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LIVING PLANET: CONNECTED PLANET

PREVENTING THE END OF THE WORLD'S WILDLIFE MIGRATIONS THROUGH ECOLOGICAL NETWORKS

A RAPID RESPONSE ASSESSMENT

Kurvits, T., Nellemann, C., Alfthan, B., Kühl, A., Prokosch, P., Virtue, M., Skaalvik, J. F. (eds). 2011. ***Living Planet: Connected Planet – Preventing the End of the World's Wildlife Migrations through Ecological Networks.*** A Rapid Response Assessment. United Nations Environment Programme, GRID-Arendal. www.grida.no

ISBN: 978-82-7701-098-4

Printed by Birkeland Trykkeri AS, Norway

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A RAPID RESPONSE ASSESSMENT

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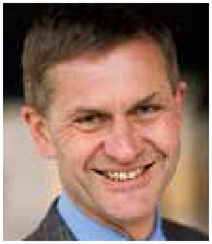
We need collaboration to ensure that migratory wildlife can continue to travel, refuel and reach their destinations

PREFACE



Through the air, over land and in water, over ten thousand species numbering millions of animals travel around the world in a network of migratory pathways. The very foundation of these migratory species is their connection to places and corridors across the planet. The loss of a single point in their migration can jeopardize the entire population, while their concentrations make them highly vulnerable to overharvesting and poaching.

In the northern regions of the world, the V-shaped formation of loudly honking geese in spring and in autumn symbolize that a new season is coming. In the 1900s people in northern Norway marvelled at the abundance of lesser white-fronted geese, which then numbered in the thousands. Today the Norwegian stock of these geese is so small that researchers are on first-name terms with each and every bird.

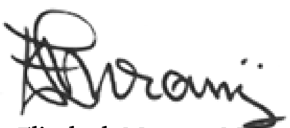
Iconic animals such as wildebeest and antelopes have declined by 35–90 per cent in a matter of decades, due to fences, roads and other infrastructure blocking their migration routes, and from overharvesting. Indeed, the current rise in poaching calls for renewed international efforts for controlling illegal hunting and creating alternative livelihoods, against the backdrop of increasing trade in endangered animals for their fur, meat, horns or tusks.

We are only just beginning to grasp the consequences that climate change is having on migratory animals and how important it is to have functional networks of habitats to allow species to adapt. A number of long-distance migrants are already declining as a result of a changing climate, including narwhals and marine turtles. In the ocean underwater noise caused by offshore energy production, naval sonars and shipping, for example, is further disrupting the lives of whales and dolphins.

In the modern world, we appreciate and fully understand the importance of communication and travel networks to society. For migratory wildlife, equivalent networks are vital to their very survival. Just as we collaborate on air traffic, roads and shipping corridors, we need a similar collaboration to ensure that migratory wildlife can also continue to travel, refuel and reach their destinations.

With 150 countries having signed one or more of the associated instruments, the Convention on Migratory Species (CMS) is becoming an increasingly important basis of international collaboration, as the only treaty addressing animal migrations on land, in the sea and in the air combined.

For this effort, the commitment of all countries is needed, so that future generations can marvel at, be amazed by, and benefit from these nomads connecting our planet.



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SUMMARY

Animal numbers continue to decline worldwide as a result of habitat loss and fragmentation, overharvesting and poaching, pollution, climate change, and the spread of invasive species. Globally, some models predict that the mean abundance of plant and animal species may decline globally from 0.7 in 2010 to 0.63 in 2050 (with natural pristine state being 1.0). This decline is equivalent to the eradication of all wild plant and wildlife species in an area the size of USA, Canada or China, respectively.

Migratory species are particularly vulnerable as their habitats are part of wider ecological networks across the planet. They depend entirely upon unrestricted travel through well-functioning ecosystems along their migratory routes to refuel, reproduce, rest and travel. Much as our own modern transport system of airports, harbours and roads cannot exist without international agreements and without refueling capacity in different countries, neither can these species persist without key feeding areas or stopover points. Understanding the need for these ecological networks – a system of connected landscape elements, and the international collaboration required to conserve them, are essential for the future survival of migratory species.

The loss of a single critical migration corridor or passage point for a migratory species may jeopardize the entire migrating population, as their ability to migrate, refuel, rest or reproduce may be lost. The successful management of migratory species throughout their full ranges requires a unique international chain of collaboration.

Furthermore, as these animals concentrate periodically in "hubs", they are highly vulnerable to overexploitation. Many migratory species have undergone dramatic declines in the last decades, with poaching and overharvesting often to blame. The numbers of many ungulate species, including elephants, wildebeest, rhinos, guanacos, Tibetan and Saiga antelopes, have fallen by 35–90 per cent over the past decades. While anti-poaching efforts temporarily reduced illegal hunting in Africa in the late 1980s and 1990s, this problem is once again on the rise, on land as well as in the sea. Migratory sharks, for example, are overharvested by fishing fleets all over the globe.

Of particular concern are expanding agriculture, infrastructure and industry in many of the key migration routes. Barriers to migration are not only having devastating impacts on migrants on land, but increasingly also in the air and sea with ever growing demands for energy and other resources. Such developments have had devastating impacts in eastern and southern Africa, where tens of thousands of wildebeest and zebra died of thirst when passage to migration was hindered by fences.

In 2010, a highway was proposed across the Serengeti, the most diverse grazing ecosystem remaining since the late Pleistocene mass extinction. Currently on hold, the road could have caused a major decline in the 1.5 million migrating wildebeest. Estimated losses were projected from 300,000 to close to one million with

The loss of a single critical migration corridor or passage point may jeopardize the entire migrating population

subsequent impacts on the entire ecosystem network, including on other grazing animals, big cats and the vegetation upon which they all depend. Similar major infrastructure projects include the Qinghai-Tibetan railway, the Golmud-Lhasa highway, and the Ulaanbaatar-Beijing railroad and veterinary fences in Southern and Eastern Africa blocking migrations of wildebeest and zebras.

Just as important are the numerous smaller piecemeal developments encroaching on many of the seasonal habitats of ungulates worldwide, from the Arctic to the tropics. These include the expansion of livestock in Argentina-Chile impacting the guanacos and vicunãs, to numerous livestock, cropland and infrastructure projects in the Americas, Africa, Europe, Asia and Australasia. The vast expanding networks of pipelines, wind farms, power lines, roads and dams are blocking migrations and restricting movements of free-ranging wildlife in every corner of the planet.

In the oceans, accidental capture and entanglement in fishing gear threatens numerous migratory marine mammals, turtles, sharks and seabirds around the world. Marine mammals not only have to avoid entanglement in fishing gear, they are also exposed to accelerating noise pollution from naval sonars, ships and infrastructure development for tens and even hundreds of kilometres. These large scale oceans industries are displacing massive numbers of marine animals every year, threatening migrations and the survival of whole species. The proposed development of a large iron mine on Baffin Island in Canada's High Arctic, with associated extensive shipping in the middle of the beluga whale migration channel may become a major threat to this species' east-west migration.

For migratory birds and bats, habitat loss is the greatest threat. Breeding, feeding and resting sites have declined by over 50 per cent in the last century, and many of these are critical to the long migrations of these species. Coastal development is rapidly increasing and is projected to have an impact on 91 per cent of all temperate and tropical coasts by 2050 and will contribute to more than 80 per cent of all marine pollution. This will have severe impacts on migratory birdlife.

The value of productive tidal flats as staging and refuelling sites has been clearly understood within the Dutch-German-Danish Wadden Sea cooperation. This area is a key hub on the East Atlantic Flyway and the Wadden Sea Secretariat has been one of the driving forces initiating international cooperation along the entire flyway with the goal to create large-scale marine protected area networks.

Similar international cooperation to protect such crucial hubs is urgently needed along other flyways as well. Along the East Asian-Australasian Flyway, the most important intertidal mudflats of the Yellow Sea are under severe human pressure and require urgent attention.

For all migratory species, ecological networks are essential for their free movement and survival. It is critical that an international framework has the highest number of signatories to ensure the best possible management of these networks. Currently 116 countries are Parties to CMS, and including all agreements under the Convention the number reaches 150. But large parts of crucial migration routes in the circumpolar region, the Americas, Eurasia, and South-East Asia are currently not covered, comprising over one-third of the global land area. Closer collaboration with non-Party countries in these regions is urgently needed to help ensure the survival of the world's transboundary migratory species.

RECOMMENDATIONS

1) ***Encourage* participation of non-party countries**, which host a significant proportion of the world's migratory species and over 1/3 of the global land area, to fully commit to the management of animal migrations, including joining CMS and its associated instruments, to improve coverage of major missing parts of global migration routes.

2) ***Identify* the 30 most threatened migration sites and corridors worldwide** to ensure joint protection and management of the migratory species connecting this planet. Such prioritization should be evolved through expertise mapping and consulting processes and should be seen as complimentary to a much wider mapping and conservation effort. CMS Parties and other countries must collaborate on such endeavours.

3) ***Prioritize* conservation of critical sites along flyways** by conserving and restoring habitats, with a focus on particularly threatened ones, such as the tidal flats and coastal zones of the Yellow Sea. The positive examples of protected areas along the East Atlantic flyway should be replicated elsewhere, including similar agreements and partnerships as developed through CMS.

4) ***Prioritize* protection of coastal zones, marine corridors and high seas habitats**. This includes to establish and effectively manage marine protected area networks along critical migration routes, including whales, sharks and turtles, with appropriate restrictions on construction, shipping, military exercises and fishing.

5) ***Request* independent international assessments when infrastructure development projects may disrupt migration routes of migratory species**, such as fences, roads, railways, pipe- and power-lines, dams, wind farms and shipping lanes, including their possible violation of the Convention on Migratory Species.

6) ***Strenghten* enforcement, intelligence and combating transnational wildlife crime through Interpol, CITES and World Customs Organization (WCO)**, including reducing poaching and smuggling of illegally caught animals, horns or other body parts. Decreasing and ultimately stopping illegal harvest will require a concerted international effort, along with improved national law enforcement in environmental crime, given the extent of the global trade in wildlife products.

7) ***Create* incentives to reduce unsustainable use**, including the development of alternative livelihoods and full participation of local communities in decision-making, and facilitate incomes and employment from eco-tourism and sustainable land-use.

8) ***Develop* an international alert system**, to notify concerned stakeholders when particularly sensitive areas or corridors of an animal migration are at risk, as migratory species are an international concern.

CONTENTS

INTRODUCTION

Across the planet, migratory wildlife swim, fly or run across continents and borders, following fine-tuned ancient routes to enable them to survive, reproduce and thrive (UNEP, 2001; Bolger *et al.*, 2008; Harris *et al.*, 2009). Much like the modern world's traffic hubs, such as airports, harbours and travel routes, these species depend on hotspots, corridors and safe havens in order to refuel, rest or navigate safely in a world full of risks. These ecological networks are vital to the survival of migratory populations. The loss of an ecological network, or parts of it, can be likened to domino effects on society for closing down air traffic, shipping and road transport – or any supply to them.

CMS – the Convention on Migratory Species – works with a range of partners to help secure these corridors and safe havens. However, while 150 countries are signatories or partial signatories, USA, Canada, Brazil, Russia and China, as well as a few others, are still not party to the Convention. These countries represent as much as 36 per cent of the global land area and large shares of the worlds coastlines. They also represent crucial parts of the global migration routes (Fig. 1).

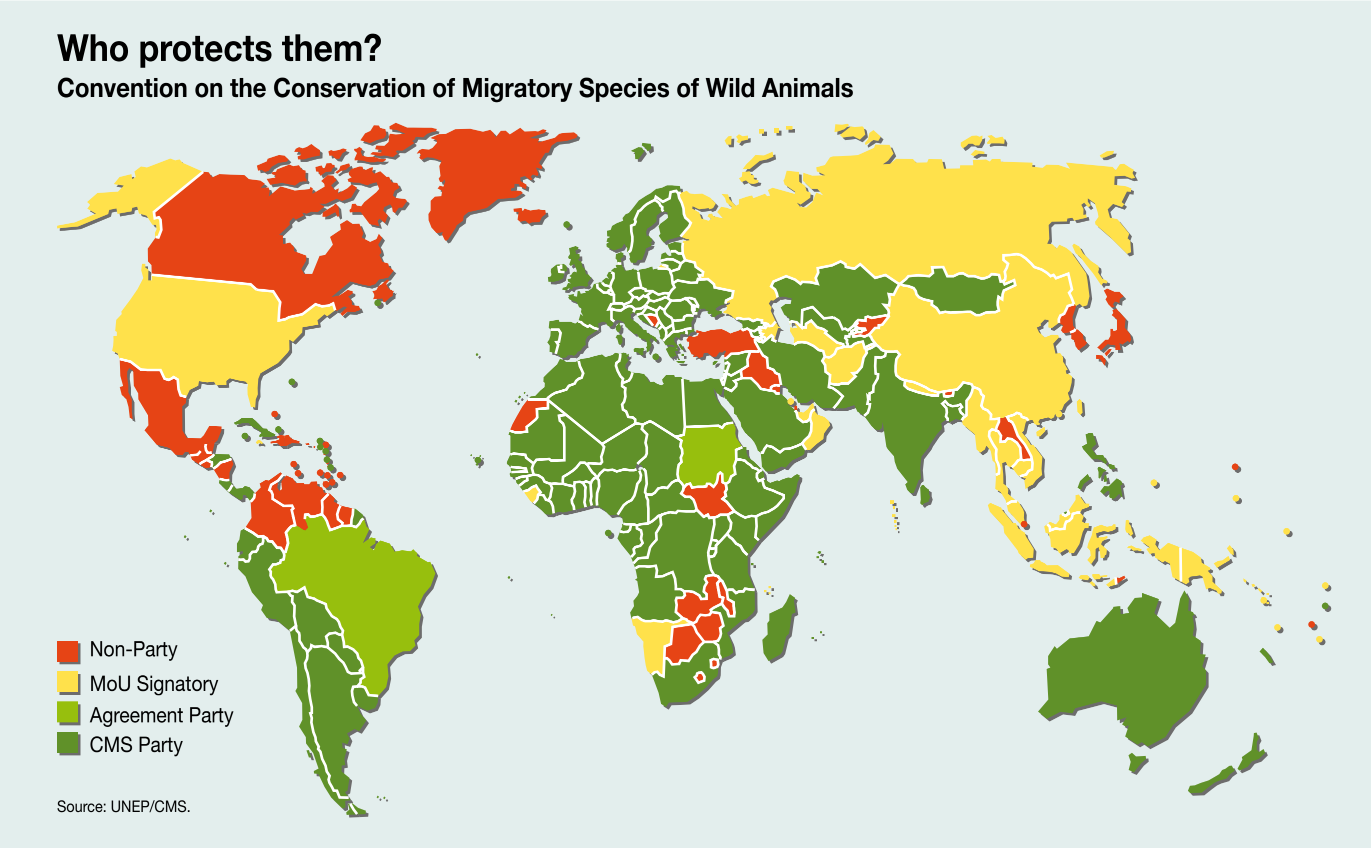


Figure 1: Parties and non-parties to the Convention of Migratory Species. Severe gaps exist in the north and east; these need to be closed urgently in order to effectively conserve the ecological networks of many endangered migratory species.

In order to help protect many of the world's critically endangered species, including many whales, sharks, great apes, big cats, migrating antelopes and birds, the expertise, capacity and support of these countries are vital to conservation success.

The problems facing conservation efforts are further compounded by the fact that development pressures and poaching are increasingly putting many endangered keystone species at further risk and in most cases now present an international challenge on enforcement and protection that cannot be met successfully through domestic efforts alone (Interpol, 2011).

Migratory species represent a special and unique international responsibility, because they simply cannot be managed by one country alone.

Recognizing the range of international conventions and agreements in which many of these non-signatory countries also play a major role, the issue of conservation of migratory species and the risks they face require international recognition and effort to become effective. Herein, an overview of some selected critical species, corridors and hotspots are highlighted for major migratory species, along with the threats facing them.

What are ecological networks?

Ecological networks connect ecosystems and populations of species that are threatened by fragmented habitats, facilitating exchange between different populations and thus increasing the chances of survival of endangered species (CBD, 2006). Migratory species represent perhaps the most vulnerable ecological elements on the planet as they depend entirely on a network of well-functioning ecosystems to refuel, reproduce and survive in every "station" they visit and upon unrestricted travel. Much as our own modern transport system of airports, harbours, and roads cannot exist without international agreements and without refueling capacity in different countries, neither can these species persist without such agreements.

Habitat transformation is a primary cause of changes in biodiversity and the breakdown of ecosystem function and services. As ecosystems are inherently complex with innumerable interactions, the perception of ecological networks is a more powerful approach to understanding the impacts of both habitat loss and fragmentation (Gonzalez *et al.*, 2011). Indeed, understanding effects at the landscape scale provides a perhaps simpler, yet more holistic way of understanding and perceiving the threats of fragmentation. Acknowledging ecological networks and how their disruption may have an impact on populations of migratory species is essential for the survival of these species and for fostering international collaboration.

In the following, an overview of the global pressure on biodiversity is given, along with a description of a series of critical examples of how international collaboration is crucial to some migratory species, and how failure to achieve it can jeopardize these populations (Fig. 3a-c).

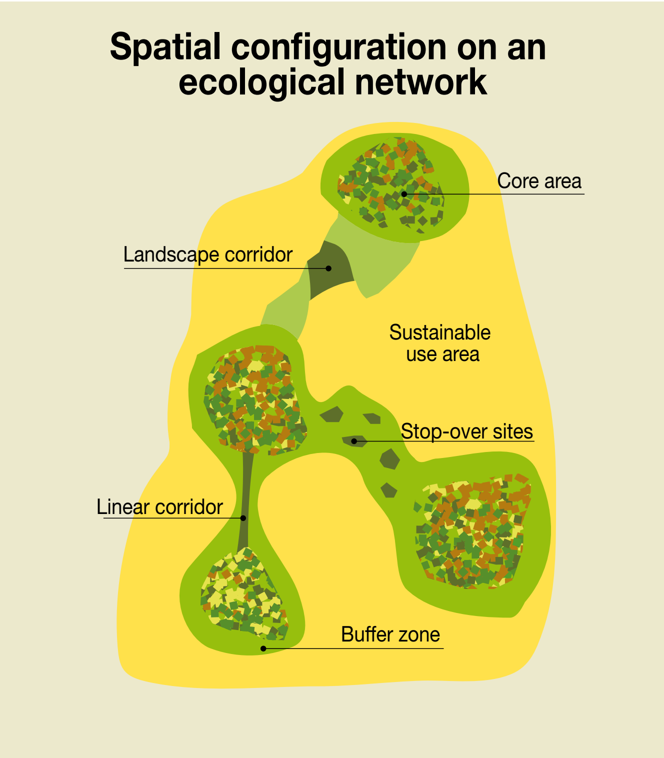


Figure 2: A spatial configuration of an Ecological Network, showing how various resources are connected in the landscape.

