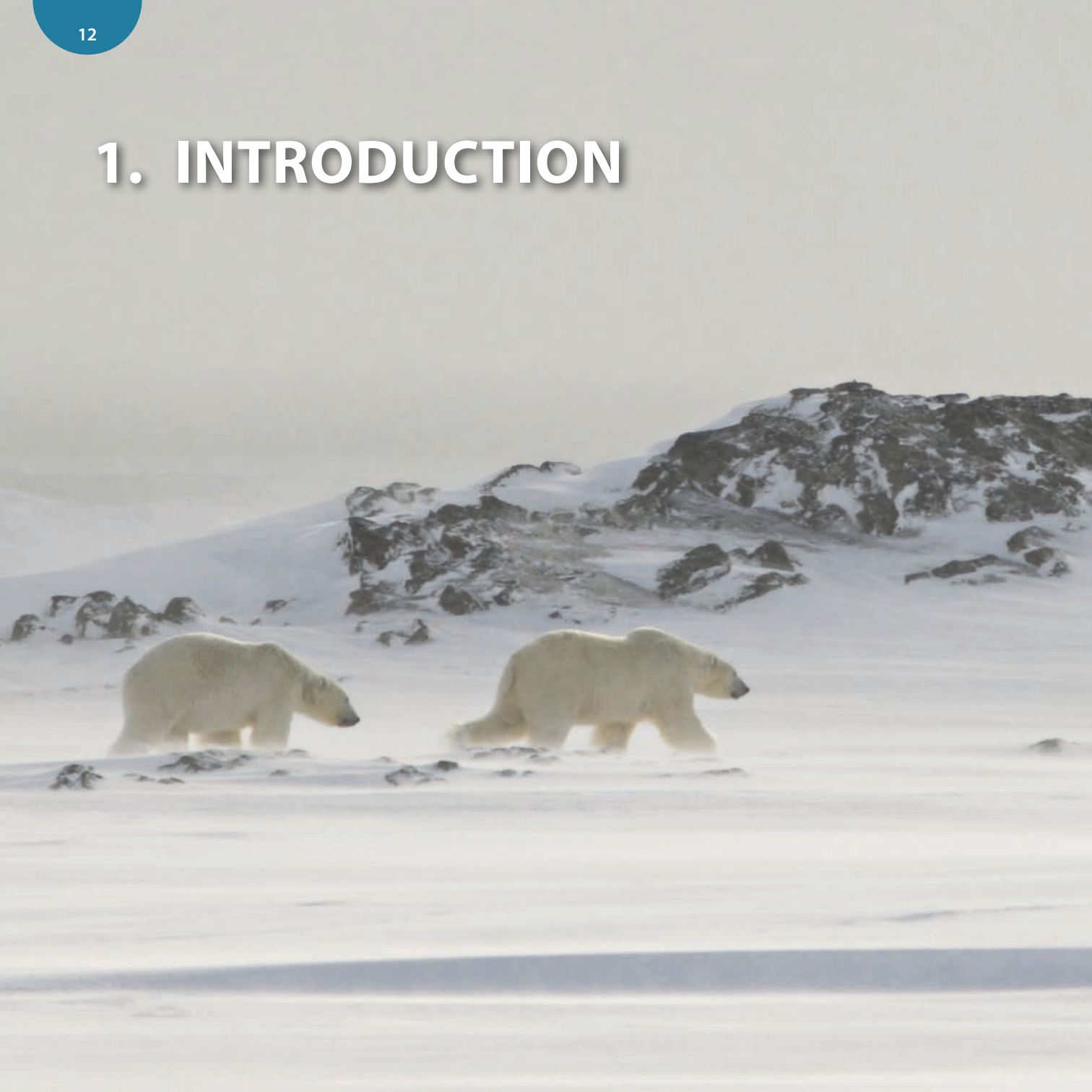
1. INTRODUCTION



The Arctic holds some of the most extreme habitats on Earth, with species and peoples that have adapted through biological and cultural evolution to its unique conditions. A homeland to some, and a harsh if not hostile environment to others, the Arctic is home to iconic animals such as polar bears *Ursus maritimus*, narwhals *Monodon monoceros*, caribou/reindeer *Rangifer tarandus*, muskoxen *Ovibos moschatus*, Arctic fox *Vulpes lagopus,* ivory gull *Pagophila eburnea* and snowy owls *Bubo scandiaca*, as well as numerous microbes and invertebrates capable of living in extreme cold, and large intact landscapes and seascapes with little or no obvious sign of direct degradation from human activity. In addition to flora and fauna, the Arctic is known for the knowledge and ingenuity of Arctic peoples, who thanks to great adaptability have thrived amid ice, snow and winter darkness.

