled Mud Carp)	VU (↘)	2011
Cypriniformes	Cyprinidae	*Cirrhinus molitorella* (Mud Carp)	NT (↘)	2010
Cypriniformes	Cyprinidae	*Cyprinus carpio* (Eurasian Carp)	VU (?)	2008
Cypriniformes	Cyprinidae	*Enteromius liberiensis*	EN (?)	2020
Cypriniformes	Cyprinidae	*Hypsibarbus lagleri*	VU (↘)	2011
Cypriniformes	Cyprinidae	*Incisilabeo behri*	VU (↘)	2011
Cypriniformes	Cyprinidae	*Labeo mesops* (Ntchila)	CR (↘)	2018
Cypriniformes	Cyprinidae	*Labeo nandina* (Nandi labeo)	NT (↘)	2010
Cypriniformes	Cyprinidae	*Labeo pangusia* (Pangusia labeo)	NT (↘)	2010
Cypriniformes	Cyprinidae	*Labeo pierrei*	VU (↘)	2011
Cypriniformes	Cyprinidae	*Labeo victorianus* (Ningu)	CR (↘)	2015
Cypriniformes	Cyprinidae	*Labeobarbus kimberleyensis* (Largemouth Yellowfish)	NT (↘)	2016
Cypriniformes	Cyprinidae	*Labeobarbus nelspruitensis* (Incomati Chiselmouth)	NT (↘)	2016
Cypriniformes	Cyprinidae	*Luciobarbus brachycephalus* (Aral Barbel)	VU (↘)	2008
Cypriniformes	Cyprinidae	*Luciobarbus capito* (Bulatmai Barbel)	VU (↘)	2008
Cypriniformes	Cyprinidae	*Luciobarbus esocinus* (Pike Barbel)	VU (↘)	2014
Cypriniformes	Cyprinidae	*Luciobarbus longiceps* (Jordan Barbel)	EN (↘)	2013
Cypriniformes	Cyprinidae	*Luciobarbus subquincunciatus* (Leopard Barbel)	CR (↘)	2013
Cypriniformes	Cyprinidae	*Luciocyprinus langsoni* (Shuttle-like Carp)	VU (↘)	2012