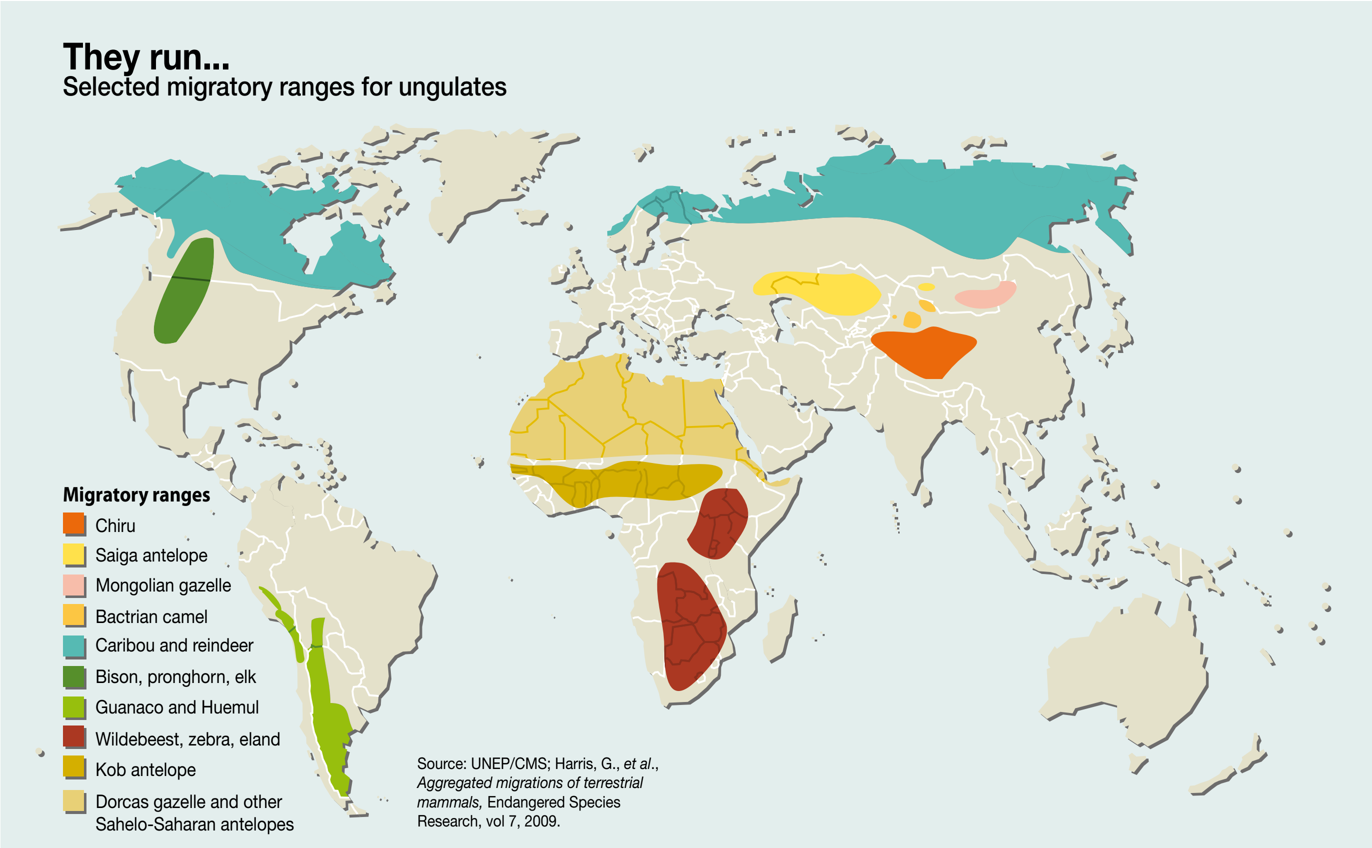


Figure 3a: Migratory species – running on land.

Populations of many migrating hoofed mammals have dropped by 35–90 per cent in the last decades

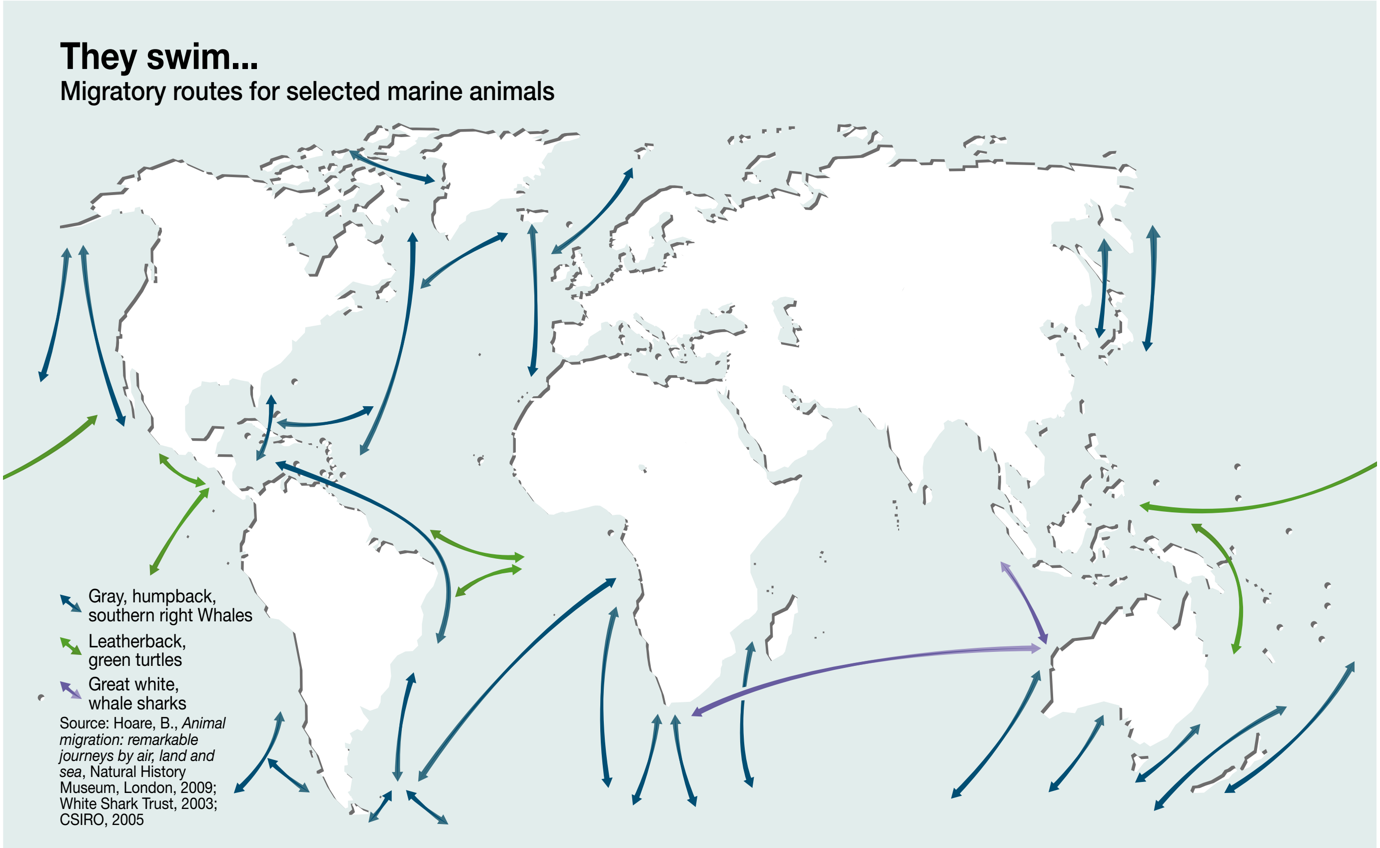


Figure 3b: Migratory species – swimming in the sea.

Bycatch is the top threat to the majority of marine mammals, being responsible for an annual loss of more than 600,000 individuals

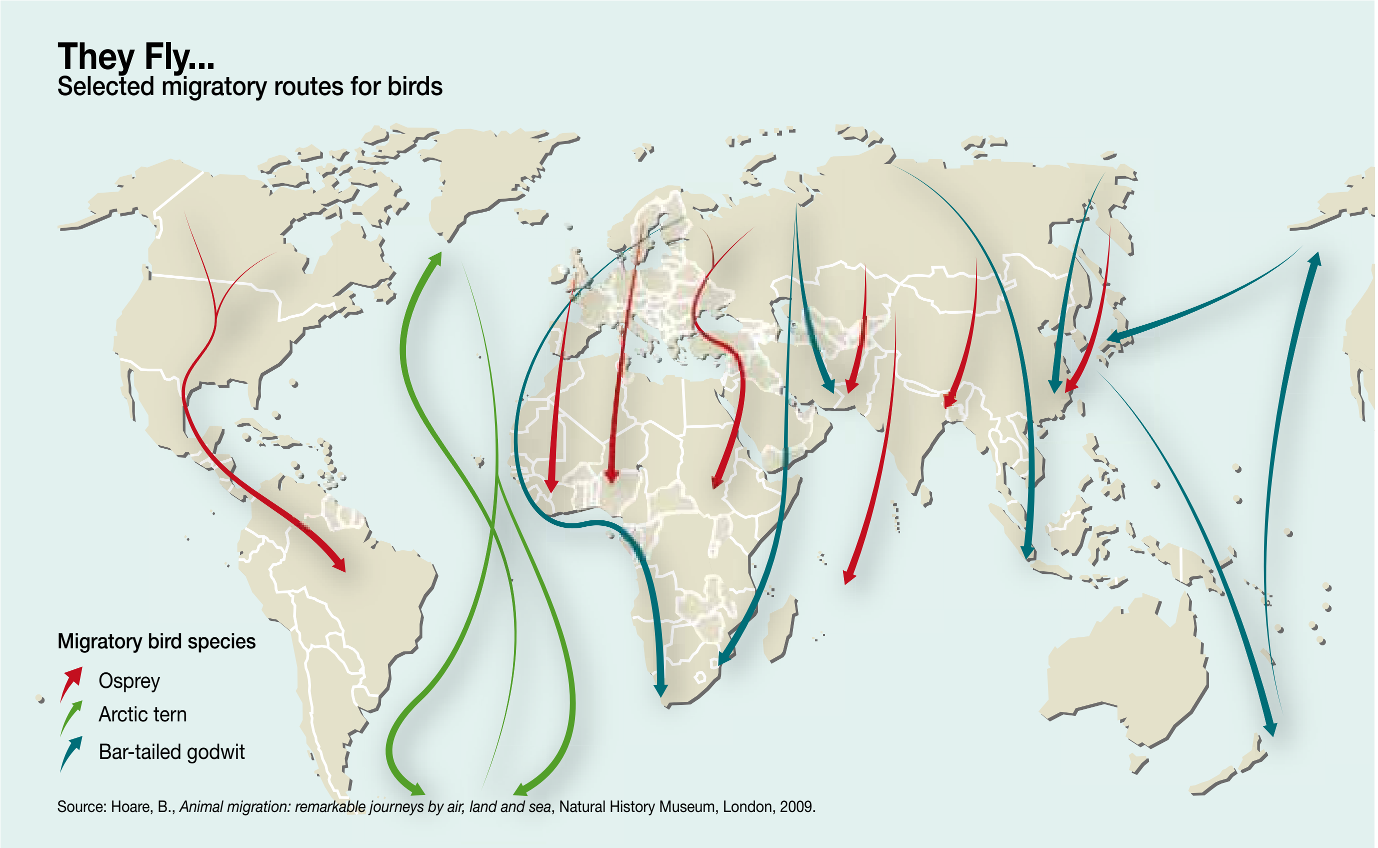


Figure 3c: Migratory species – flying in the air.

Approximately 1,800 of the world's 10,000 bird species are long-distance migrants

Habitat loss and global biodiversity loss 2000–2050

To understand the rising risk to migratory species, it is imperative to begin with an overview of global changes and declines in biodiversity worldwide, as this pattern is an even greater threat to migratory species than to most non-migratory species.

The "Big Five" primary causes of biodiversity loss in general are habitat destruction/fragmentation, overharvesting/poaching, pollution, climate change and introduction of invasive species. These impacts affect virtually all species on the planet, both sedentary and migratory alike.

There are several global scenarios of biodiversity but all consistently point to further biodiversity loss across the next century, however at differing rates (Perira *et al.*, 2011). Scenarios of future habitat loss by the GLOBIO 3.0 model have been used extensively by various agencies of the United Nations, the Organization for Economic Co-operation and Development (OECD) and the Convention on Biological Diversity (CBD) (see www.globio.info), and suggest, like most other models, a substantial increase in both the rate and extent of biodiversity loss over the next four decades (Fig. 5a-e).

The CBD estimates that the accelerating rate of deforestation, which has taken place over the last century, has contributed to reducing the abundance of forest species by more than 30 per cent. The rate of species loss in forest regions is considerably faster than in other ecosystems. Between now and 2050, it is projected that there will be a further 38 per cent loss in abundance of forest species (UNEP-GLOBIO 2008).

Photographic impression of mean species abundance indicator

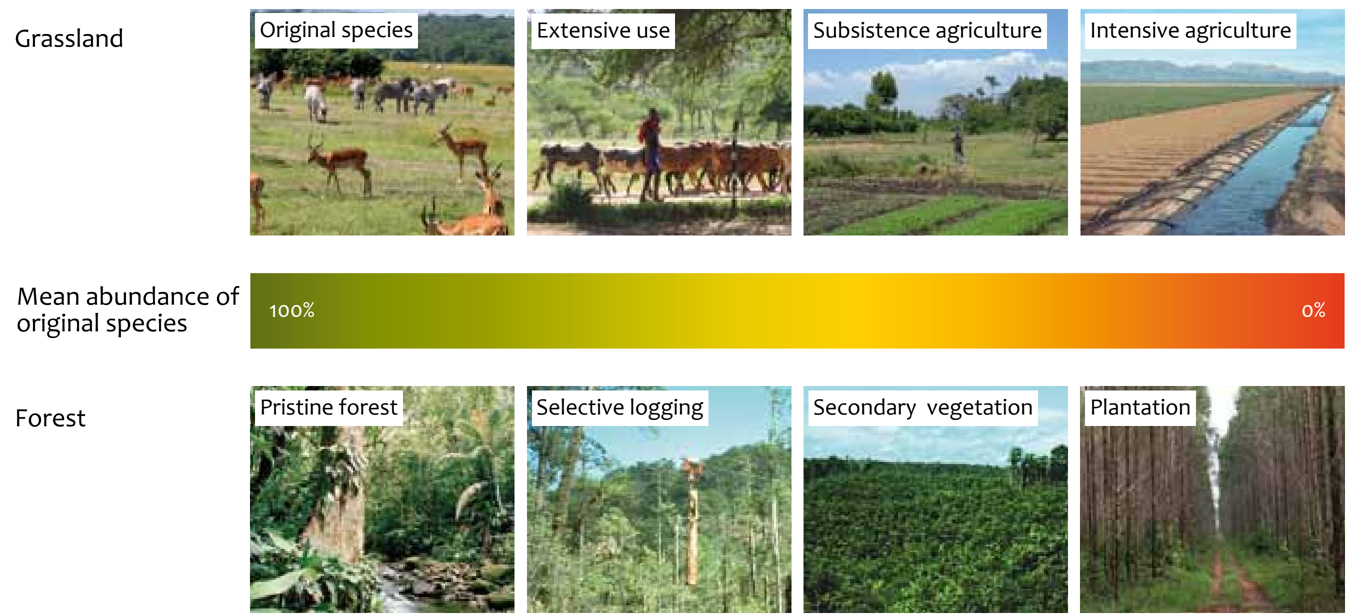


Figure 4: A photographic demonstration of what Mean Species Abundance (MSA) means in terms of changes in the landscape and its wildlife (UNEP, 2009).

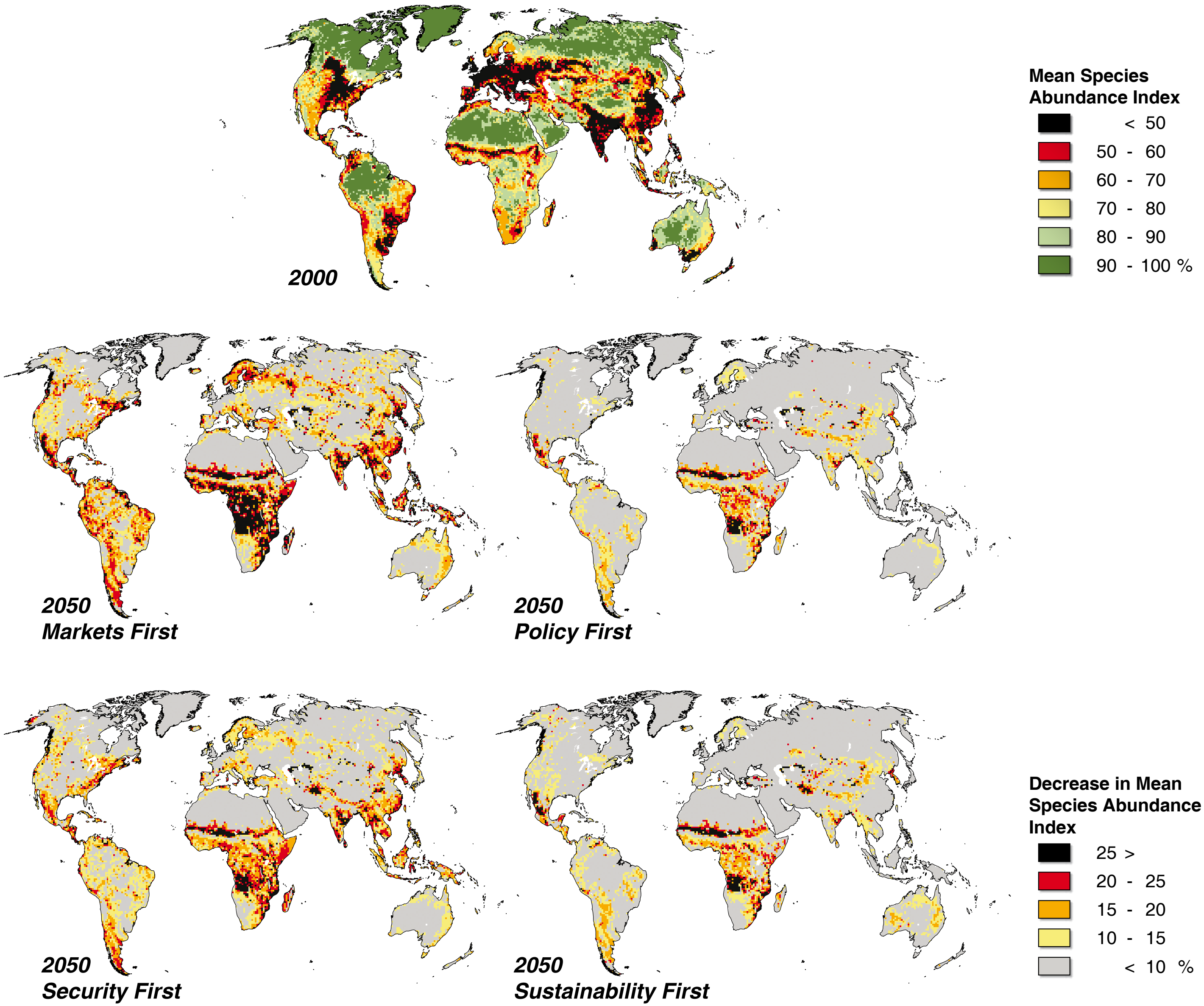


Figure 5a-e: Four SRES scenarios for 2050 and the current state (ca. 2000) of biodiversity loss expressed as Mean Species Abundance.