The purpose of this Arctic Biodiversity Assessment (ABA) is to synthesize and assess the status and trends of biodiversity in the Arctic and provide a first and much-needed description of the state of biodiversity in the Arctic (see Box 1 for this assessment's definition of the Arctic). It creates a baseline for global and regional assessments of Arctic biodiversity, and is a basis for informing and guiding future Arctic Council work. It provides up-to-date knowledge, identifies data and knowledge gaps, describes key mechanisms driving change and presents science-based suggestions for action to address major pressures.

Polar bears are iconic species of the Arctic, representing the fascination for wildlife in the cold northern region shared by people living in the Arctic as well as beyond.
Photo: Wild Arctic Pictures/shutterstock.com

The ABA identifies current status together with historical trends in abundance and distribution where available, and includes projections of future change informed by scientific literature. It draws on a vast number of scientific publications, supplemented by 'eye witness' observations from indigenous peoples in the context of Traditional Ecological Knowledge (TEK). The ABA has been through comprehensive peer review to ensure the highest standard of analysis and unbiased interpretation. The results are a benchmark against which to help measure and understand the significance of future change, without which the scope and gravity of future changes will be less clearly identifiable, undermining our ability to reduce harm.

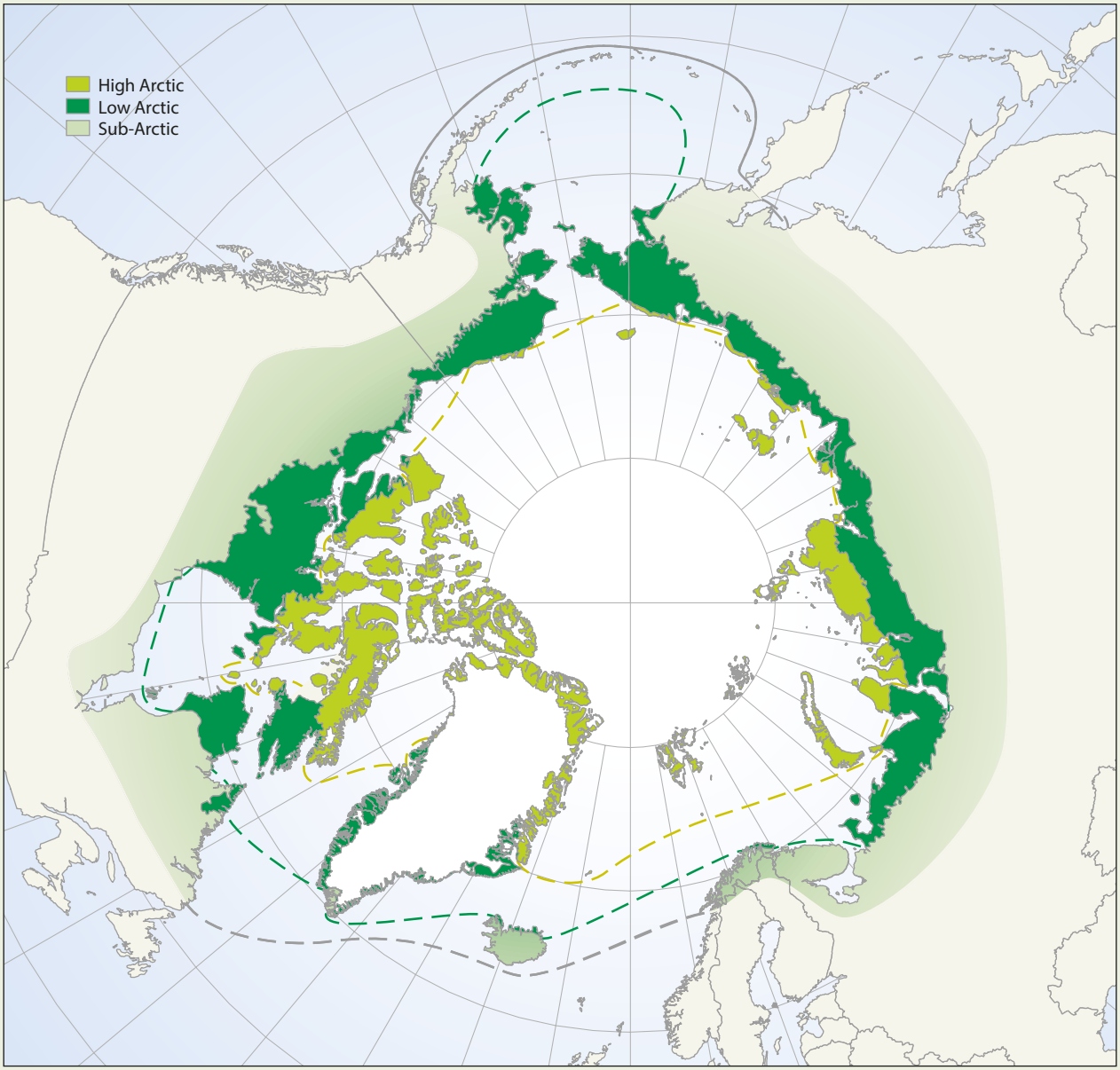
Change in the Arctic comes in many forms and from a variety of sources. Several of these stressors have been the subject of intense research and assessments documenting the effects and impacts of human activity regionally and globally, and seeking ways to conserve the biological and cultural wealth of the Arctic in the face of considerable pressures to develop its resources. These assessments have focused primarily on effects and impacts from a range of present and future stressors, such as global warming (ACIA 2005, AMAP 2009a, AMAP 2011a), oil and gas activities (AMAP 2009b), social change (AHDR 2004), marine shipping (AMSA 2009) and environmental contaminants (AMAP 1998, 2004, 2010, 2011b). The ABA, in contrast, looks not at the stressors but at the biodiversity being stressed.