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Cypriniformes	Cyprinidae	*Mekongina erythrospila* (Pa Sa-ee)	NT (↘)	2011
Cypriniformes	Cyprinidae	*Naziritor chelynoides* (Dark Mahseer)	VU (↘)	2010
Cypriniformes	Cyprinidae	*Neolissochilus hexagonolepis* (Katli)	NT (↘)	2009
Cypriniformes	Cyprinidae	*Probarbus jullieni* (Jullien's Golden Carp)	CR (↘)	2019
Cypriniformes	Cyprinidae	*Probarbus labeamajor* (Thicklipped Barb)	EN (↘)	2011
Cypriniformes	Cyprinidae	*Probarbus labeaminor* (Thinlip Barb)	NT (↘)	2011
Cypriniformes	Cyprinidae	*Scaphognathops bandanensis* (Bandan sharp-mouth Barb)	VU (↘)	2011
Cypriniformes	Cyprinidae	*Schizocypris brucei*	VU (↘)	2020
Cypriniformes	Cyprinidae	*Schizothorax esocinus* (Chirruh Snowtrout)	VU (↘)	2020
Cypriniformes	Cyprinidae	*Schizothorax plagiostomus* (Snow Trout)	VU (↘)	2022
Cypriniformes	Cyprinidae	*Schizothorax richardsonii* (Asla)	VU (↘)	2010
Cypriniformes	Cyprinidae	*Tor putitora*	EN (↘)	2018
Cypriniformes	Cyprinidae	*Tor sinensis* (Red Mahseer)	VU (?)	2018
Cypriniformes	Danionidae	*Opsaridium microlepis*	VU (↘)	2018
Cypriniformes	Leuciscidae	*Alburnus sarmaticus*	EN (?)	2010
Cypriniformes	Leuciscidae	*Alburnus schischkovi* (Black Sea Bleak)	EN (?)	2008
Cypriniformes	Leuciscidae	*Aspiolucius esocinus* (Pike Asp)	EN (↘)	2020
Cypriniformes	Xenocyprididae	*Hypophthalmichthys molitrix*	NT (↘)	2011
Elopiformes	Megalopidae	*Megalops atlanticus* (Tarpon)	VU (↘)	2018
Gadiformes	Gadidae	*Gadus morhua* (Atlantic Cod)	VU (uns.)	1996
Gadiformes	Gadidae	*Melanogrammus aeglefinus* (Haddock)	VU (uns.)	1996
Gadiformes	Merlucciidae	*Merluccius bilinearis* (Silver Hake)	NT (?)	2015
Gadiformes	Merlucciidae	*Merluccius senegalensis* (Senegalese Hake)	EN (↘)	2012
Gobiiformes	Gobiidae	*Awaous bustamantei*	VU (?)	2009
Gobiiformes	Gobiidae	*Ctenogobius claytonii* (Mexican Goby)	VU (?)	2019
Gobiiformes	Gobiidae	*Schismatogobius insignus*	EN (?)	2020
Hexanchiformes	Hexanchidae	*Hexanchus griseus* (Bluntnoise Sixgill Shark)	NT (↘)	2019
Hexanchiformes	Hexanchidae	*Notorynchus cepedianus* (Broadnose Sevengill Shark)	VU (↘)	2015
Lamniformes	Odontaspididae	*Carcharias taurus* (Sand Tiger Shark)	CR (↘)	2020
Lophiiformes	Lophiidae	*Lophius vomerinus* (Cape Monk)	NT (?)	2009
Myliobatiformes	Aetobatidae	*Aetobatus flagellum* (Longhead Eagle Ray)	EN (↘)	2020
Myliobatiformes	Aetobatidae	*Aetobatus narinari* (Whitespotted Eagle Ray)	EN (↘)	2020
Myliobatiformes	Dasyatidae	*Bathytoshia centroura* (Roughtail Stingray)	VU (↘)	2019
Myliobatiformes	Dasyatidae	*Brevitrygon imbricata* (Bengal Whipray)	VU (↘)	2020
Myliobatiformes	Dasyatidae	*Fontitrygon colarensis* (Colares Stingray)	CR (↘)	2019
Myliobatiformes	Dasyatidae	*Fontitrygon geijskesi* (Wingfin Stingray)	CR (↘)	2019
Myliobatiformes	Dasyatidae	*Hemitrygon akajei* (Red Stingray)	NT (↘)	2019
Myliobatiformes	Dasyatidae	*Hemitrygon laosensis* (Mekong Stringray)	EN (↘)	2021
Myliobatiformes	Dasyatidae	*Himantura uarnak* (Coach Whipray)	EN (↘)	2020
Myliobatiformes	Dasyatidae	*Pastinachus ater* (Broad Cowtail Ray)	VU (↘)	2020
Myliobatiformes	Dasyatidae	*Pastinachus sephen* (Cowtail Ray)	NT (↘)	2017
Myliobatiformes	Dasyatidae	*Pateobatis bleekeri* (Bleeker's Whipray)	EN (↘)	2020
Myliobatiformes	Dasyatidae	*Pateobatis fai* (Pink Whipray)	VU (↘)	2015
Myliobatiformes	Dasyatidae	*Pateobatis uarnacoides* (Whitenoise Whipray)	EN (↘)	2020
Myliobatiformes	Dasyatidae	*Telatrygon zugei* (Pale-edge Sharpnose Ray)	VU (↘)	2019
Myliobatiformes	Dasyatidae	*Urogymnus polylepis* (Giant Freshwater Whipray)	EN (↘)	2021
Myliobatiformes	Myliobatidae	*Aetomylaeus nichofii* (Banded Eagle Ray)	VU (↘)	2015