Global Mean Species Abundance (MSA), a measure used to project both the species diversity and the abundance, is projected to decrease from about 0.70 in 2000, to about 0.63 by 2050 (Alkemade *et al.*, 2009). To put these figures in context, 0.01 of global MSA is equivalent to completely converting 1.3 million km² (an area the size of Peru or Chad) of intact primary ecosystems to completely transformed areas with no original species remaining, in less than a decade (Alkemade *et al.*, 2009).

Or in other words – a projected decline of 0.07 in Mean Species Abundance by 2050 is equivalent to eradicating all original plant and wildlife species in an area of 9.1 million km² – roughly the size of the United States of America or China – in less than 40 years (Alkemade *et al.*, 2009).

Correspondingly, the abundance of farmland birds in Europe (as well as in many other parts of the world), many of which are migratory, have already experienced a dramatic decline in the last decades, by around 50 per cent (Fig. 6).

Nearly one-third of the world's land area has been converted to cropland and pastures, and an additional one-third is already heavily fragmented, with devastating impacts on wildlife (UNEP, 2001; Alkemade *et al.*, 2009; Pereira *et al.*, 2011).

Wetlands and resting sites have declined by over 50 per cent in the last century, and many of these are critical to the long migrations of birdlife (UNEP, 2010a). Coastal development is increasing rapidly and is projected to have an impact on 91 per cent of all temperate and tropical coastlines by 2050 and will contribute to more than 80 per cent of all marine pollution (UNEP, 2008). This will have severe impacts on migratory birdlife. The development is particularly critical between 60 degrees north and south latitude.

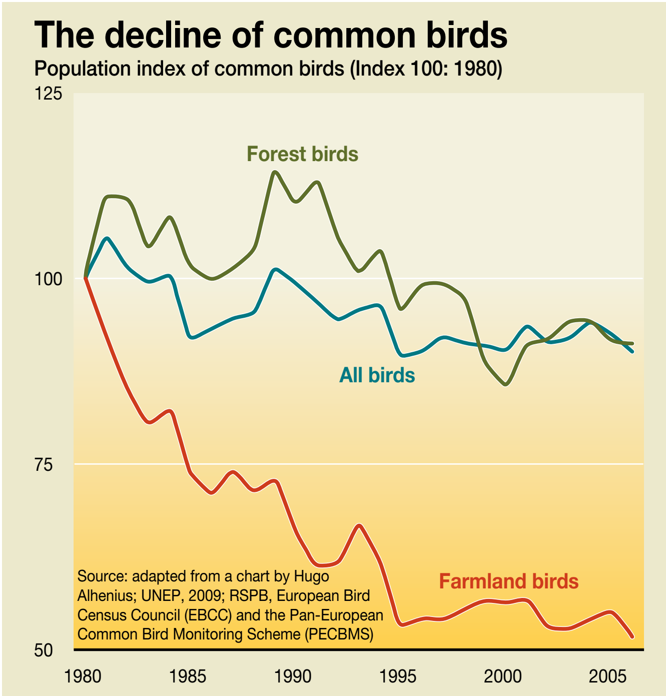


Figure 6: Change in abundance of birdlife in Europe during the last 30 years (UNEP, 2009; RSPB, European Bird Census Council (EBCC) and the Pan-European Common Bird Monitoring Scheme (PECBMS)).

Why do migratory species require special collaboration?

Habitat loss and fragmentation are primary threats to migratory species which, unlike non-migratory species, have less opportunity to simply shift to alternative habitats, with their entire life cycle being dependent upon access to specific areas spaced along their migration corridor (Berger, 2004; Bolger *et al.*, 2008). Hence, while habitat loss to non-migratory species may reflect a proportional decline in population, the loss of critical points for a migratory species may jeopardize the entire population. Even with only a smaller fraction of their route or total habitat destroyed, their ability to migrate, refuel or reproduce may become entirely compromised. In many cases migrating birds or ungulates have to leave areas seasonally as food sources become depleted or inaccessible. Although less visible, this is the case for marine species as well.

RUNNING
MIGRATION ON LAND

Changes in precipitation, temperature and vegetation, as well as predation and disease risk, are drivers of mass migrations in large herbivores. Their migrations in turn determine the movements of a number of carnivores. Populations of many migrating ungulates have dropped by 35–90 per cent in the last decades. Fences, roads and railways have delayed or stopped migrations, or have exposed migratory animals to poaching as they move in large numbers along these barriers in search of safe passage (Bolger *et al.*, 2008). Migratory herbivores concentrate seasonally, often during calving, migration or at water sources in the dry season. This behaviour and its predictability makes them vulnerable to overharvesting.

Wildebeest, elephants, buffalo, caribou, chiru and Saiga antelopes, and many other ungulates have to migrate at the onset of dry season, summer or winter as the available water resources or forage diminish and become concentrated in certain areas, making the animals highly vulnerable to poachers and predators. This resource-driven migration is well known, but the complexity of the ecological network is underestimated. One should also take into account forage, predators, social dynamics, physiology and predator avoidance, which form part of the dynamics between the species, its surroundings and the landscape.

Habitat destruction, fragmentation, and poaching are particularly important threats to migratory species. Critically dependent upon certain bottlenecks and corridors, as well as specific sites along their migration for wintering, summer ranges, reproduction and refuelling of body reserves, they become highly vulnerable to habitat loss or barriers in these locations. For millennia, ancient human hunters built pitfall and pit trapping systems to harvest migrating ungulates, such as caribou and Saiga antelope.

Indeed, in spite of journeys of several hundred and for some of several thousand kilometres, the largest range covered by any ungulate herds is that of North-American caribou (*Rangifer* ssp.). Migratory ungulates may be entirely dependent upon narrow corridors, sometimes a few hundred metres to a few kilometres at the narrowest points, as has been shown in the case of pronghorn (*Antilocapra americana*). Some of these corridors have been used for at least 5,800 years (Berger, 2004), many most likely for far, far longer.

Poaching

Unsustainable use and poaching are on the rise worldwide, and have been growing problems since the early 1990s. Indeed, after a drop following the "poacher wars" in Africa in the 1960s to early 1980s, poaching gradually started again as enforcement went down, such as in the Serengeti (Metzger *et al.*, 2010). Poaching also increased again in Central Asia and neighbouring China following the changes in the former USSR, and it has been particularly high since the mid-1990s. In Southeast Asia, as well as across Africa and Latin America, there has been an increase in poaching since the mid-2000s.

In Africa and Southeast Asia, the ivory trade and demand for Rhino horn has increased substantially. In September 2011, WWF reported that poachers had killed 287 rhinos in South Africa in 2011 alone (WWF, 2011; CNN, 2011), including sixteen critically endangered black rhinos, and the rhino is probably extinct in the Democratic Republic of Congo (UNEP, 2010a). A shift has also been noted towards substantial poaching on the forest elephant in central and western Africa (UNEP, 2010b). Many other migratory ungulate species are also exposed to poaching.

Overexploitation is the primary threat to large herbivores in central Eurasia. The dramatic decline of the Saiga antelope (*Saiga tatarica*) from approximately 1 million animals to less than 50,000 within a decade following the collapse of the Soviet Union is probably the fastest population crash of a large mammal in the last hundred years. This long-distance migrant is valuable for its meat and horn, the latter of which is used in Traditional Chinese Medicine. Poachers target the saiga males since only these bear the precious horn (see photos), which in turn has led to a reproductive collapse and the species becoming Critically Endangered (Milner-Gulland *et al.*, 2003).

In this vast region, poaching rose dramatically during the 1990s to mid-2000s. Chiru antelopes (*Pantholops hodgsonii*), which are wanted for their highly valuable Shahtoosh wool, were exposed to heavy poaching and dropped from an estimat-

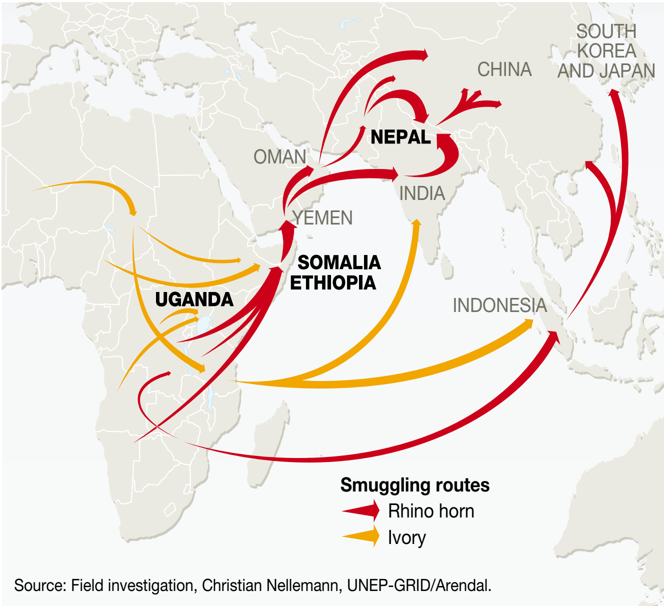


Figure 7: Major smuggling routes for rhino horn to and from Nepal (UNEP, 2010b).

ed over one million to less than 75,000 (Schaller, 1998; Bolger *et al.*, 2008), then increased to ca. 75,000–100,000 due to heavy anti-poaching by Chinese authorities and an impressive establishment of many extensive reserves. Poachers smuggled much of the wool either to other parts of Central Asia or in more recent years also directly to Nepal and onwards to buyers in the rest of Asia, fetching anything from US$1,000–10,000 for a Shahtoosh shawl, typically around US$2,000–5,000. The antelopes have to be killed for the wool. However, poaching continues (Bleisch *et al.*, 2009).

Extreme declines have been observed due to overexploitation in mountain, as well as steppe- and desert ungulates across Central Asia, China and the Russian Federation (Lhagvasuren and Milner-Gulland, 1997; Wang *et al.*, 1997; Milner-Gulland *et al.*, 2001; Milner-Gulland *et al.*, 2003; Bolger *et al.*, 2008).

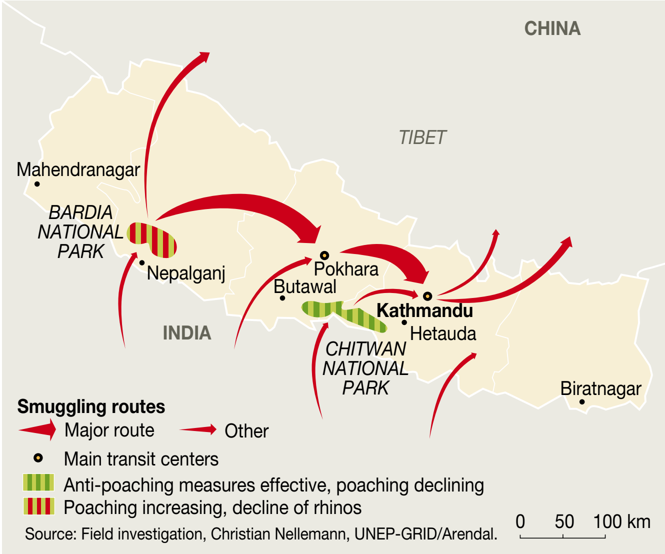


Figure 8: Major smuggling routes to and from Nepal (UNEP, 2010b).

The geographic distribution of the Mongolian gazelle (*Procapra gutturosa*) in Inner Mongolia, China declined by 75 per cent as a result of overhunting, and the population declined from around two million in the 1950s to approximately 1 million today (Bolger *et al.*, 2008; IUCN, 2011), though some uncertainty and disagreement exist on estimates. Rhinos, elephants, and tigers are also subject to heavy poaching in Asia, fetching as much US$75,000 for one 1–2 kg rhino horn on the black market (UNEP, 2010b). Major smuggling routes go to China, Taiwan, and Korea, but also Japan. Nepal was an important transit route during the civil war, where many rhinos were killed, e.g., Bardia National Park (UNEP, 2010b).

A consortium has been established between INTERPOL, the World Bank, CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora), WCO (World Customs Organization), and UNODC (UN Office on Drugs and Crime) to help further combat wildlife crime. However, few resources have been made available and it is imperative that substantial funding is procured in order to address the extent and organized nature of illegal trade and poaching on wildlife. CMS and CITES closely collaborate on migratory species conservation, such as the Saiga antelope and elephants, whose products are internationally traded.

Road development and agricultural expansion

Ungulates have some of the longest migrations of all terrestrial animals, up to several thousand kilometres for species such as the North American caribou (*Rangifer* ssp.). Migration is a crucial element in the survival of many ungulates, their ability to survive in marginal landscapes being based on the opportunity to migrate. Twenty-four large mammal species (and their subspecies) are known to migrate in large aggregations today – all of these are ungulates (Harris *et al.*, 2009).

Infrastructure may have an impact on wild ungulates by creating direct disturbance and road kills locally, though this effect is usually less important compared with avoidance or blocking of migrations. Of far greater concern is when infrastructure generates increased traffic and human activity surrounding these corridors leading to increased logging, hunting, poaching and settlements, as well as introduction of invasive species, livestock and agricultural expansion. This in turn, may lead to more regional indirect impacts such as avoidance of road corridors in the range of 4–10 km, and even up to 30 km, by migrating ungulates, thus generating semi-permeable corridors. These are corridors that in theory are passable, but rarely, depending on the situation at hand, are crossed in reality. The combined actions lead to cumulative impacts, resulting in a partial or full breakdown of the ecological network involved,

such as by displacement of migratory species, calving grounds or wintering ranges, which may also lead to reproductive collapse, genetic isolation, increased predation risk or starvation.

The veterinary fences across Botswana and Namibia to halt the spread of foot-and-mouth disease to domestic cattle caused the death of tens of thousands of wildebeest, which were no longer able to reach their water sources. The fences also had an impact on other migratory wildlife including zebras, giraffes, buffalo, and tsessebes (Mbaiwa and Mbaiwa, 2006). Some of the animals have been observed walking along the fences trying to cross, similar to delays observed in Central Asia and China following construction of railroads and border fences (see below). This, in turn, makes them highly vulnerable to predators and poachers.

Indeed, major migratory ungulate populations in many parts of southern Africa and Central Asia have dropped by 50–90 per cent in the past half century as migrations have been impeded or blocked (Mbaiwa and Mbaiwa, 2006; Bolger *et al.*, 2008).

Infrastructure development can lead to both increased poaching and agricultural expansion while a blockage of migration may also force animals into more marginal habitat. In Mongolia, the Ulaanbaatar-Beijing railway is believed to be the most important causal factor in closing the historic east-west migration of Mongolian gazelle (Lhagvasuren & Milner-Gulland 1997; Ito *et al.* 2005).

Many migratory species die attempting to cross fences and barriers. Unfortunately, building roads and railroads may result in avoidance (Lian *et al.*, 2008) and likely reduced crossings, as is well documented for numerous species. A famous photo launched in 2006 revealed a group of antelopes crossing under the train, but the photo was later revealed to be a fake (Qiu, 2008; Yang and Xia, 2008). Indeed, new satellite data suggest that while Chiru antelopes still cross the Qinghai-Tibetan railway and the Golmud-Lhasa highway to reach and return from their calving grounds, the animals spend 20–40 days looking for passages and waiting (Xia *et al.*, 2007; Buho *et al.*, 2011). The infrastructure has likely led to serious delays in their movement to and from the calving area, which in turn may affect productivity and survival.

Development of livestock and fencing, even livestock within protected areas, also affect the wildlife and migrations, including Tibetan gazelle (*Procapra picticaudata*), Goitered gazelles (*Gazella subgutturosa*), and Kiang wild ass (*Equus kiang*) (Fox *et al.*, 2009).

Habitat loss and often subsequent competition and poaching caused by agricultural expansion into the most productive seasonal habitats, along with halting or delaying or hindering migrations, is a primary threat to many migratory ungulate populations. In Masai Mara, Kenya, a decline of 81 per cent between the late 1970s and 1990s in the migratory wildebeest (*Connochaetes taurinus*) population has been reported (Ottichilo *et al.* 2001; Bolger *et al.*, 2008). Populations of almost all wildlife species have declined to a third or less of their former abundance both in the protected Masai Mara National Reserve and in the adjoining pastoral ranches (Ogutu *et al.*, 2011). Human influences appeared to be the fundamental cause (Ogutu *et al.*, 2011). Other reports have shown major declines in wildebeest in i.e. Tarangire in Tanzania that declined by 88 per cent over 13 years (Tanzania Wildlife Research Institute 2001; Bolger *et al.*, 2008). Increased anti-poaching training and enforcement, including training of trackers and improved crime scene management to secure evidence for

prosecution is strongly needed (Nellemann *et al.*, 2011). This also includes better regulation of fencing and managing the expanding livestock and cropland with specific reference to protecting wildlife migrations and seasonal habitat to avoid further declines in wildlife populations (Ogutu *et al.*, 2011).

The effect of roads, expanding agriculture and livestock, along with increased poaching can also be observed in South America, such as on the wild camelids in the steppe, deserts and Andean foothills of Argentina and Chile. Guanacos (*Lama guanicoe*) and vicunãs (*Vicugna vicugna*) have lost 40–75 per cent of their ranges, and probably dropped at least 90 per cent in their numbers over the last centuries (Cajal, 1991; Franklin *et al.*, 1997). Only a fraction, probably less than 3 per cent of the guanaco and some 34 per cent of that of vicunãs are in protected areas (Donadio and Buskirk, 2006). Also these species often avoid areas with expanding livestock and have been heavily exposed to poaching.

While roads or railways rarely result in complete physical blockage, there is ample evidence and documentation that such infrastructure slows, delays or reduces the frequency of crossings substantially, increases risk of predation or poaching, causes expansion in agriculture along road corridors and subsequently habitat loss resulting in declines in migratory populations over time (UNEP, 2001; Bolger *et al.*, 2008; Vistnes and Nellemann, 2009), thus impacting entire ecological networks involving a range of species.

Also here, international collaboration on enforcement as well as removal of barriers is critical. Indeed, migrations and habitat can sometimes even be restored if barriers to migrations, such as fences or infrastructure, are removed (Bartlam-Brooks, 2011). This even accounts for removal of trails or roads or housing (Nellemann *et al.*, 2010). In a study in Northern Botswana, a fence constructed in 1968 persisted up to 2004, and effectively hindered migration of the plains zebra (*Equus burchelli antiquorum*) between the Okavango Delta and Makgadikgadi grasslands (a round-trip distance of 588 km), revealed that only after four years some zebra had already reinstated this migration (Bartlam-Brooks, 2011).

The Serengeti

The Serengeti National Park represents the largest intact system of migratory species remaining on the planet since the Late Pleistocene mass extinction. Indeed, nowhere do we still find such an abundance of ungulate diversity and wildlife-plant interactions as in the Serengeti, with over at least 2 million herbivores present, critical to other endangered predators like lions, leopards, cheetahs and wild dogs. The continued migration of wildlife, so crucial to the entire ecological network and system there represent a global heritage and is therefore listed as a UNESCO World Heritage site.

In 2010 a major highway was proposed across the Serengeti. However, following intense international pressure, the Tanzanian Government announced in 2011 that it will favour an alternative route to the South, outside the park. The original proposal involved the construction of a 50-kilometre (31-mile) road, which would cut right through the northern part of the park in Tanzania, forming part of the 170-kilometre long Arusha-Musoma highway to run from the Tanzanian coast to Lake Victoria, and on to Uganda, Rwanda, Burundi and the Democratic Republic of Congo, where access to minerals and timbers will be facilitated.

About 1.5 million wildebeest and zebras, as well as newly re-established wild dog and rhinoceros populations, cross the path of the proposed road on migrations to both the north and the return to the south every year.