Box 1. Definition of the Arctic

For this assessment a more scientific definition of the Arctic was needed than the CAFF boundaries, which are defined as much by political boundaries as by climatic and biological zoning, and therefore vary considerably among the Arctic nations. That such a clear definition is a prerequisite for a meaningful account of Arctic biodiversity can be illustrated by the highly varying numbers of 'Arctic' bird species found in the literature. By including huge tracts of boreal forest and woodland into the Arctic, as politically defined by CAFF, figures of up to "450 Arctic breeding bird species" have been quoted (Zöckler 1998, Trouwborst 2009) as compared with the c. 200 species given in the present report based on a stricter ecological definition (Ganter & Gaston, Chapter 4).

The name Arctic derives from the ancient Greek word *Arktikós*, meaning the land of the North. It relates to *Arktos*, the Great Bear, which is the star constellation close to the Pole Star. There are several definitions of the Arctic. From a geophysical point of view, the Arctic may be defined as the land and sea north of the Arctic Circle, where the sun does not set on the summer solstice and does not rise on the winter solstice. From an ecological point of view, it is more meaningful to use the name for the land north of the tree line, which generally has a mean temperature below c. 10-12 °C for the warmest month, July (Jonasson *et al.* 2000). With this definition, the Arctic land area comprises about 7.1 million km^2, or some 4.8% of the land surface of Earth (Box 1 Fig. 1).

Box 1 Figure 1. Map of the top of the northern hemisphere with the high and low Arctic zones delineated according to the Circumpolar Arctic Vegetation Map (CAVM Team 2003), together with a tentative demarcation of the sub-Arctic. Lines indicating similar marine zones are sketched.


High Arctic
Low Arctic
Sub-Arctic

(Box 1. continued)

Similarly, the Arctic waters are defined by characteristics of surface water masses, i.e. the extent of cold Arctic water bordering temperate waters including 'gateways' between the two biomes. The Arctic Ocean covers about 10 million km^2 (see Michel, Chapter 14 for details).