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Myliobatiformes	Myliobatidae	*Myliobatis freminvillei* (Bullnose Eagle Ray)	VU (↘)	2019
Myliobatiformes	Myliobatidae	*Myliobatis goodei* (Southern Eagle Ray)	VU (↘)	2019
Myliobatiformes	Rhinopteridae	*Rhinoptera bonasus* (American Cownose Ray)	VU (↘)	2019
Myliobatiformes	Rhinopteridae	*Rhinoptera javanica* (Javanese Cownose Ray)	EN (↘)	2020
Myliobatiformes	Rhinopteridae	*Rhinoptera steindachneri* (Pacific Cownose Ray)	NT (↘)	2019
Orectolobiformes	Ginglymostomatidae	*Nebrius ferrugineus* (Tawny Nose Shark)	VU (↘)	2020
Orectolobiformes	Hemiscylliidae	*Chiloscyllium griseum* (Gray Bamboo Shark)	VU (↘)	2020
Orectolobiformes	Hemiscylliidae	*Chiloscyllium hasselti* (Indonesian Bambooshark)	EN (↘)	2020
Orectolobiformes	Hemiscylliidae	*Chiloscyllium indicum* (Slender Bambooshark)	VU (↘)	2020
Orectolobiformes	Stegostomidae	*Stegostoma tigrinum* (Zebra Shark)	EN (↘)	2015
Osteoglossiformes	Notopteridae	*Chitala blanci* (Royal Featherback)	NT (?)	2011
Perciformes	Carangidae	*Trachurus japonicus* (Japanese Jack Mackerel)	NT (↘)	2017
Perciformes	Carangidae	*Trachurus trachurus* (Atlantic Horse Mackerel)	VU (↘)	2013
Perciformes	Channidae	*Channa bankanensis*	NT (↘)	2019
Perciformes	Cichlidae	*Oreochromis mossambicus* (Mozambique Tilapia)	VU (↘)	2017
Perciformes	Datnioididae	*Datnioides undecimradiatus* (Mekong Tiger Perch)	VU (↘)	2011
Perciformes	Epinephelidae	*Epinephelus aeneus* (White Grouper)	NT (↘)	2016
Perciformes	Epinephelidae	*Epinephelus polyphekadion* (Camouflage Grouper)	VU (↘)	2016
Perciformes	Epinephelidae	*Epinephelus striatus* (Nassau Grouper)	CR (↘)	2016
Perciformes	Epinephelidae	*Hyporthodus nigritus* (Warsaw Grouper)	NT (?)	2016
Perciformes	Epinephelidae	*Mycteroperca microlepis* (Gag)	VU (↘)	2016
Perciformes	Istiophoridae	*Istiophorus platypterus* (Sailfish)	VU (↘)	2021
Perciformes	Istiophoridae	*Makaira nigricans* (Blue Marlin)	VU (↘)	2021
Perciformes	Labridae	*Bolbometopon muricatum* (Green Humphead Parrotfish)	VU (↘)	2007
Perciformes	Osphronemidae	*Osphronemus exodon* (Elephant Ear Gourami)	VU (↘)	2007
Perciformes	Pomatomidae	*Pomatomus saltatrix* (Bluefish)	VU (↘)	2014
Perciformes	Sciaenidae	*Argyrosomus inodorus* (Silver Kob)	VU (↘)	2018
Perciformes	Sciaenidae	*Argyrosomus japonicus* (Dusky Meagre)	EN (↘)	2018
Perciformes	Sciaenidae	*Cynoscion acoupa* (Acoupa Weakfish)	VU (↘)	2019
Perciformes	Sciaenidae	*Cynoscion regalis* (Common Weakfish)	EN (↘)	2019
Perciformes	Sciaenidae	*Larimichthys crocea* (Large Yellow Croaker)	CR (↘)	2016
Perciformes	Scombridae	*Scomberomorus commerson* (Narrow-banded Spanish Mackerel)	NT (↘)	2009
Perciformes	Scombridae	*Scomberomorus munroi* (Spotted Mackerel)	NT (↘)	2009
Perciformes	Scombridae	*Scomberomorus concolor* (Monterey Spanish Mackerel)	VU (↘)	2011
Perciformes	Scombridae	*Thunnus maccoyii* (Southern Bluefin Tuna)	EN (↗)	2021
Perciformes	Scombridae	*Thunnus obesus* (Bigeye Tuna)	VU (↘)	2021
Perciformes	Scombridae	*Thunnus orientalis* (Pacific Bluefin Tuna)	NT (↘)	2021
Perciformes	Sparidae	*Stenotomus chrysops* (Scup)	NT (↘)	2011
Perciformes	Sparidae	*Rhabdosargus globiceps* (White Stumpnose)	VU (↘)	2009
Perciformes	Xiphiidae	*Xiphias gladius* (Swordfish)	NT (↘)	2021
Petromyzontiformes	Petromyzontidae	*Caspiomyzon wagneri* (Caspian Lamprey)	NT (?)	2008
Pleuronectiformes	Paralichthyidae	*Paralichthys lethostigma* (Southern Flounder)	NT (↘)	2015
Pleuronectiformes	Pleuronectidae	*Glyptocephalus cynoglossus* (Witch Flounder)	VU (↘)	2021
Pleuronectiformes	Pleuronectidae	*Hippoglossoides platessoides* (American Plaice)	EN (↘)	2021
Pleuronectiformes	Pleuronectidae	*Hippoglossus hippoglossus* (Atlantic Halibut)	NT (↘)	2021
Pleuronectiformes	Pleuronectidae	*Platichthys bicoloratus* (Stone Flounder)	VU (↘)	2021