These 1.3 million wildebeest are key determinants of the entire ecological network and ecosystem in the Serengeti, where over 500,000 calves are born every year in February. The wildebeest consume nearly half of the grasses, and fertilize the plain, comparable to 500 truckloads of dung and 125 road tankers of urine every single day (Dobson and Borner, 2010). Not only do they fertilize the ecosystem, with positive effects on numerous other species, the trampling and impacts on seedlings and other plants also create habitat and forage for numerous other species, while helping to regulate the wild fires by keeping fuel low in certain areas.

Some projections suggest that if the road were built, numbers may fall to less than 300,000 (Dobson and Borner, 2010), others that the herd could decline by a third (Holdo *et al.*, 2011), which in turn to loss of populations in other areas and a possible break-down of parts of the Serengeti ecosystem. While a road would not cause a complete failure of any migration, there is ample evidence today that even roads, apparently passable, can cause avoidance, reduce crossings or delay or hinder migrations (UNEP, 2001; Ito *et al.* 2005; Xia *et al.*, 2007; Bolger *et al.*, 2008; Lian *et al.*, 2008; Harris *et al.*, 2009; Nellemann and Vistnes, 2009; Buho *et al.*, 2011).

Figure 9: Proposed commercial roads across the Serengeti and surrounding region.

Cheetah *(Acinonyx jubatus)*

CMS STATUS Appendix I (except populations in Botswana, Namibia and Zimbabwe) **CMS INSTRUMENT(S)** None

Historically present across Africa and into western Asia, cheetahs have experienced major contractions in range and population size, threatening the survival of the species. It now occurs in less than one-tenth of its historical range in eastern Africa, and just one-fifth in southern Africa. It has all but disappeared from Asia, apart from an isolated pocket in Iran. Southern and eastern Africa both hold globally significant populations, about one-third of which move across international boundaries. Information on the status of the species in many countries, and especially in north and central Africa, is limited.

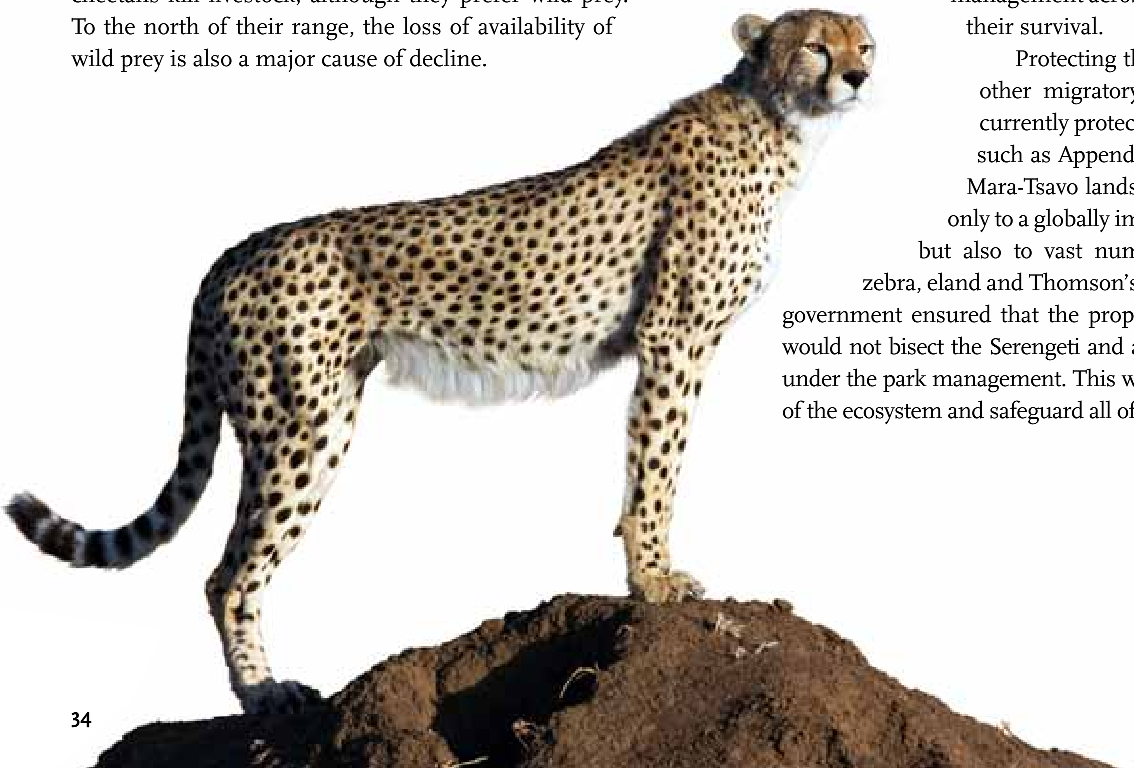
Threats to migration pathways

Habitat loss and fragmentation represent the over-arching threat to cheetahs. With annual home ranges of up to 3,000 km^2, they need far larger areas to survive than almost any other terrestrial carnivore species. The majority of the cheetah's known range falls outside government-protected areas, mainly on community and private lands that are not secure from economic development and often face intense land use pressures. There can also be conflict with subsistence pastoralists and commercial ranchers if cheetahs kill livestock, although they prefer wild prey. To the north of their range, the loss of availability of wild prey is also a major cause of decline.

Opportunities for ecological networks

Most cheetah populations inside protected areas are too small to remain viable if they are isolated from surrounding lands, and without active management, they are likely to eventually go extinct. It is thought that viable cheetah populations require areas in excess of 10,000 km^2. This requires maintaining connectivity across a landscape of protected areas and multi-use environments in a systematic way. The transboundary nature of many cheetah populations makes cooperation and management across national borders essential for their survival.

Protecting the cheetah's range also benefits other migratory wildlife, including those not currently protected by international agreements such as Appendix I of the CMS. The Serengeti-Mara-Tsavo landscape, for example, is home not only to a globally important population of cheetahs, but also to vast numbers of migratory wildebeest, zebra, eland and Thomson's gazelle. In 2011, the Tanzanian government ensured that the proposed commercial road network would not bisect the Serengeti and all roads inside the park remain under the park management. This will help to maintain the integrity of the ecosystem and safeguard all of these populations.



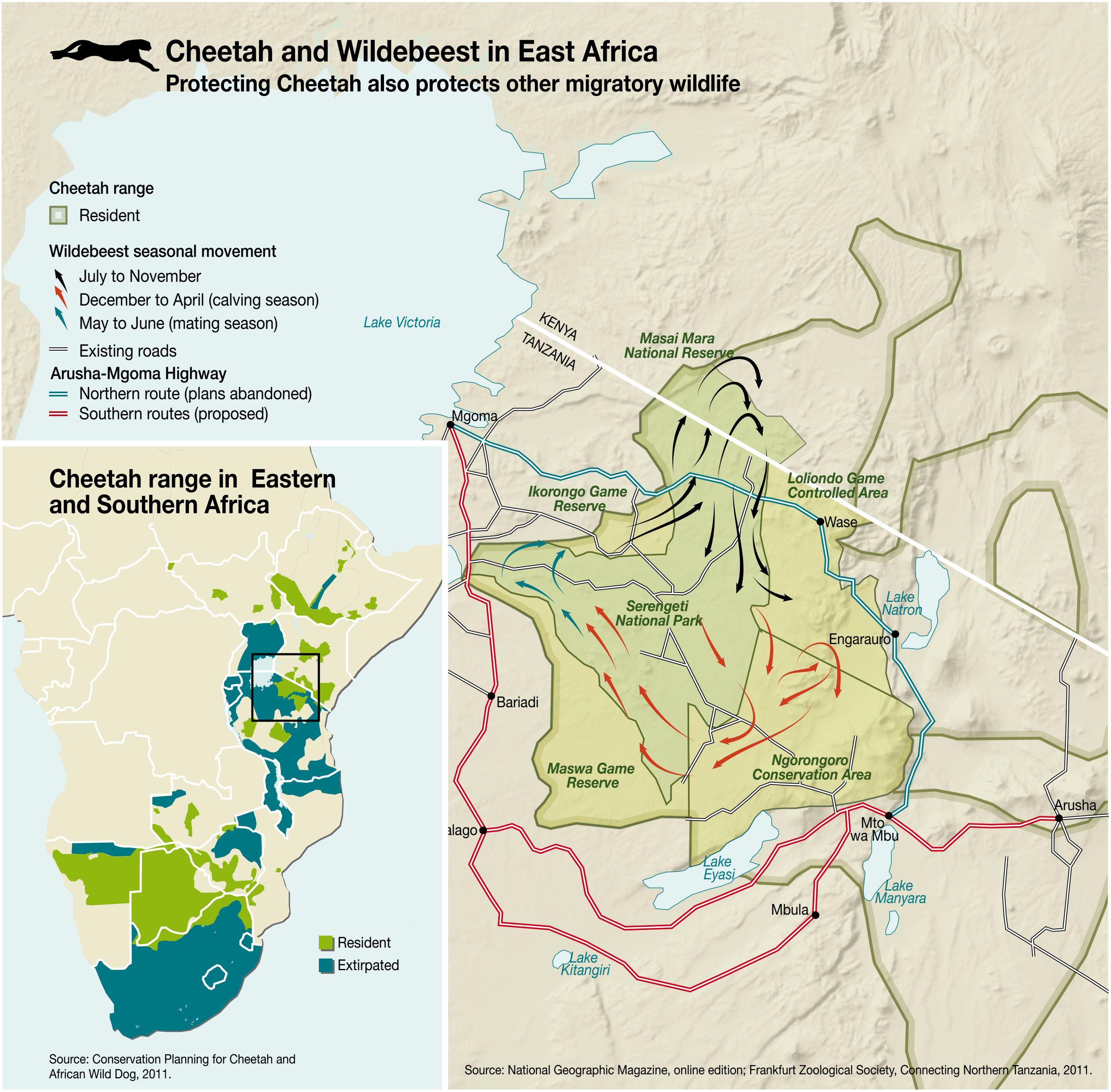


Figure 10: Cheetah range.

Saiga antelope (*Saiga* spp.)

CMS STATUS Appendix II | **CMS INSTRUMENT(S)** MoU concerning Conservation, Restoration and Sustainable Use of the Saiga Antelope

The Saiga antelope is a migratory herbivore of the steppes and deserts of Central Asia and Russia, capable of travelling hundreds of kilometres north to south on its annual migrations. Saigas have been hunted since prehistoric times and today poaching remains the primary threat to this critically endangered species. The Saiga is particularly valuable for its horn, which is used in Chinese traditional medicine, but is also hunted for its meat. Following the collapse of the Soviet Union, Saiga populations crashed by more than 95 per cent within a decade. In response, the Saiga was listed on Appendices II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and CMS. These two treaties collaborate closely to address both Saiga population management and illegal trade in synergy. Since 2006, a CMS Memorandum of Understanding (MoU) on the Saiga Antelope has been in force, which has been signed by all range states.

Threats to migratory pathways and critical sites

While a number of Saiga populations are starting to stabilize, three continue to be in a precarious state (North-West Pre-Caspian, Ural and Ustiurt populations). Recent disease-related mass mortality events in the Ural population, during which 12,000 and 450 Saigas died in May 2010 and May 2011 respectively, have reduced this population by one-third. The two transboundary populations (Ural, Ustiurt) are declining most severely. Well-equipped commercial poachers are

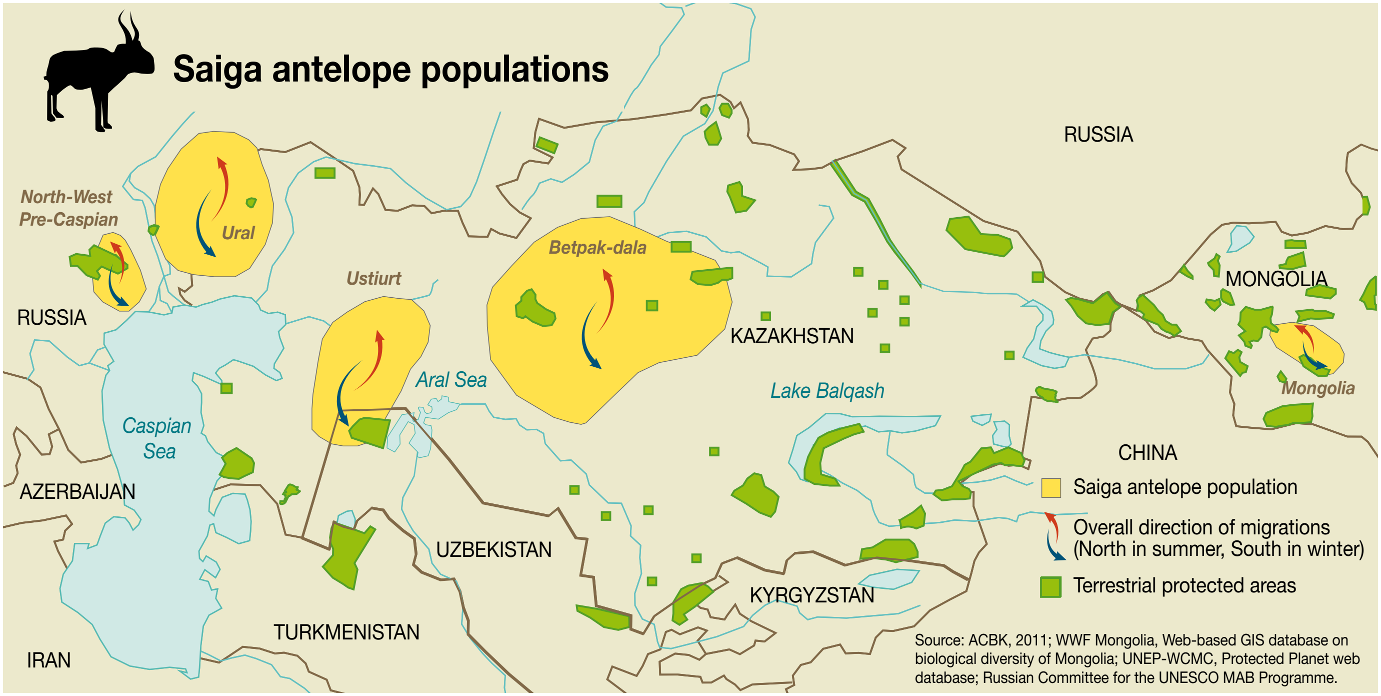


Figure 11: Saiga antelope populations.

currently on the rise in the Betpak-dala population, directly targeting the horn for export to South-East Asia. Saiga populations are also affected by pasture degradation, disturbance, competition with livestock (especially in Mongolia) and the construction of barriers. Climate change is likely to become a significant threat in the future.

Opportunities for ecological networks

The Medium-Term International Work Programme (2011–2015) under the Saiga MoU provides the building blocks for a functioning ecological network for Saiga Antelopes, starting with monitoring and identification of critical sites through to protected area designation and transboundary patrolling. The calving and rutting areas are particularly sensitive and need protection from disturbance, which could also be provided through seasonal protected areas. The full participation of local communities and creation of socio-economic incentives provide the backbone of the Work Programme.

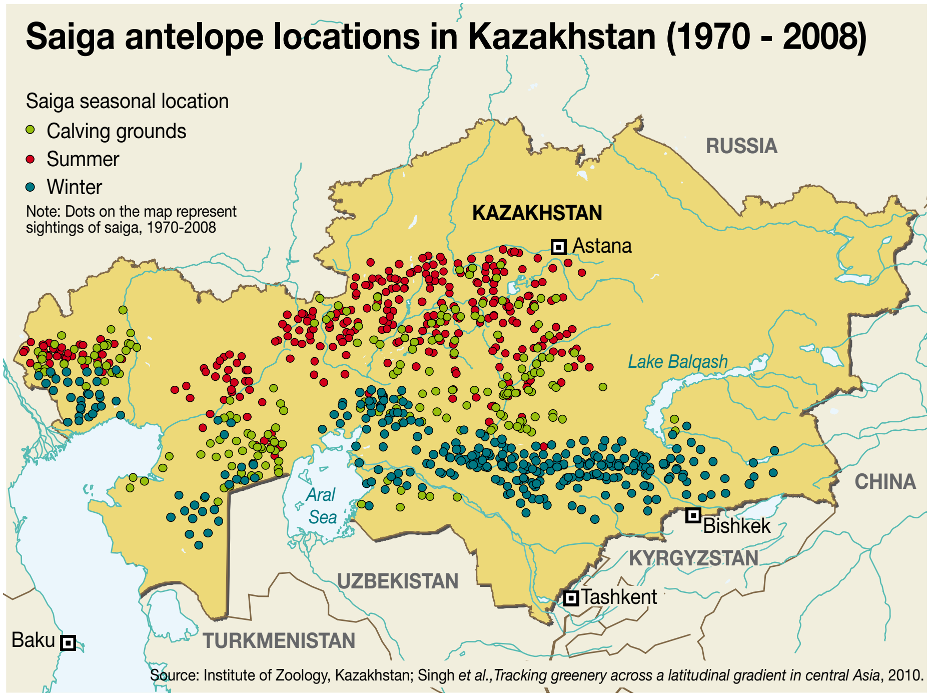


Figure 12: Saiga antelope locations in Kazakhstan.

Mountain gorillas in the Virungas

CMS STATUS Appendix I | **CMS INSTRUMENT(S)** Agreement on the Conservation of Gorillas and Their Habitats

Virunga National Park, Africa's oldest national park and a UNESCO World Heritage Site, covers more than 7,800 km^2, including both forested volcanic slopes and lowland savannahs in eastern Democratic Republic of Congo (DRC). It is home to a large number of endangered species and nearly 200, or one-quarter, of the world's remaining Mountain Gorillas (UNEP, 2010a).

Threats to migratory pathways and critical sites

The gorillas in DRC are threatened by poachers and habitat loss, mainly by the commercial burning of trees to make charcoal. The park has been occupied by various competing militias since the early 1990s. They have attacked the park headquarters and killed rangers and gorillas alike and have been heavily involved in the making and marketing of charcoal. Using prisoners or forced labour for the work, militias have been estimated to make over 28 million USD a year by illegally selling charcoal from the Virungas. Not only is the park damaged in this process, but the proceeds fund yet more conflict. In August and September 2009, rangers destroyed some 1000 charcoal-making kilns inside the park, but it is a dangerous business. In the past decade more than 200 rangers have been killed in the five parks on the DRC border, out of a ranger force of ca. 2,000 men (UNEP, 2010a).

Opportunities for ecological networks

Despite operating in the middle of one of the world's worst conflict zones, collaboration between DRC, Rwanda and Uganda allows the gorillas to move freely across borders and has enabled the mountain gorilla population slowly to recover, although they remain critically endangered. The wider Virunga population was estimated to be 400–500 in the 1950s, fell to 250 by 1981, but successful conservation measures led to its recovery. Despite the turbulent history of the region over the past 20 years, in late 2003 the first census since 1989 revealed that the population in the Virunga mountains had grown by 17 per cent to 380 (UNEP, 2010a). By 2010, it had reached 480, a 3.7 per cent annual growth rate (IGCP, 2010).

Transboundary collaboration in the Virungas has yielded very positive results, which is clearly demonstrated by the fact that mountain gorilla numbers have increased over the past 15 years despite the conflict, while other mammal populations have decreased. The success can be attributed to the enhanced collaboration between the three countries as well as the gorillas' impressive revenue-generating potential for the region (Lanjouw *et al.* 2001, Plumptre, 2007).

This success encouraged the three governments to extend their cooperation to the wider Virunga landscape, including the creation of a transboundary network of protected areas and a core secretariat to coordinate activities, established in Kigali, Rwanda in 2008.

International action for the mountain gorillas shows how critical transboundary collaboration can be, but also how a species can survive against all odds even amidst a conflict zone.

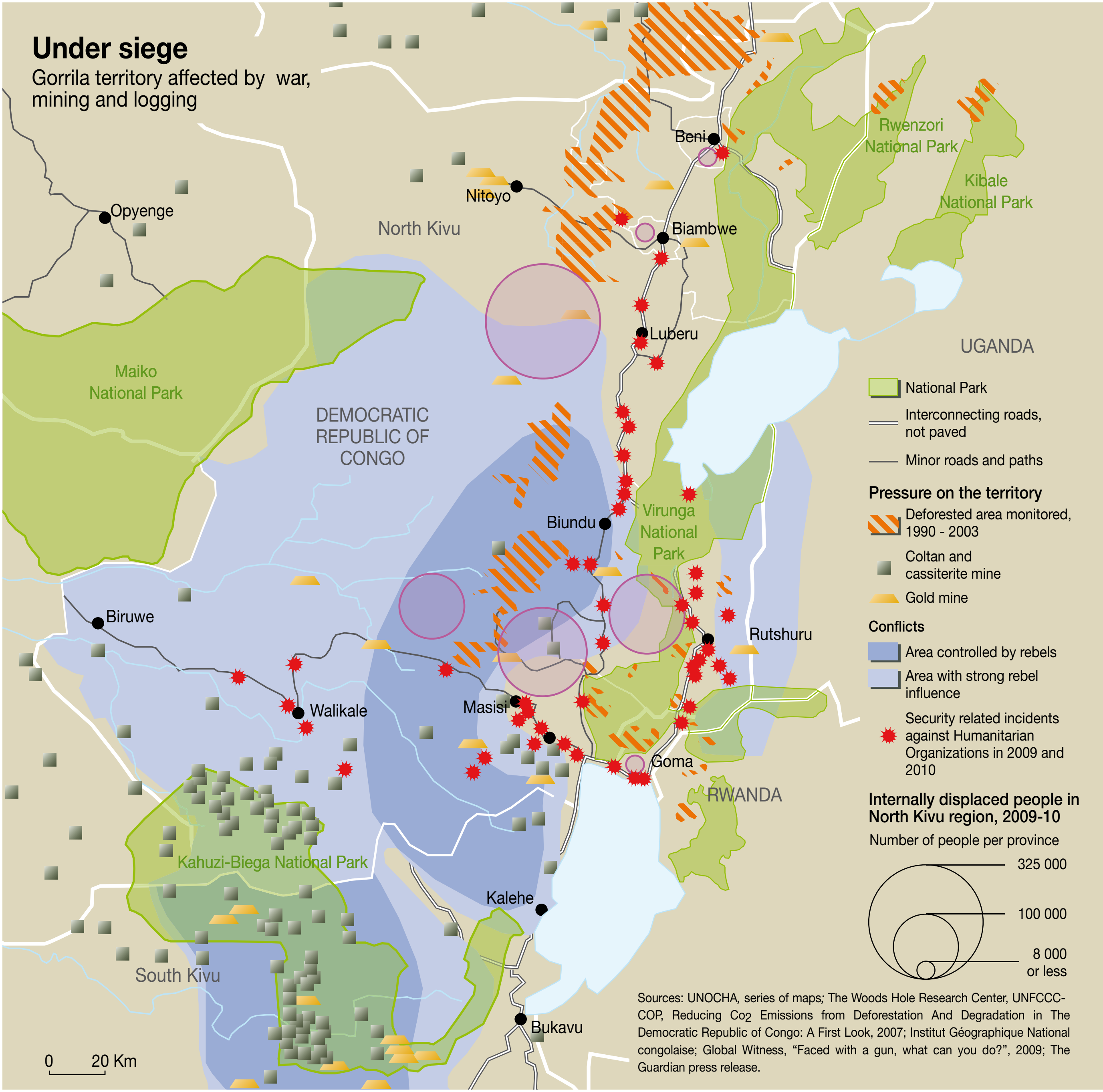


Figure 13: Gorilla territory affected by war, mining and logging.

Snow leopard *(Uncia uncia)*

CMS STATUS Appendix I **CMS INSTRUMENT(S)** None

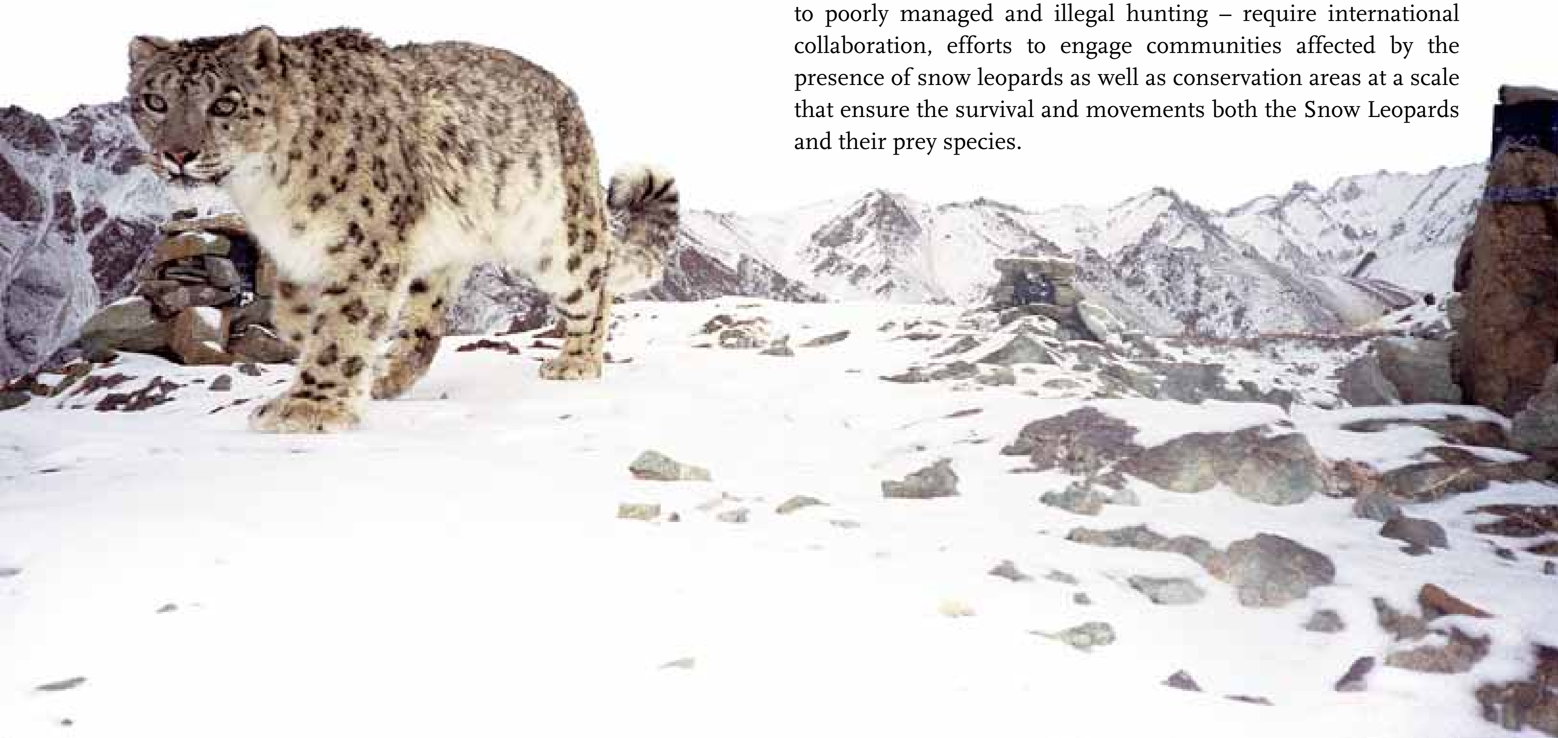
The Snow leopard inhabits the alpine and sub-alpine regions of Asia's most spectacular mountain ranges. Occupying nearly 2 million km², the snow leopard's range extends across 12 range states from Russia and Mongolia to Nepal and Bhutan. Unfortunately this magnificent predator had to be listed as Endangered by the World Conservation Union (IUCN). As few as 3,500–7,000 cats may remain in the wild and the population is thought to be dwindling across most of its range.

Threats to migration pathways

Primary threats to the species include illegal trade in cubs, pelts and bones for traditional medicine, loss of natural prey due to poorly managed hunting and retaliatory killing by humans in response to predation on livestock (Hussain 2000; Mishra *et al.* 2003). These problems are compounded by lack of information and conservation management as well as non-existent regulatory enforcement across much of these high mountain landscapes that require specially trained anti-poaching units to be effective and appropriate funding for options to reduce conflicts between farmers and snow leopards. Snow Leopards often move across international boundaries in these mountains to find prey or mates. Impassable border fencing poses a threat to the movements of wild mountain sheep and goats, which also affects the availability of natural prey for the snow leopard.

Opportunities to protect migration pathways

There is a growing recognition of the need for transboundary data sharing, coordinated data collection methods, and coordinated management planning to improve the ability of range states to adequately manage and protect the snow leopard and its prey across these transboundary landscapes. Furthermore, the primary threats – conflict with farmers, poaching and loss of prey due to poorly managed and illegal hunting – require international collaboration, efforts to engage communities affected by the presence of snow leopards as well as conservation areas at a scale that ensure the survival and movements both the Snow Leopards and their prey species.



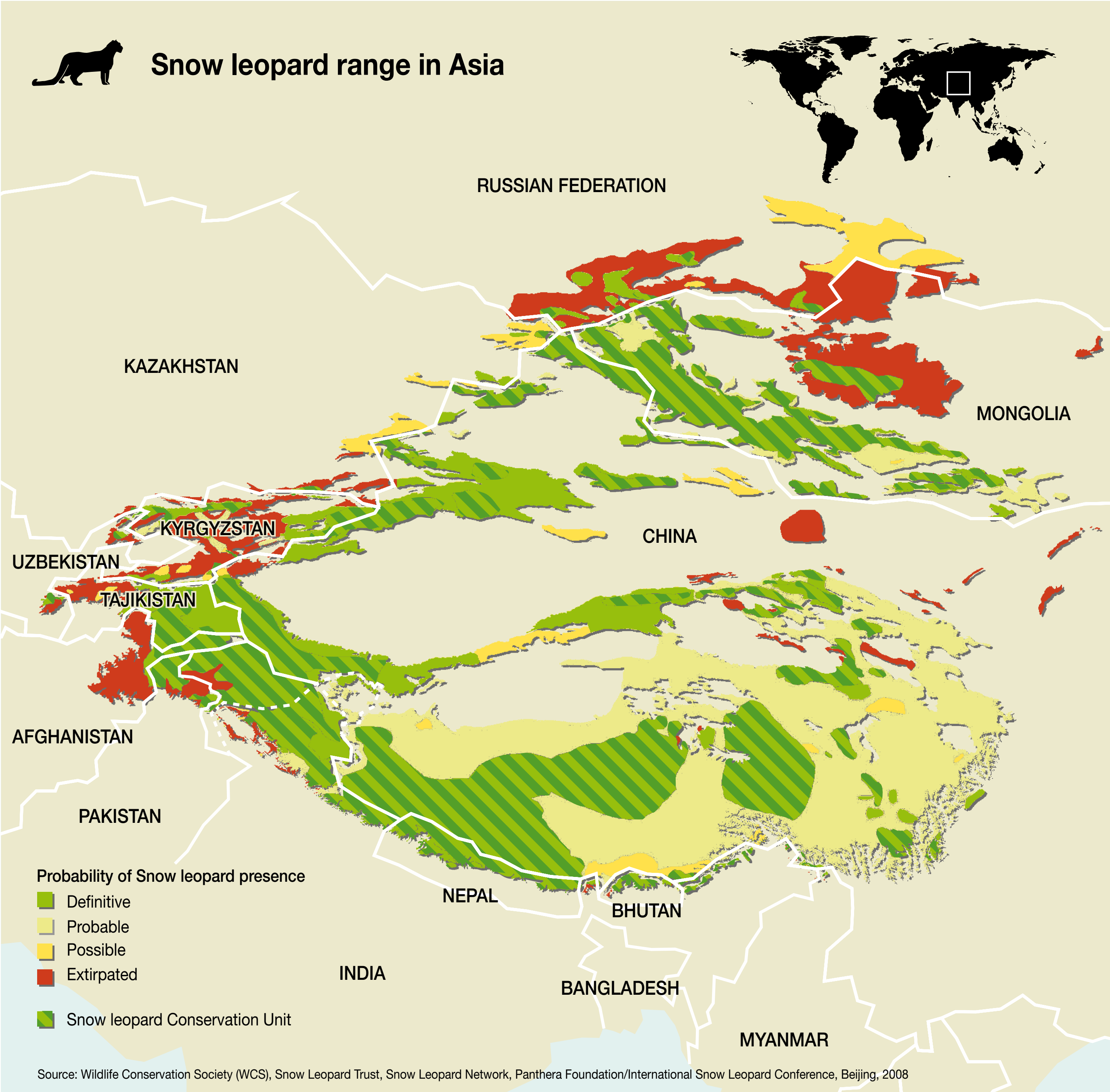


Figure 14: Snow leopard ranges.

SWIMMING
MIGRATION IN THE SEA

Many swimming migratory species in rivers, lakes and in the oceans are subject to some of the very same challenges: dam development in rivers, shipping routes affecting migrations due to noise, invasive species having an impact on their food chain, and illegal harvest, overharvest and bycatch (WCD, 2000; UNEP, 2001; UNEP, 2008).

Bycatch generally covers the accidental capture of non-target species in fisheries and threatens numerous migratory marine mammals, turtles, sharks and seabirds. It is the top threat to the majority of marine mammals being responsible for an annual loss of more than 600,000 individuals. Trawls, gillnets and driftnets, long lines and purse-seines are particularly problematic with animals becoming entangled in fishing gear or attracted by bait.

A small population of Irrawaddy dolphins (*Orcaella brevirostris*) in the inner Malampaya Sound, Philippines, classified as "Critically Endangered" in the IUCN Red List, is currently threatened by bycatch in the local crab net/trap fishery (Smith *et al.*, 2004). Irrawaddy dolphins and finless porpoises (*Neophocaena phocaenoides*) are bycaught regularly in gillnets and kelong (fish traps) and to a lesser extent in trawls in Malaysian waters (Perrin *et al.*, 2005). Freshwater populations of Irrawaddy dolphins in two rivers – the Mahakam of Indonesia and Mekong of Vietnam, Cambodia, and southern Laos – and one population in the Songkhla Lake in Thailand – are also classified in the IUCN Red List as 'Critically Endangered', with gillnet entanglement identified as the dominant threat (Beasley *et al.*, 2002; Kreb, 2002; Smith, 2003; Smith *et al.*, 2009). Although the data have not yet been collected, it is probable that there is a high level of Indo-Pacific bottlenose dolphin (*Tursiops aduncus*) bycatch throughout this region as well (Wang & Yang, 2009). Spinner dolphins (*Stenella longirostris*) and Fraser's dolphins (*Lagenodelphis hosei*) experience substantial bycatch in the tuna driftnet fishery in Negros Oriental, Philippines (Dolar *et al.*, 1994), and similar fisheries for large pelagic species operate in other parts of the country (Perrin *et al.*, 2005). Cetaceans may also be taken in round-haul nets; one estimate for the eastern Sulu Sea was 2,000–3,000 per year. In a recent 'rapid-assessment' of 105 fishing villages, 67 per cent were found to have some level of cetacean bycatch, with the bycaught dolphins usually used for shark bait in longline fisheries (Perrin *et al.*, 2005). Preliminary research indicates that the bycatch and entanglement of some small cetaceans in fisheries, especially finless porpoises (*Neophocaena phocaenoides phocaenoides* and *N.p asiaeorientalis*), is also high in Chinese waters (Zhou & Wang, 1994).

Impacts of noise pollution and disturbance by shipping

There are numerous studies on the impacts of dams and other infrastructure on hindering movements of salmonids, fish and river dolphins (UNEP, 2001; WCD, 2000).

However, there has in recent years been far more focus on the effect of noise pollution from shipping and recreational boats on marine mammals, including both naval military sonar and other anthropogenic sounds that can cause hearing damage or affect fish and animal behaviour and communication in the ocean (MacCauley *et al*., 2003; Wellgart, 2007; Papanicolopulu, 2011; Zirbel *et al*., 2011). There is particularly increasing evidence on behavioural changes in cetaceans – whale and dolphins – when exposed to noise pollution (Nowacek *et al*., 2007; Lusseau, 2008).

Odontocete cetaceans (toothed whales) use high frequency echo-location sounds for navigating and foraging and are highly sensitive to artificial sounds in the ocean, and have particularly the ability to detect and hear both very low and very high frequencies, dependent upon species. Mass strandings from a few to several hundred have occurred in numerous cetacean species, including beaked whales following military exercises with sonar (Balcomb and Claridge, 2001), and of other whales, dolphins and porpoises. The causes of mass strandings are in all likelihood very diverse (Walker *et al*., 2005). Some may have been related to hearing loss possibly caused by boat noise, pollution (from PCB) or other causes, while others from a range of other factors including natural ones (Mann *et al*., 2010).

However, noise pollution from shipping may also have effects other than mass strandings, namely through causing cetaceans to avoid shipping lanes and harbours in previously important habitat and migration routes. Artificial sound has even been used effectively to deter killer whales from salmon farms (Morton and Symonds, 2002). Avoidance of cetaceans to even few small-vessel tourist boats has been documented as a long-term effect, with possible implications for local populations (Bejder *et al*., 2006). More recent studies confirm substantial changes in cetaceans' behaviour when exposed to boat noise, greater than previously suspected (Williams and Ashe, 2007; Bearzi *et al*., 2011; Seuront and Cribb, 2011).

Humpback whales (*Megaptera novaeangliae*) have been shown to alter behaviour near vessels (Stamation *et al*., 2010), and several studies show dolphins avoiding areas with boat traffic (Bejder *et al*., 2006). There are numerous studies documenting changes and

drops of up to 58 per cent in cetacean communication and sounds when exposed to vessel traffic (Jensen *et al.*, 2009). Noise from merchant ships elevates the natural ambient noise level by 20–30 dB in many areas, with especially high frequency sounds, to which some cetaceans are very sensitive (Frankel *et al.*, 1995; Arveson and Vendittis, 2000). Boat noise is easily audible to killer whales (*Orcinus orca*) as far as 15 km away (Erbe, 2002), minke whale (*Balaenoptera acutorostrata*) "boings" have been picked up at over 100 km distance (Oswald *et al.*, 2011). Distances between communicating humpback whales in one study were over 5 km. Recent research using the underwater microphones of the Sound Surveillance System (SOSUS) can track singing blue, fin, humpback and minke whales and has revealed that whale song can probably be heard across several thousand kilometres (Croll *et al.*, 2002).

Another issue is the rising number of off-shore wind power installations. The extremely loud noise generated during construction can be heard over large distances underwater (Carlos, 2008) and can displace animals from their habitats in a radius of more than 15 kilometres from the source (Brandt *et al.*, 2011).

There has been rising concern over the use of military sonar, but also of other shipping impacts (MacCauley *et al.*, 2003; Nowacek *et al.*, 2007; Wellgart, 2007; Papanicolopulu, 2011; Zirbel *et al.*, 2011), suggesting that major ships can cause whales to undertake detours of great distances. Such detours may cause severe reductions in crossings of traditional migration points. This, in turn, may cause direct blocking or halting of migratory cetaceans if areas such as archipelagos or in the Canadian High Arctic, where there is shallow water in the straits among many major islands, are opened up to regular shipping and transport.

In particular, this may be a high risk to the white beluga whales (*Delphinapterus leucas*), which appear to be highly sensitive compared with bowhead whales (*Balaena mysticetus*) to anthropogenic noise, even to helicopters or fix-wing aircraft flying overhead; up to 38 per cent of the Belugas responded to aircraft flying overhead, even at several hundred metres' distance and altitude with very short duration (Patenaude *et al.*, 2002). As the sounds' effects and exposure time of overflights are far less than those of shipping, this creates particularly concern for the beluga whales that live in a normally very pristine environment and exclusively in the High Arctic, a possibly diminishing range with climate change. Protection of their opportunity to migrate between sites with different qualities and food is therefore imperative to this species (Fig. 16).

They migrate across the Arctic, in northern Canada and Greenland, particularly foraging in the southernmost bays of Baffin Island, the northeastern Canadian Arctic, Hudson Bay and into the West Greenland coast. There are several separate populations of Beluga Whales (IUCN, 2011), an estimated 20,000–30,000 around Baffin Island, where the coastal waters provide crucial habitat for the whales and a centre between East and West of the Beluga distribution from Alaska to Greenland.

Studies have shown the high sensitivity of Beluga Whales to shipping (Caron and Sergeant, 1988). Movements of Belugas through the mouth of the Saguenay river were monitored by several researchers for a decade (Caron and Sergeant, 1988). A decline in the Beluga passage rate of more than 60 per cent over this period – from 3.9 belugas/hour to 1.3 belugas/hour in the later years – was recorded (Caron and Sergeant, 1988) over a relatively short period, between 1982 and 1986, which coincided with an increase in recreational boat activities in the area. The ice breaker MV Arctic has also been shown to generate more high frequency noise than did comparable vessels. Belugas should be able to detect the vessel from at least as far as 25 to 30 km (Cosens and Dueck, 1993). This may explain why Belugas in Lancaster Sound seem to react to ships at longer distances than do other stocks of Arctic whales. Belugas were displaced along ice-edges by as much as 80 kilometres (Finley *et al.,* 1990).

A large iron mine, operated by the Baffinland Iron Mines Corporation, has now been proposed in Baffin Island, with possibly severe impacts on wildlife on the island, such as development across the calving grounds of the caribou, and the establishment of two major ports. A 149-kilometre railway, 100 kilometres of roads and 83 quarries (producing ca. 29,500,000 tons) are planned, with an estimated traffic of 110 trucks per day during the operation phase (Baffinland, 2011). From the two planned ports for shipping and construction – the Milne Port and Steensby Port – there will be up to 23 freight vessels (165,000–206,000 tons) during the first years of construction, to a more permanent six operating freight vessels (46,000–60,000 tons), in addition to three to six tankers from each port (Baffinland, 2011).

The possible establishment of this project in Canada's High Arctic will not only possibly have major terrestrial impacts, but it will also severely endanger the migration of the Beluga Whales between Greenland and Canada's Arctic and possibly crucial parts of their winter range.

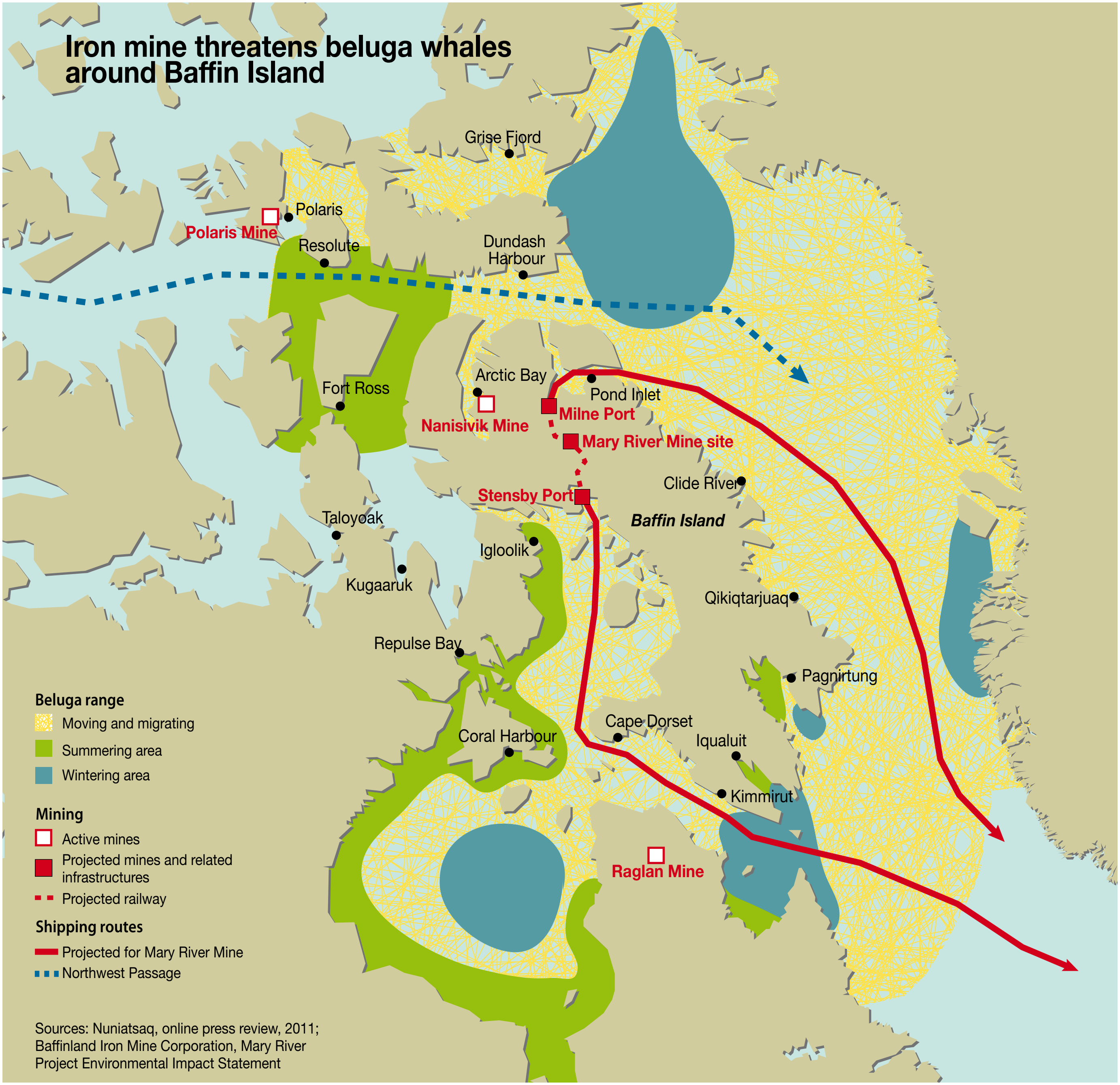


Figure 15: Proposed iron mine in Canadas High Arctic may jeopardize the white beluga whales and interfere with their migrations.

Humpback whale (*Megaptera novaeangliae*)

CMS STATUS Appendix I **CMS INSTRUMENT(S)** MoU on for the Conservation of Cetaceans and their Habitats in the Pacific Islands Region; Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS)

Humpback whale populations occur around the globe, and while the exact nature of the population boundaries is still not well-understood, genetically distinct breeding sub-populations are well-recognized. Humpback annual migrations between feeding grounds in polar waters to mating and calving grounds in tropical waters are amongst the longest of any mammal. Following heavy exploitation during much of the 19th and 20th centuries, Humpback Whales have been legally protected from commercial whaling since 1966, except for aboriginal and subsistence take, and in most areas their populations are showing signs of recovery. However, there is little evidence of significant population recovery in the Oceania sub-population, which migrates between Oceania and the Southern Ocean. Listed as Endangered, this sub-population is estimated to be as small as 3,000–5,000 animals, less than a quarter of its original size.

Threats to critical sites and migratory pathways

Because humpback whales in the Oceania region are still at very low population levels, the impacts of current or potential future threats could significantly affect their recovery. These threats include habitat degradation, pollution, disease, noise, bycatch and entanglement in fishing nets, collisions with ships, the depletion of prey species, and climate change. Mortality due to entanglement and collisions with ships has been reported within the Southern Hemisphere. To varying degrees these threats are all present in both the Oceania region and the Southern Ocean.

Opportunities for ecological networks

The International Whaling Commission's Southern Ocean Whale Sanctuary and temporary moratorium against commercial whaling offers limited protection to humpback whales from commercial whaling, but scientific whaling remains a threat. There is no focused mechanism to address any of the other threats faced by Humpbacks at this end of their migration.

In Oceania, the CMS Pacific Cetaceans Memorandum of Understanding (MOU) and the Pacific Regional Environment Programme (SPREP) offer the framework for protection from the range of threats faced by humpbacks in the Pacific Islands Region. They offer significant opportunity for transboundary cooperation in the Oceania region, bringing together governments, researchers, NGOs and stakeholders in a coordinated effort to identify and address threats and issues for the recovery of this species.

Identifying critical habitat areas and crucial migratory pathways in Oceania and the Southern Ocean and collaborating with appropriate Southern Ocean mechanisms, such as the Convention on the Conservation of Antarctic Marine Living Resources, to identify a network of protected areas across its migratory range would further aid this species.

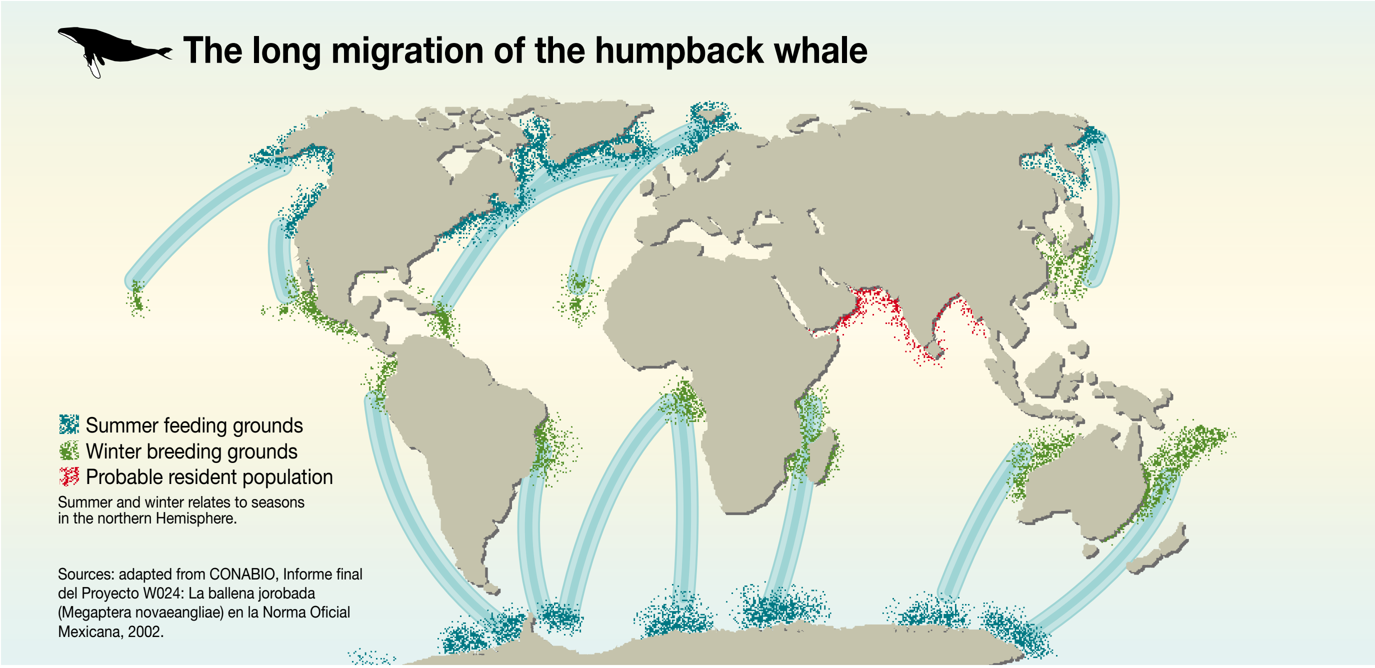


Figure 16: Humpback whale migrations.

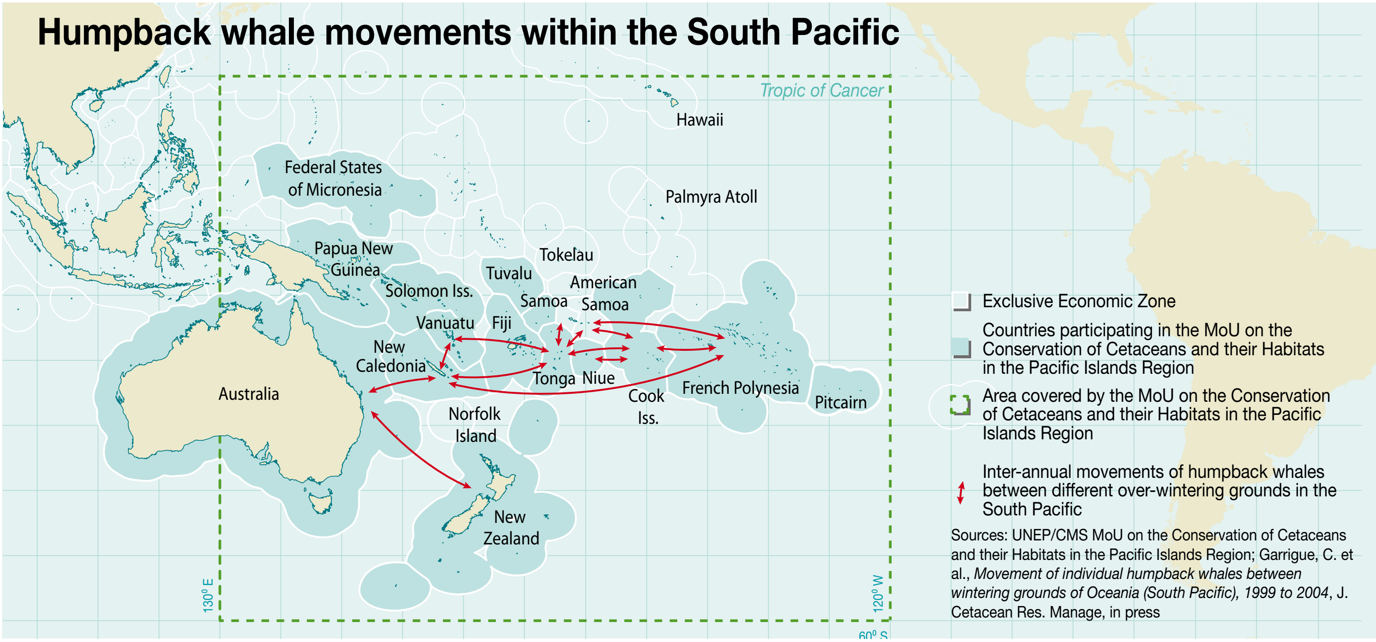


Figure 17: Humpback whale movements in the South Pacific.

Leatherback turtle (*Dermochelys coriacea*)

CMS STATUS Appendix I & II **CMS INSTRUMENT(S)** MoU on on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia; MoU concerning Conservation Measures for Marine Turtles of the Atlantic Coast of Africa

The leatherback turtle is a long-distance migratory sea turtle, travelling between tropical breeding grounds and multiple pelagic and coastal foraging regions located in temperate and tropical waters. There are effectively two breeding stocks in the Pacific: a western Pacific stock that nests in Indonesia (Papua Barat), Papua New Guinea, Solomon Islands, and Vanuatu; and an eastern Pacific stock that nests in Mexico, Costa Rica, and Nicaragua. A third stock that nested on beaches in Terengganu, Malaysia appears to have been nearly extirpated within the past decade. The western Pacific stock harbours the last remaining significant nesting aggregations in the Pacific with an estimated 2,700–4,500 breeding females. Pacific leatherback turtles are endangered throughout their range.

Threats to critical sites and migratory pathways

Predation by pigs and dogs, as well as continued human harvest of eggs and turtles, beach erosion, and low hatch success remain significant impacts to the western Pacific stock. The eastern Pacific stock, which used to host the worlds' largest leatherback nesting population, has declined by more than 90 per cent over the past two decades due to unsustainable harvesting of turtle eggs and fishery bycatch. It is estimated that thousands of leatherbacks are hooked each year in fishery longlines and gillnets, which can result in severe injuries or death. Urban developments along the coast can also destroy and degrade beaches that are used for nesting. Leatherbacks can also confuse floating plastic bags and other debris with jellyfish, their main diet. The potential for Pacific-basin wide leatherback extirpation remains significant.

Opportunities for ecological networks

Whilst conservation efforts are underway on nesting beaches, there are significant opportunities for enhanced regional and international cooperation in the management of leatherbacks in high-use areas and migratory corridors across the Pacific, including within existing marine protected areas. Greater information on fisheries bycatch is important for evaluating the relative effects of different fisheries. Bycatch mortality can be reduced through mandatory use of turtle-friendly fishing gear by foreign long line vessels fishing in national waters. Continued tagging and tracking studies of leatherbacks and other migratory marine species that share similar high-seas habitats and common threats can play an important role in informing the spatio-temporal management of fisheries and coastal activities, and can inform the design of time-area closures during certain periods of the year.

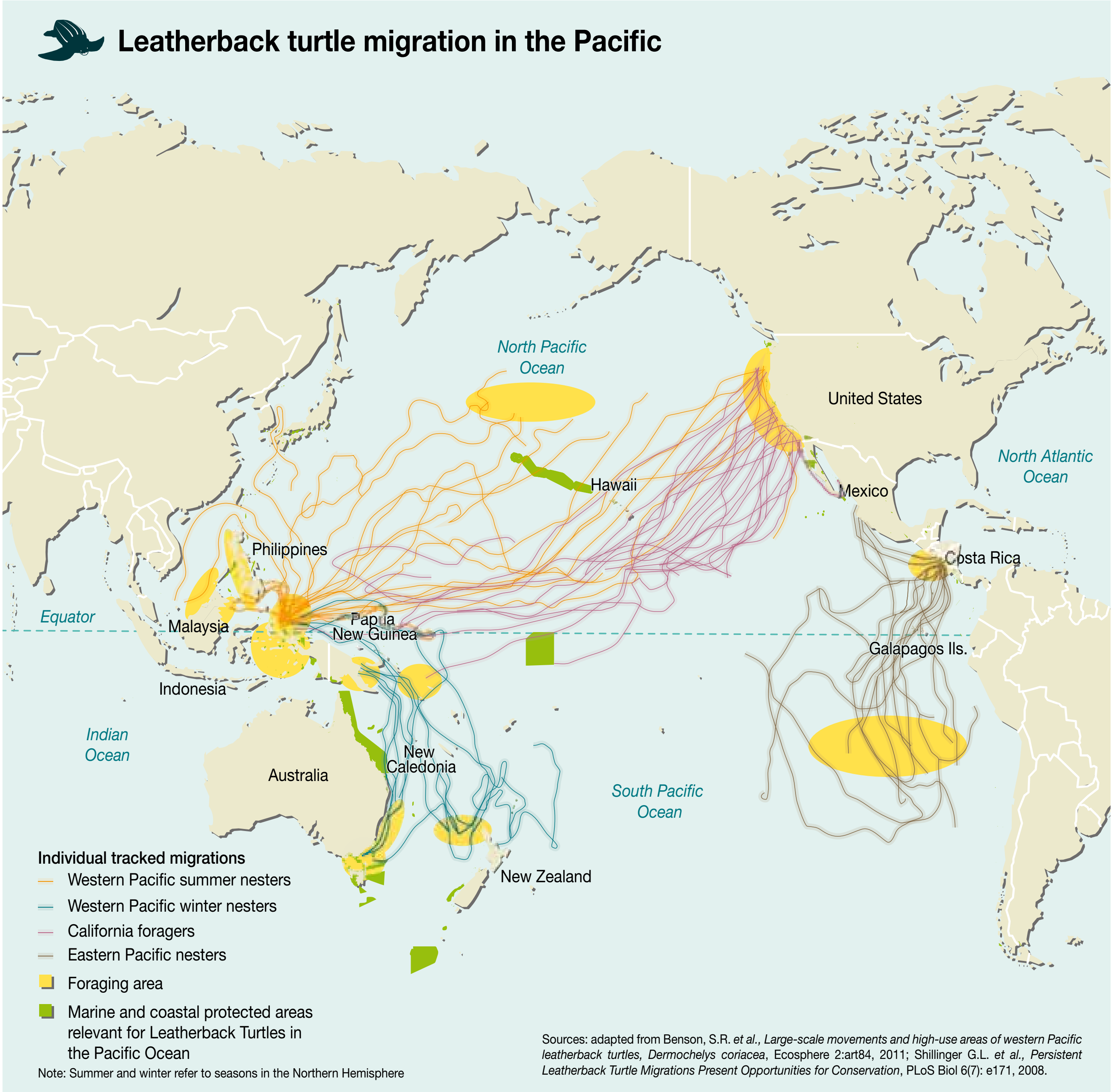


Figure 18: Leatherback turtle migrations.

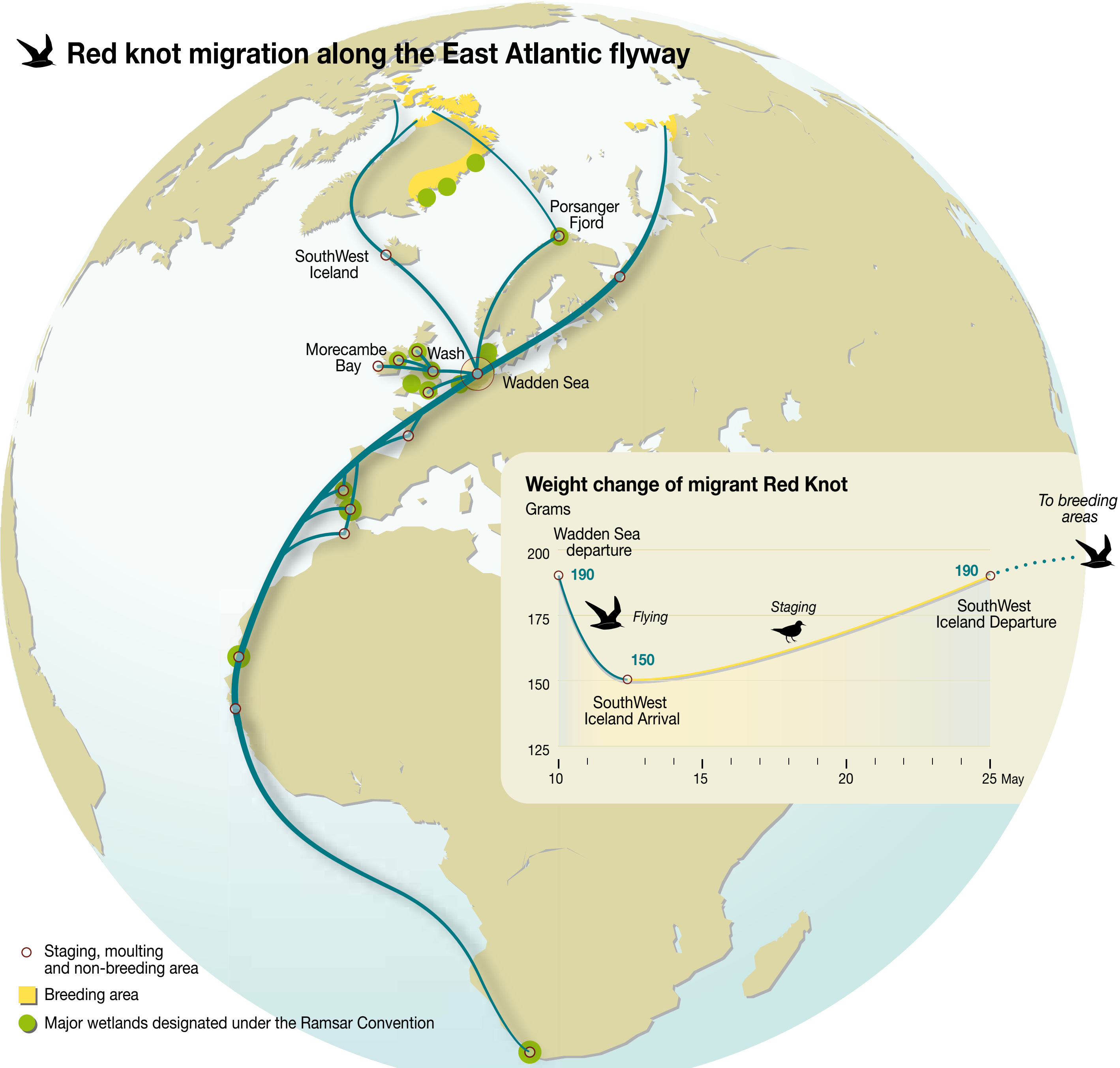
FLYING
MIGRATION IN THE AIR

Bird migration has fascinated humans for thousands of years. The navigational accuracy, extraordinary journeys and mechanisms of migration are better understood for birds than for any other taxonomic group. Approximately 1,800 of the world's 10,000 bird species are long distance migrants (Sekercioglu, 2007). Much less is known about bat migration, not least since these small animals mostly migrate at night. Bats are however capable of long and difficult journeys. In North America and Africa, for example, a number of bat species migrate up to 2,000 km from north to south (Fleming *et al.*, 2003; Hoare, 2009)

Within more than hundred million years flying species have evolved and developed complex migration strategies, adapting to climate changes, annual weather cycles and specific food availability. The osprey (*Pandion haliaetus*), for example, a raptor species specialized on fishing in lakes and rivers with a worldwide distribution, has to move thousands of kilometres to the south, as lakes freeze over for up to eight months in the north, effectively hindering any access to the fish below in what can be several metres of compact ice in Alaska, Canada, Northern Europe and Russia. Draining of a river on the other hand for cropland irrigation in southern Africa, Australia or in Argentina could deplete the food source for the eagles in winter, and hence impact the osprey populations in the high North. There is little time and space for the species to adapt to such fast anthropogenic change.

Shorebirds, which raise millions of offspring during a very short breeding season in the Arctic tundra, are an excellent example of a highly specialized migratory species. Among them is the bar-tailed godwit (*Limosa lapponica*), which makes the longest known non-stop flight of any bird and also the longest journey without pausing to feed by any animal, 11,680 kilometres along a route from Alaska to New Zealand (Gill *et al.*, 2009). The Sooty shearwater is famous for one of the longest recorded round-trips, covering 65,000 kilometres across the Pacific Ocean in 262 days (Hoare, 2009).

For many shorebirds coastal habitats are of critical importance, including tidal flats, where rich food supplies are easily reachable at low tide. For bar-tailed godwits there are no tidal flats available (as "airports" to refuel) along the arduous journey between Alaska and New Zealand. At the beginning and end of the journey, however, intact coastal habitats are vital. Long-distance birds are well adapted to managing their busy flight schedules. Birds can double in weight before take-off for flights of several thousand kilometres. Within several days birds can lose half of their body mass indicating the energy required for



Source: personal communication with Peter Prokosch, GRID-Arendal; Piersma, T., Davidson, N., *The Migration of Knots,* WSG Bulletin 64, 1992.

Figure 19: Red knot migration along the Eastern Atlantic Flyway.

the amazing journeys these animals undertake. A number of studies suggest that in addition to the storage and depletion of fat, the muscles and internal organs also undergo considerbale change in size during the course of long-distance migrations (Piersma, 1998). For the red knot (*Calidris canutus*) the "airport" analogy fits well and illustrates just how important it is to protect the essential refuelling sites. Red knots set off in April with large fat reserves (fuel) from the airport "West Coast National Park" (the Langebaan Lagoon tidal flats in South Africa) to fly 7,000–8,000 km until they reach the tidal flats of Guinea Bissau, the airport "Banc d'Arguin National Park" in Mauritania. They recover the resources they lost and intensively feed for three weeks on protein-rich shellfish allowing them to almost double in weight. The next long-haul flight of 48–72 hours in duration takes them to the UNESCO World Heritage Site "Wadden Sea", which is also covered by a CMS agreement on seals. Having lost most of their "African fuel" the birds once again refuel for the last leap to the "Great Arctic Reserve" on Taimyr in North Siberia (Dick *et al.*, 1987; Prokosch, 1988).

International conservation cooperation within the framework of the African-Eurasian Waterbird Agreement (AEWA) along the East Atlantic Flyway is ongoing in an effort to protect as many of these crucial airports (large scale tidal flats) as national parks or other types of MPAs as possible.

Similar international conservation cooperation needs to scale up in the region of the East Asian-Australasian Flyway, where in particular the tidal flats of the Yellow Sea are the most important "airport". Much has happened in the last two decades along the eastern Yellow Sea coast. Traditionally, reclamation of tidal flats was limited to agricultural purposes. However, in only the last two decades of the 20th century, nearly 800 km² of coastal wetlands on the south-western coast of Korea have been lost to reclamation for industrial development. Huge projects like Saemangeum, which enclosed 400 km² of tidal flats including the two estuaries of Mangyeung and Dongjin with a 33 km long dyke, have decreased important refueling space for Arctic shorebirds significantly.

Yellow Sea, the flyway hub

Figure 20: The East Asian-Australasian flyway for migratory birds.

Now, through public debate in the media about the advantages and disadvantages of reclamation projects, local communities are joining forces in the eastern Yellow Sea region to protect the tidal flats from further deterioration and destruction. National policy in South Korea is also turning from reclamation to conservation and wise use (Van de Kam *et al.*, 2010).

On the following pages a number of CMS-relevant case studies of migratory birds and bats are presented.

Grassland birds in southern South America

CMS STATUS Appendix I & II | **CMS INSTRUMENT(S)** MoU on the Conservation of Southern South American Migratory Grassland Bird Species and Their Habitats

The grasslands of Argentina, Bolivia, Brazil, Paraguay, and Uruguay in southern South America represent important habitat to numerous migratory and resident bird species. These birds play vital roles in the ecosystem by dispersing seeds and controlling insect populations. Some species, such as the buff-breasted sandpiper (*Tryngites subruficollis*), migrate some 20,000 km from their breeding grounds along the Arctic coast to their non-breeding range on the pampas of southern South America. Due to rapid declines, this species is considered Near-Threatened. Other species, such as the chestnut seedeater (*Sporophila cinnamomea*) and the saffron-cowled Blackbird (*Xanthopsar flavus*) also cross international borders within southern South America, and depend on grassland habitat for both breeding and non-breeding activities. Both of these species are classified as Vulnerable.

Threats to migration pathways

The fragmentation, degradation and loss of grassland ecosystems in southern South America by human activities are key threats to grassland bird populations. These important habitats are being placed at risk by unsustainable agricultural activities, pollution from pesticides and other agrochemicals, conversion to pasture land for cattle, and the transformation of natural grassland into eucalyptus and pine plantations for paper production. Long distance migrants, such as the buff-breasted sandpiper, are even more vulnerable to habitat loss as they also face stresses on their breeding grounds and along their migration routes.

Opportunities for ecological networks

Unlike various waterbird species, many grassland bird species do not usually congregate in great concentrations at discrete sites. Instead, there are areas that attract large numbers of both breeding and non-breeding populations and can be considered as important strongholds for grassland species. The Convention on Migratory Species (UNEP/CMS) and the governments of Argentina, Bolivia, Brazil, Paraguay, and Uruguay, in collaboration with BirdLife International and Asociacion Guyra Paraguay, have drawn up an action plan that identifies conservation measures for the protection of these birds and their habitats. The action plan focuses on the identification of new protected areas to create a network of habitats. In addition, it recommends actions to be taken outside of protected areas to help conserve habitat on private lands. International cooperation will also be important to encourage conservation actions at breeding, non-breeding, and migration stopover sites outside of this region.

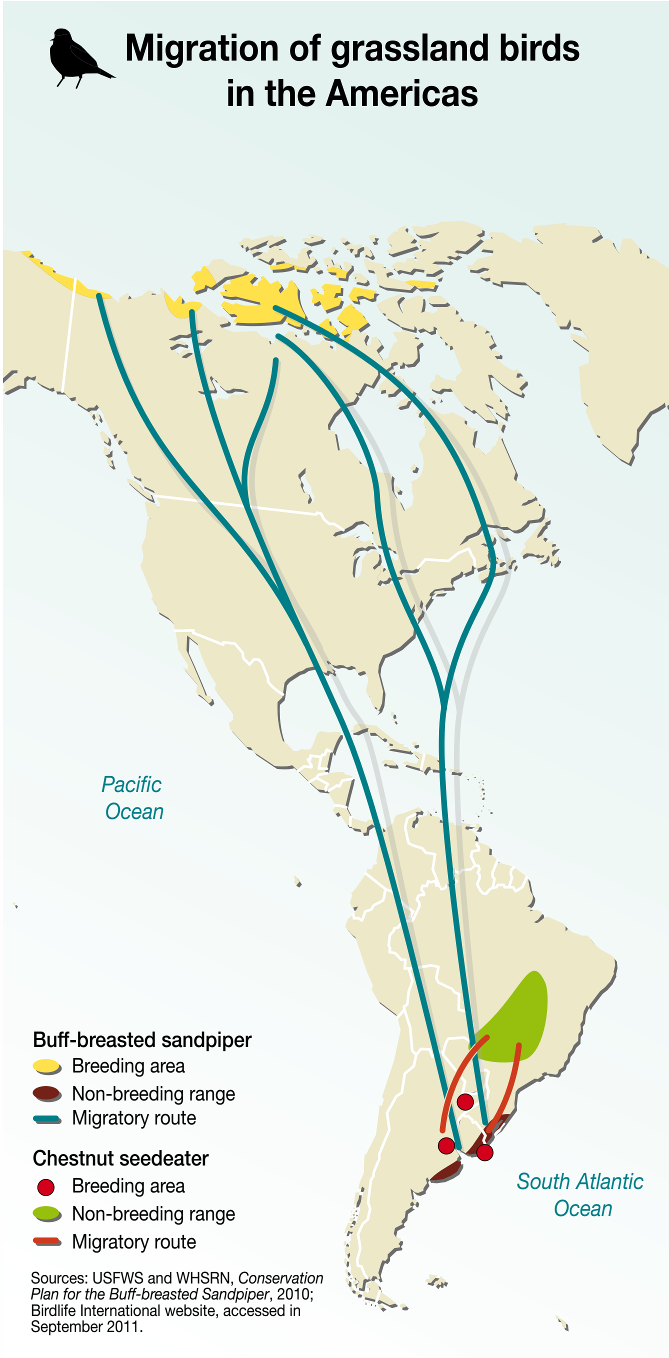


Figure 21: Migration of grassland birds in America.

Red knot (*Calidris canutus*)

CMS STATUS Appendix I & II | **CMS INSTRUMENT(S)** African-Eurasian Waterbird Agreement (AEWA)

The red knot is a migratory shorebird that travels up to 20,000 km twice a year from its breeding grounds on the high Arctic tundra to its southern non-breeding sites. Along with having one of the longest total migrations of any bird, some populations also fly as much as 8,000–9,000 km between stopover sites in a single flight. As a shellfish-eating specialist avoiding pathogen-rich freshwater habitats, the red knot relies on the few large tidal flats with abundant food resources that the world has to offer. To undertake the physiologically demanding flight from West Africa to northern Siberia, for example, *Calidris c. canutus* refuels during three weeks of fast feeding in the national parks of Banc d'Arguin in Mauritania and the European Wadden Sea. After nearly doubling its weight, it burns off stored fat during the 3 or more days of non-stop flying.

Threats to migration pathways

Of the six subspecies of red knot, one is now stable, four are in decline, and the trend in the sixth population is unclear. These declines can be attributed to the loss of important feeding areas and food sources along its migration routes. Both *C. c. canutus* and *C. c. islandica*, for example, are highly dependent upon the shellfish resources of the Wadden Sea along the East Atlantic flyway. However, as a result of embanking tidal habitats, and mechanical shellfish harvesting in parts of the Wadden Sea, both populations have suffered significant declines.

Similar situations exist for other knot populations. In China and Korea, for example, large-scale reclamation projects have already destroyed over 50 per cent of the tidal flats in the Yellow Sea over the last 30 years with much more underway, putting enormous pressure on both the *C. c. piersmai* and *C. c. rogersi* populations that are unique to the East Asian-Australasian Flyway. Along the West Atlantic flyway, overharvesting of horseshoe crabs in Delaware Bay has resulted in a shortage of crab eggs for *C. c. rufa* and other shorebirds. Their population has plummeted from over 100,000 birds in 2001 to fewer than 20,000 by 2011.

Opportunities for ecological networks

Protecting key refueling sites and their associated food resources along the migration routes of the red knot is vital to its survival. Major progress has been made in this regard along the East Atlantic flyway as part of the African-Eurasian Waterbird Agreement (AEWA). *C. c. canutus*, *C. c. islandica*, and several other shorebird species benefit from the protection of key areas along this flyway. The present partnership development between countries along the East Asia-Australasian flyway system could potentially lead to similar levels of protection. Efforts are also needed to protect the food resources associated with these stopover sites. Mechanical shellfish harvesting was terminated in the Wadden Sea in 2006, but smaller-scale manual harvesting practices always run the risk of increasing again for economic reasons. Discontinuation of the harvesting practices of horseshoe crabs in Delaware Bay are imperative to help the recovery of *C. c. rufa* red knots and other shorebirds along the West Atlantic flyway.