The open landscapes of the Arctic are often named tundra, which originates from the Saami words for barren habitats, *tūndar* or *tunturi*. In general, the low Arctic has much more lush vegetation than the high Arctic, where large lowland areas may be almost devoid of vegetation, like the Arctic deserts of the northernmost lands in the world.

The sub-Arctic or forest tundra is the northernmost part of the boreal zone, i.e. the area between the timberline and the tree line.* Hence, the sub-Arctic is not part of the Arctic, just as the sub-tropics are not part of the tropics. Like the Arctic, the word *boreal* is derived from Greek: *Boreas* was the god of the cold northern winds and bringer of winter. Related zones are found in mountainous areas outside of the Arctic as sub-alpine, low-alpine and high-alpine biomes.

This assessment follows the Circumpolar Arctic Vegetation Map's (CAVM Team 2003) definition of the Arctic, since this map builds on scientific criteria for Arctic habitats.

Furthermore, inclusion of tree-covered sub-Arctic habitats would have expanded the volume of species and ecosystems beyond achievable limits. Yet, different chapters may cover additional bordering areas as needed to provide scientific and ecological completeness. The entire Arctic tundra region (sub-zones A-E on the CAVM) is addressed as comprehensively as possible in terms of species and ecosystem processes and services.

Oceanic tundra (e.g. the Aleutian Islands), the sub-Arctic and other adjacent areas are addressed as appropriate in regard to (1) key ecosystem processes and services, (2) species of significance to the Arctic tundra region, (3) influences on the Arctic tundra region, and (4) potential for species movement into the current Arctic tundra region, e.g. due to global change.

For the separation between the high Arctic and the low Arctic, we follow the simplest division which is between sub-zones C and D on the CAVM (Box 1 Fig. 1). The southern limit of the sub-Arctic is 'loose', since work on a CAFF Circumpolar Boreal Vegetation Map is pending (CBVM 2011). Contrary to the Arctic zones on land, the boundaries at sea are tentative, and on Box 1 Fig. 1 they are indicated only with rough boundaries between the different zones.

* While the tree line is the limit of often scattered tree growth or forest tundra, the timberline is the limit of harvest of useable timber.

The ABA consists of four components: (1) *Arctic Biodiversity Trends 2010 – Selected Indicators of Change*, which provided a preliminary snapshot of status and trends of Arctic biodiversity (Box 2), (2) the Arctic Biodiversity Assessment, Status and Trends in Arctic Biodiversity, a comprehensive, peer-reviewed scientific assessment of Arctic biodiversity, and scientific synthesis, (3) *Indigenous observations of change* (under development) and (4) *Arctic Biodiversity Assessment: Summary for Policy Makers*.

A key challenge for conservation in the Arctic is to shorten the gap between data collection and policy response. The Arctic Council has recognized this challenge and in recent years, through the working group for Conservation of Flora and Fauna (CAFF), has worked towards developing a solution. This approach has focused on not just developing a classical assessment but also addressing the collection, processing and analysis of data on a continuous basis. The ABA is not just a one-time, static assessment, but rather provides a baseline of current knowledge, closely linked to the development of the Circumpolar Biodiversity Monitoring Program (CBMP) as the engine for ongoing work, including the production of regular and more flexible regional and circumpolar assessments and analyses.

Box 2.
Arctic Biodiversity Trends 2010: selected indicators of change

The *Arctic Biodiversity Trends 2010: selected indicators of change* report was the first product produced from the Arctic Biodiversity Assessment. Released in 2010, it was Arctic Council's response to the United Nations International Year of Biodiversity in 2010. At the same time it was a contribution to the Convention on Biological Diversity (CBD)'s Third Global Biodiversity Outlook to measure progress towards the CBD's target "to achieve, by 2010, a significant reduction of the current rate of biodiversity loss at the global, regional, and national levels as a contribution to poverty alleviation and to the benefit of all life on Earth."