Order	Family	*Scientific name* (Common name)	IUCN Red List category (Population trend)	Year of IUCN Red List assessment
Pleuronectiformes	Pleuronectidae	*Pseudopleuronectes americanus* (Winter Flounder)	VU (↘)	2021
Pleuronectiformes	Pleuronectidae	*Reinhardtius hippoglossoides* (Greenland Halibut)	NT (↘)	2021
Rajiformes	Rajidae	*Amblyraja radiata* (Thorny Skate)	VU (↘)	2019
Rajiformes	Rajidae	*Beringraja pulchra* (Mottled Skate)	EN (↘)	2019
Rajiformes	Rajidae	*Leucoraja ocellata* (Winter Skate)	EN (↘)	2019
Rajiformes	Rajidae	*Malacoraja senta* (Smooth Skate)	VU (↗)	2019
Rajiformes	Rajidae	*Okamejei kenojei* (Spiny Skate)	VU (↘)	2019
Rajiformes	Rajidae	*Raja straeleni* (Biscuit Skate)	NT (↘)	2020
Rhinopristiformes	Rhinidae	*Rhynchobatus djiddensis* (Whitespotted Wedgefish)	CR (↘)	2018
Rhinopristiformes	Rhinobatidae	*Acroteriobatus annulatus* (Lesser Guitarfish)	VU (↘)	2019
Rhinopristiformes	Rhinobatidae	*Pseudobatos horkelii* (Brazilian Guitarfish)	CR (↘)	2019
Rhinopristiformes	Rhinobatidae	*Rhinobatos annandalei* (Bengal Guitarfish)	CR (↘)	2020
Rhinopristiformes	Rhinobatidae	*Rhinobatos lionotus* (Smoothback Guitarfish)	CR (↘)	2019
Salmoniformes	Salmonidae	*Coregonus lavaretus* (European Whitefish)	VU (?)	2008
Salmoniformes	Salmonidae	*Coregonus maraena* (Maraene)	VU (↘)	2010
Salmoniformes	Salmonidae	*Hucho hucho* (Danube Salmon)	EN (?)	2008
Salmoniformes	Salmonidae	*Hucho taimen* (Siberian Taimen)	VU (↘)	2012
Salmoniformes	Salmonidae	*Parahucho perryi* (Sakhalin Taimen)	CR (↘)	2006
Salmoniformes	Salmonidae	*Salmo coruhensis* (Anatolian Sea Trout)	NT (↘)	2013
Salmoniformes	Salmonidae	*Salmo nigripinnis* (Sonaghen)	VU (?)	2008
Salmoniformes	Salmonidae	*Salmo stomachicus* (Gillaroo)	VU (?)	2008
Salmoniformes	Salmonidae	*Salvelinus confluentus*	VU (uns.)	1996
Siluriformes	Ailiidae	*Clupisoma naziri* (Indus Garua)	NT (↘)	2019
Siluriformes	Ariidae	*Arius gagora* (Gagora Catfish)	NT (↘)	2009
Siluriformes	Bagridae	*Mystus bocourti*	VU (↘)	2007
Siluriformes	Clariidae	*Clarias magur* (Walking Catfish)	EN (↘)	2010
Siluriformes	Pangasidae	*Pangasianodon hypophthalmus* (Striped Catfish)	EN (↘)	2011
Siluriformes	Pangasidae	*Pangasius krempfi* (Pa Souay Hang Leuang)	EN (↘)	2011
Siluriformes	Pangasidae	*Pangasius sanitwongsei* (Giant Pangasius)	EN (↘)	2007
Siluriformes	Siluridae	*Ompok bimaculatus* (Butter Catfish)	NT (?)	2009
Siluriformes	Siluridae	*Ompok pabda* (Pabdah Catfish)	NT (↘)	2009
Siluriformes	Siluridae	*Wallago attu* (Wallago)	VU (↘)	2019
Siluriformes	Sisoridae	*Bagarius bagarius* (Goonch)	VU (↘)	2022
Siluriformes	Sisoridae	*Bagarius suchus* (Crocodile Catfish)	NT (?)	2011
Squaliformes	Somniosidae	*Somniosus microcephalus* (Greenland Shark)	VU (↘)	2019
Squaliformes	Somniosidae	*Somniosus pacificus* (Pacific Sleeper Shark)	NT (↘)	2019
Squaliformes	Squalidae	*Squalus mitsukurii* (Shortspine Spurdog)	EN (↘)	2019
Syngnathiformes	Syngnathidae	*Hippocampus kuda* (Spotted Seahorse)	VU (↘)	2012
Syngnathiformes	Syngnathidae	*Microphis deocata* (Deocata Pipefish)	NT (?)	2016
Tetraodontiformes	Molidae	*Mola mola* (Ocean Sunfish)	VU (↘)	2011
Tetraodontiformes	Tetraodontidae	*Takifugu ocellatus* (Ocellated Puffer)	NT (↘)	2011
Torpediniformes	Platyrhinidae	*Platyrhina sinensis* (Chinese Fanray)	EN (↘)	2019

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Crustaceans				
Decapoda	Coenobitidae	*Birgus latro* (Coconut Crab)	VU (↘)	2018
Decapoda	Palaemonidae	*Macrobrachium hirtimanus*	EN (↘)	2013
Decapoda	Palaemonidae	*Macrobrachium occidentale*	NT (?)	2012
Horseshoe crabs				
Xiphosura	Limulidae	*Limulus polyphemus* (American Horseshoe Crab)	VU (↘)	2016
Xiphosura	Limulidae	*Tachypleus tridentatus* (Tri-spine Horseshoe Crab)	EN (↘)	2018

Lesser Flamingos (*Phoeniconaias minor*)

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Arctic Tern (*Sterna paradisaea*)

CMS

CMS Secretariat
UN Campus
Platz der Vereinten Nationen 1
D-53113 Bonn
Germany

Tel: (+49) 228 815 24 01/02
Fax: (+49) 228 815 24 49
E-mail: cms.secretariat@cms.int
www.cms.int