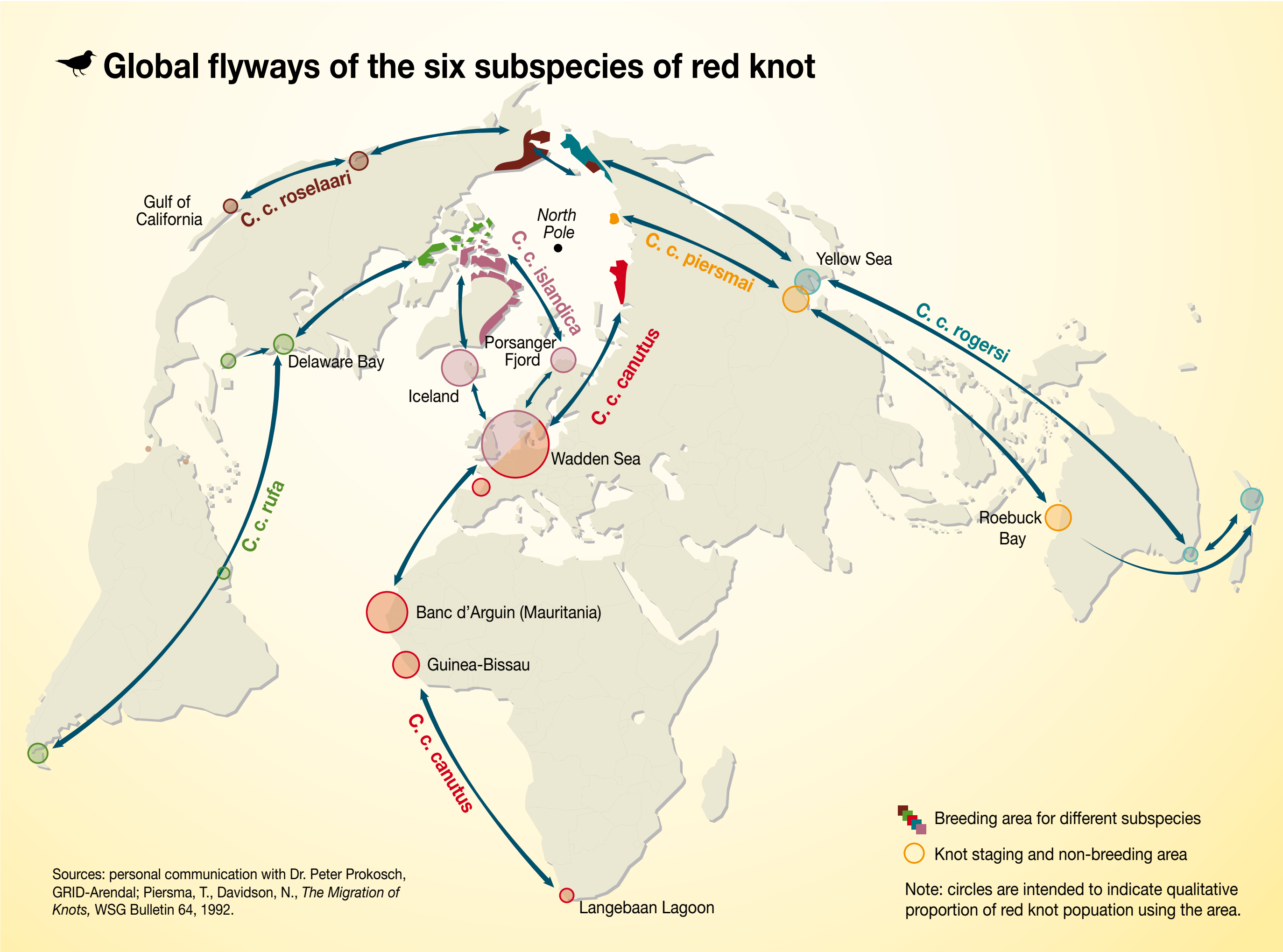


Figure 22: Red knot flyways.

Lesser white-fronted goose (*Anser erythropus*)

CMS STATUS Appendix I & II | **CMS INSTRUMENT(S)** African-Eurasian Waterbird Agreement (AEWA)

The globally threatened lesser white-fronted goose is a Palearctic migrant, breeding discontinuously in forest- or shrub tundra and mountainous shrubby wetlands from Fennoscandia to easternmost Russia. The species has declined rapidly since the 1950s leading to a fragmentation of its breeding range. Many key stop-over and wintering sites are still unknown. Today, three distinct wild sub-populations remain, of which the two Western Palearctic subpopulations (Fennoscandian and Western main) continue to decline. The Eastern main sub-population is currently thought to be stable. In addition, a small population which migrates to the Netherlands has been supplemented/re-introduced in Sweden using a human-modified flyway.

Threats to migration pathways

Although legally protected in almost all range states, accidental and illegal hunting are thought to pose the main threats to the lesser white-fronted goose. This is particularly the case along the flyway of the Western main population, but hunting is also considered the foremost threat in the south-eastern European wintering areas of the small Fennoscandian population.

The lesser white-fronted goose is a so-called look-alike species, which constitutes the major barrier to implementing effective conservation measures to minimize the negative impact of hunting. It very closely resembles the greater white-fronted goose (*Anser albifrons*), which is a common quarry species across its entire range. When migrating together in mixed flocks the two species are hard to distinguish, particularly in flight.

Additional threats include habitat loss and predation. Further, gaps in key knowledge, such as the location of the wintering sites of the Western main population, continue to limit the effective implementation of conservation measures.

Opportunities for ecological networks

Enforcing hunting bans on geese at key sites when lesser white-fronted geese are present is currently considered the only way to effectively halt the ongoing decline of the species. This should be coupled with awareness-raising, identification training and involvement of hunters in conservation efforts at key sites.

An International Working Group has been convened for this threatened species under the African-Eurasian Waterbird Agreement (AEWA) International Single Species Action Plan for the Conservation of the Western Palearctic population of the lesser white-fronted goose. Bringing together representatives from all 22 key range states, the Working Group aims to coordinate and enhance conservation efforts along the flyways of the two Western Palearctic sub-populations, for example, by agreeing on which conservation activities should be prioritized, developing a common monitoring scheme, and sharing best practices as well as resources. Within this framework, the UNEP/AEWA Secretariat also encourages and assists range states in forming National Working Groups and drafting National Action Plans for the species. This will also hopefully contribute to ensuring a long-term commitment in individual range states to participate actively in the conservation of the lesser white-fronted goose.

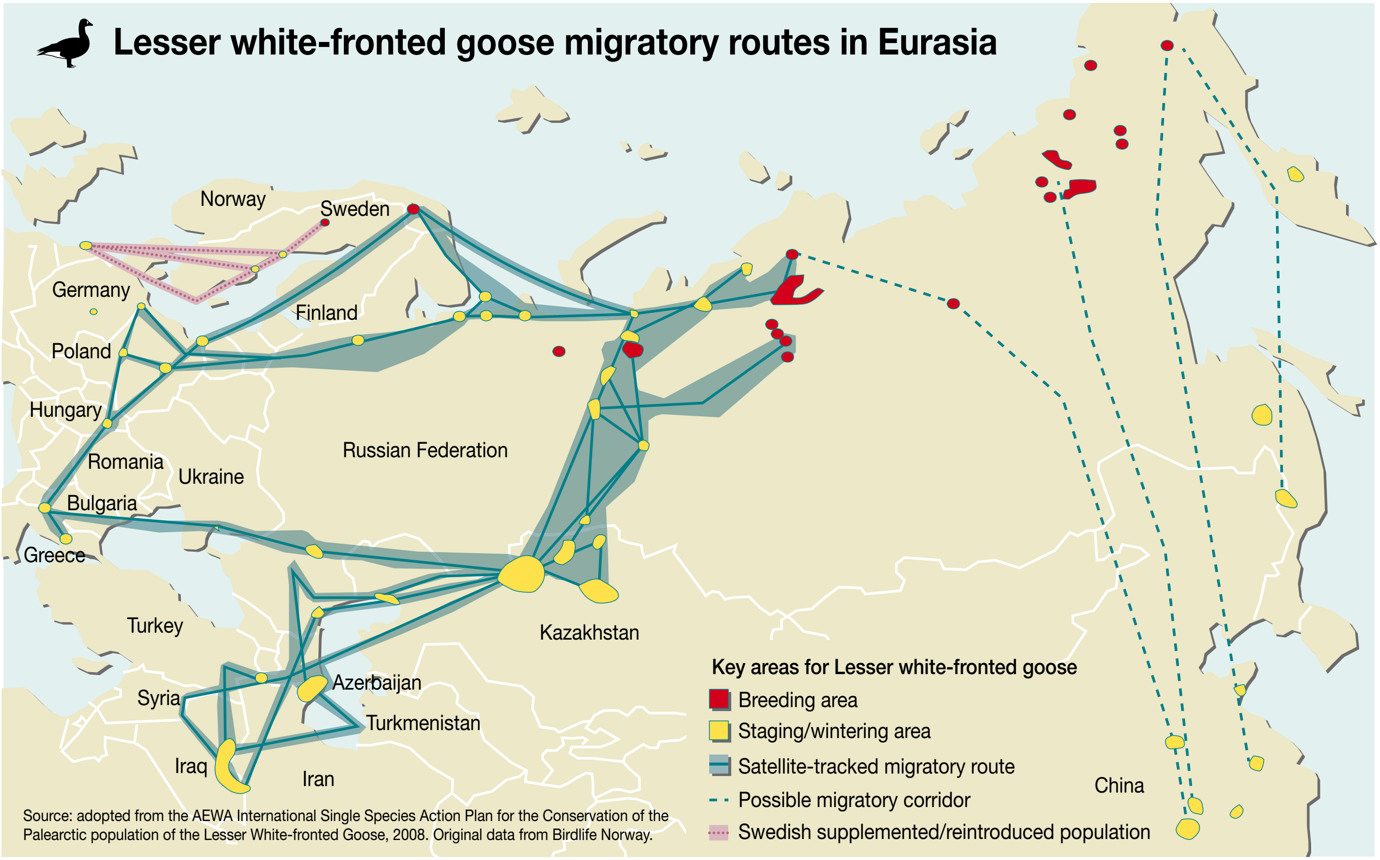


Figure 23: Migration of lesser white-fronted goose.

Nathusius' pipistrelle *(Pipistrellus nathusii)*

CMS STATUS Appendix II | CMS INSTRUMENT(S) EUROBATS

The tiny Nathusius' pipistrelle, weighing only 6–10 grams, travels almost 2,000 km from its breeding grounds in north-eastern Europe to its main hibernation areas in south-west Europe. Populations in Russia are thought to winter in the eastern Caucasus and the Volga Delta. Recently, the breeding range of Nathusius' pipistrelle has expanded towards the west and the south. New nursery colonies have been found in Ireland, the Netherlands, France, and Germany. Only females return to their breeding areas. After their first migration, males usually stay in mating roosts along migration routes or in hibernation areas, and in riverine forests and marshlands. Nathusius' Pipistrelles may also regularly cross the North Sea as many bats have been found on oilrigs. Nathusius' pipistrelle is protected under the Agreement on the Conservation of Populations of European Bats (EUROBATS).

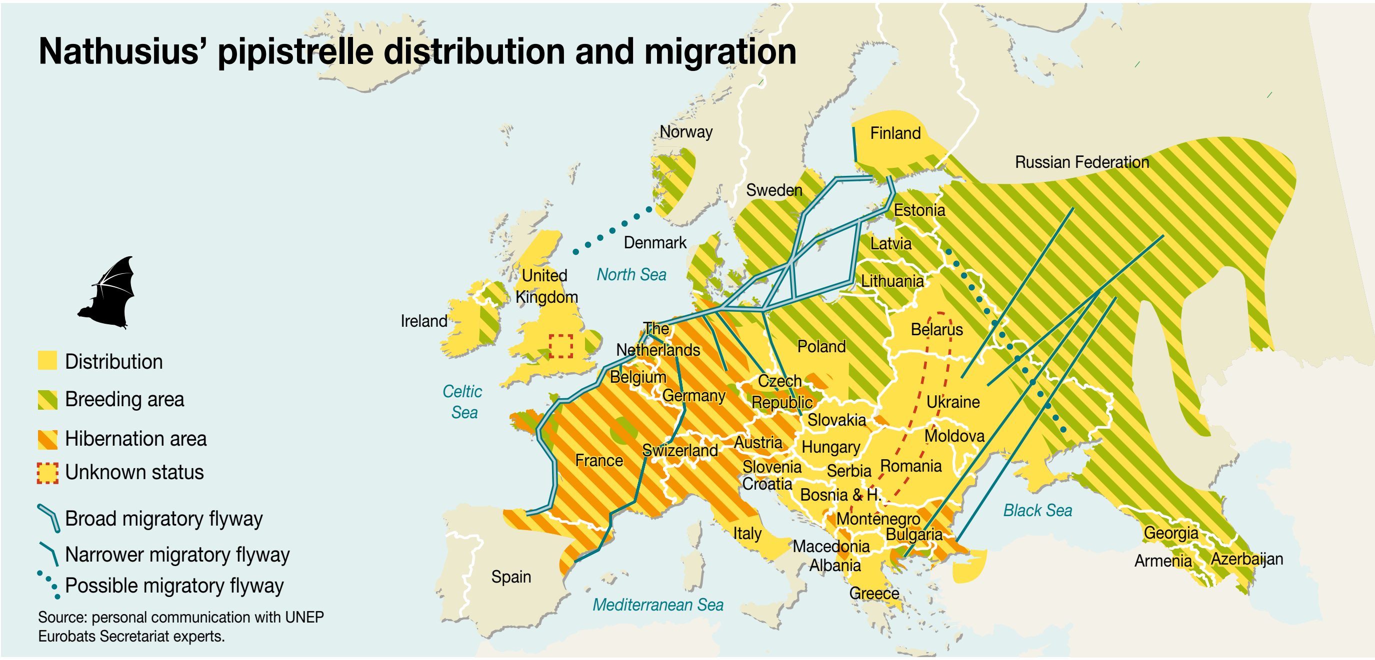


Figure 24: Distribution and migration of Nathusius' pipistrelle.

Threats to migration pathways

The main threat to Nathusius' pipistrelles is the loss of habitat due to forest practices that do not take account of bat needs. The felling of trees with cavities, especially in riverine woodlands, and the drainage of wetlands can affect both breeding and wintering populations. The availability of suitable roosts along their migration paths is also vital for the species.

Nathusius' pipistrelle is increasingly faced with a new threat: wind turbines. Bats are known to be particularly sensitive to wind turbines. They can be fatally injured if they enter the pressure zone around the spinning blades of the turbine, suffering from a collapse of the lungs and internal organs known as "barotrauma". The increasing development of wind farms along migration routes in coastal areas, in mating areas, and in wetlands where the pipistrelle hibernates, has revealed that mortality as a result of collision with wind turbines or barotrauma is high. The bats appear to be attracted to wind turbines operating at low wind speeds, possibly because of insects collecting above the turbine which the bats feed on. During the last few decades many onshore and offshore wind farms have been built along these routes but the extent of the impact on Nathusius' pipistrelle populations is still unknown.

Opportunities for ecological networks

To protect Nathusius' pipistrelle, the conservation and enhancement of wetlands and riverine forests with old trees is essential to allow bats to forage and mate along migration routes. The construction of wind turbines should be prohibited in these habitats or their use curtailed at night or during the migration period. Using higher cut-in speeds, i.e., the minimum wind speed at which the wind turbine will generate usable power, should also be considered in areas where threatened bats are present.

DISCUSSION AND RECOMMENDATIONS

A broad range of threats – the Big five – of habitat loss and fragmentation, overharvesting, pollution including noise, climate change and introduction of invasive species all provide major threats to the world's migratory species.

Migratory species are so much more vulnerable to changes in their ecosystems, because they depend on a complex ecological network to exist. These points, hubs, passages, corridors and critical sites where they aggregate to feed, breed, rest and reproduce are vital to them. As has been demonstrated in this report, and overwhelmingly in peer-reviewed scientific studies, migratory species require dedicated collaboration among all the countries of the world to secure their ecological networks, as well as protection of the animals themselves against exploitation. There have been over 6,000 peer-reviewed biological research papers including the term "migratory" in just the last two decades (ISI Web of Science, November 2011), and hundreds of thousands of additional reports. Continued monitoring and additional research is very important for mitigation and conservation.

However, there already exists substantial and sufficient knowledge to decisively determine that full global compliance and collaboration are needed if these species are to survive. The dramatic declines in many populations, including whales, ungulates and birds is evidence enough of the very serious situation facing migratory species if urgent action is not taken.

To ensure their survival extensive international collaboration is required. A single country alone cannot secure the survival of a transboundary migratory species. It requires collaboration on the protection, management, harvest and law enforcement, as many of these species, which aggregate in certain sites are particularly vulnerable to overharvesting and poaching. The rapid rise in the international illegal trade in live animals, horns, tusks, bones, fur, wool and other products will also need a dedicated enforcement effort, including from INTERPOL and its member countries, as national laws in most cases are already in place. Furthermore, the continued loss of habitats, as well as the construction of barriers such as roads, or intensive traffic or shipping in their migration corridors, cannot be managed by any single country for a transboundary migratory, species. When such development projects endanger transboundary species it is a concern for the entire international community.

An alert system should be put in place to notify both parties and non-parties alike of particular emerging threats, such as when development projects or harvest practices particularly endanger major critical populations or locations. It remains the responsibility of all countries, both parties and non-parties to ensure that migratory species receive the necessary protection. This cannot be done without addressing their full ecological networks on an international basis.

RECOMMENDATIONS

1) ***Encourage* participation of non-party countries**, which host a significant proportion of the world's migratory species and over 1/3 of the global land area, to fully commit to the management of animal migrations, including joining CMS and its associated instruments, to improve coverage of major missing parts of global migration routes.

2) ***Identify* the 30 most threatened migration sites and corridors worldwide** to ensure joint protection and management of the migratory species connecting this planet. Such prioritization should be evolved through expertise mapping and consulting processes and should be seen as complimentary to a much wider mapping and conservation effort. CMS Parties and other countries must collaborate on such endeavours.

3) ***Prioritize* conservation of critical sites along flyways** by conserving and restoring habitats, with a focus on particularly threatened ones, such as the tidal flats and coastal zones of the Yellow Sea. The positive examples of protected areas along the East Atlantic flyway should be replicated elsewhere, including similar agreements and partnerships as developed through CMS.

4) ***Prioritize* protection of coastal zones, marine corridors and high seas habitats**. This includes to establish and effectively manage marine protected area networks along critical migration routes, including whales, sharks and turtles, with appropriate restrictions on construction, shipping, military exercises and fishing.

5) ***Request* independent international assessments when infrastructure development projects may disrupt migration routes of migratory species**, such as fences, roads, railways, pipe- and power-lines, dams, wind farms and shipping lanes, including their possible violation of the Convention on Migratory Species.

6) ***Strenghten* enforcement, intelligence and combating transnational wildlife crime through Interpol, CITES and World Customs Organization (WCO)**, including reducing poaching and smuggling of illegally caught animals, horns or other body parts. Decreasing and ultimately stopping illegal harvest will require a concerted international effort, along with improved national law enforcement in environmental crime, given the extent of the global trade in wildlife products.

7) ***Create* incentives to reduce unsustainable use**, including the development of alternative livelihoods and full participation of local communities in decision-making, and facilitate incomes and employment from eco-tourism and sustainable land-use.

8) ***Develop* an international alert system**, to notify concerned stakeholders when particularly sensitive areas or corridors of an animal migration are at risk, as migratory species are an international concern.

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Migrating caribou (Rangifer tarandus granti) of the Porcupine Herd in the Arctic National Wildlife Refuge are at continuous risk from pressures to open the refuge for petroleum exploration, which could interfere with their migration. The caribou migrate from their winter ranges in both Canada and further south in Alaska to the coastal plain in the refuge in Alaska and back, several thousand km every year, the longest of any migrating terrestrial mammal on the planet.

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