The report presented a broad spectrum of changes in Arctic ecosystems and biodiversity and provided a snapshot of the trends being observed in Arctic biodiversity today. It highlighted the potentially significant consequences of changes taking place in the Arctic and provided evidence that some anticipated impacts on Arctic biodiversity were already occurring.

The report was based on a suite of 22 indicators developed by the Circumpolar Biodiversity Monitoring Program (CBMP) to cover major species groups with wide distributions across Arctic ecosystems. These indicators include those closely associated with biodiversity use by indigenous and local communities, as well as those with relevance to decision-makers.

Conservation action based on the findings of the ABA will not happen in a vacuum. All Arctic Council states have made commitments that, directly or indirectly, help protect biodiversity and ecosystems through a number of conventions as well as bi- and multi-lateral agreements, including the Convention on Biological Diversity (CBD), United Nations (UN) Framework Convention on Climate Change (UNFCCC), Convention to Combat Desertification (CCD), Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals; CMS), Ramsar Convention on Wetlands of International Importance, UN Educational, Scientific and Cultural Organization (UNESCO), World Heritage Convention (WHC) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Each Arctic Council country is a Party to at least one of these conventions and has, thereby, made commitments that have the effect of protecting and restoring biodiversity (Box 3).

This synthesis draws on the evidence, findings and suggested actions presented in the peer-reviewed technical chapters of the ABA. It provides an overview of their primary findings and the extensive cross-sectoral scientific literature, and presents suggestions for priority actions on conservation and research. It starts with a description of the characteristics of Arctic biodiversity, outlines the interactions between humans and Arctic wildlife through millennia, provides a brief summary of the conclusions of each chapter and then discusses challenges facing biodiversity by describing stressors from both within and outside the Arctic.

Box 3. International conventions on biodiversity issues and the Arctic

Six international conventions focus on biodiversity issues: the Convention on Biological Diversity, the Convention on Conservation of Migratory Species, the Convention on International Trade in Endangered Species of Wild Fauna and Flora, the International Treaty on Plant Genetic Resources for Food and Agriculture, the Ramsar Convention on Wetlands, and the World Heritage Convention. While each of these conventions has distinct and specific aims and commitments, they share common goals of biodiversity conservation and sustainable use.

All Arctic Council countries work through one or several of these conventions to develop and implement national and international policies for the conservation and sustainable use of biodiversity. Collectively, these conventions aim to ensure the conservation and sustainable use of migratory species, areas of natural heritage, wetlands, plant genetic resources and the protection of endangered species. These conventions are complementary to the Arctic Council's efforts to address the conservation of Arctic biodiversity and to promote practices that ensure the sustainability of the Arctic's living resources.

In relation to the United Nations Convention on Biological Diversity (CBD), a Resolution of Cooperation between CAFF and the CBD, signed in 2010, encourages the two organizations to provide and use information and opportunities to promote the importance of Arctic biodiversity. This has led to many opportunities to provide Arctic-specific information into CBD processes (CAFF 2012), and will directly contribute to the achievement of the Strategic Plan for Biodiversity 2011-2020 adopted by CBD Parties in 2010.

The Strategic Plan for Biodiversity 2011-2020 is comprised of a shared vision, a mission, strategic goals and 20 ambitious yet achievable targets, collectively known as the Aichi Targets. The mission calls for effective and urgent action to halt the loss of biodiversity in order to ensure that, by 2020, ecosystems are resilient and continue to provide essential services, thereby securing the planet's variety of life, and contributing to human well-being, including the eradication of poverty.

The 2013 Arctic Biodiversity Assessment will provide data and information on the status and trends of biological diversity in the Arctic to the Fourth Global Biodiversity Outlook and will also contribute to the achievement of the Strategic Plan for Biodiversity 2011-2020 and the Aichi Targets. The Aichi Targets of direct relevance to the findings of the Arctic Biodiversity Assessment are:

- **Target 5**
  By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.

- **Target 6**
  By 2020 all fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species, fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems and the impacts of fisheries on stocks, species and ecosystems are within safe ecological limits.

- **Target 9**
  By 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment.

- **Target 10**
  By 2015, the multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning.

- **Target 11**
  By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes.

- **Target 12**
  By 2020, the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained.

- **Target 14**
  By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable.