# **Global Biodiversity** Outlook 3

Convention on Biological Diversity

2010 International Year of Biodiversity

# Table of Contents

Citation:
Secretariat of the Convention on Biological Diversity (2010) *Global Biodiversity Outlook 3*. Montréal, 94 pages.

For further information, please contact:
Secretariat of the Convention on Biological Diversity
World Trade Centre
413 St. Jacques Street, Suite 800
Montreal, Quebec, Canada H2Y 1N9
Phone: 1(514) 288 2220
Fax: 1 (514) 288 6588
E-mail: secretariat@cbd.int
Website: http://www.cbd.int

Layout and design: Phoenix Design Aid A/S, ISO 9001/ ISO 14001certified and approved $CO^2$ neutral company. www.phoenixdesignaid.com.
Graphics: In-folio
Printed by Progress Press Ltd., Malta, a FSC certified company. Printed on chlorine-free paper made of pulp from sustainably managed forests and using vegetable-based inks and water-based coatings.

# Foreword

# *Foreword by the United Nations Secretary-General*

In 2002, the world's leaders agreed to achieve a significant reduction in the rate of biodiversity loss by 2010. Having reviewed all available evidence, including national reports submitted by Parties, this third edition of the *Global Biodiversity Outlook* concludes that the target has not been met. Moreover, the *Outlook* warns, the principal pressures leading to biodiversity loss are not just constant but are, in some cases, intensifying.

The consequences of this collective failure, if it is not quickly corrected, will be severe for us all. Biodiversity underpins the functioning of the ecosystems on which we depend for food and fresh water, health and recreation, and protection from natural disasters. Its loss also affects us culturally and spiritually. This may be more difficult to quantify, but is nonetheless integral to our well-being.

Current trends are bringing us closer to a number of potential tipping points that would catastrophically reduce the capacity of ecosystems to provide these essential services. The poor, who tend to be most immediately dependent on them, would suffer first and most severely. At stake are the principal objectives outlined in the Millennium Development Goals: food security, poverty eradication and a healthier population.

The conservation of biodiversity makes a critical contribution to moderating the scale of climate change and reducing its negative impacts by making ecosystems -- and therefore human societies -- more resilient. It is therefore essential that the challenges related to biodiversity and climate change are tackled in a coordinated manner and given equal priority.

In several important areas, national and international action to support biodiversity is moving in a positive direction. More land and sea areas are being protected, more countries are fighting the serious threat of invasive alien species, and more money is being set aside for implementing the Convention on Biological Diversity.

However, these efforts are too often undermined by conflicting policies. To tackle the root causes of biodiversity loss, we must give it higher priority in all areas of decision-making and in all economic sectors. As this third *Global Biodiversity Outlook* makes clear, conserving biodiversity cannot be an afterthought once other objectives are addressed – it is the foundation on which many of these objectives are built. We need a new vision for biological diversity for a healthy planet and a sustainable future for humankind.

*BAN Ki-moon*
*Secretary-General*
*United Nations*

# *Message from the Executive Director of UNEP*

A new and more intelligent compact between humanity and the Earth's life-support systems is urgently needed in 2010—the UN's International Year of Biodiversity. This was the year when governments had agreed to substantially reduce the rate of biodiversity loss: this has not happened. Instead of reflecting, governments, business and society as a whole need to urgently renew and recommit to this enterprise if sustainability is to be realized in the 21st century.

The Global Biodiversity Outlook-3 contains the sobering facts and figures while pin pointing several key reasons as to why the challenge of conserving and indeed enhancing biodiversity remains unmet. One key area is economics: many economies remain blind to the huge value of the diversity of animals, plants and other life-forms and their role in healthy and functioning ecosystems from forests and freshwaters to soils, oceans and even the atmosphere.

The Economics of Ecosystems and Biodiversity, hosted by UNEP, is a major exercise aimed at bridging understanding and driving action in this area.
It will complement the GBO-3 in advance of the Convention on Biological Diversity meeting in Nagoya later in the year. Already some compelling and catalyzing facts are emerging.

✤ Annual losses as a result of deforestation and forest degradation alone may equate to losses of US$2 trillion to over US$4.5 trillion alone. These could be secured by an annual investment of just US$45 billion: a 100 to 1 return.

Many countries are beginning to factor natural capital into some areas of economic and social life with important returns, but this needs rapid and sustained scaling-up.

✤ In Venezuela, investment in the national protected area system is preventing sedimentation that otherwise could reduce farm earnings by around US$3.5 million a year.

✤ Planting and protecting nearly 12,000 hectares of mangroves in Vietnam costs just over US$1 million but saved annual expenditures on dyke maintenance of well over US$7 million.

Mainstreaming the economics of biodiversity and the multi-trillion dollar services of the ecosystems which it supports into development, decision-making can make 2010 a success.

Other 'litmus tests' include bridging the gap between science and policy-makers by perhaps the establishment of an Intergovernmental Panel on Biodiversity and Ecosystem Services. Public awareness will also be key: de-mystifying terms such as biodiversity and ecosystems is one challenge. The other is to make the link between biodiversity and livelihoods and the important role of biodiversity and natural systems in meeting other sustainability challenges such as climate change, water scarcity and agriculture.

Governments also need to rise to the challenge of Alien Invasive Species. By some estimates, they may be costing the global economy US$1.4 trillion or more. In sub-Saharan Africa, the invasive witchweed is responsible for annual maize losses amounting to US$7 billion: overall losses to aliens may amount to over US$12 billion in respect to Africa's eight principal crops.

Last but not least, a successful conclusion to negotiations on an international regime on access and benefit sharing of genetic resources is needed. This is the missing pillar of the CBD and perhaps its financial mechanism: a successful conclusion would indeed make 2010 a year to applaud.

The arrogance of humanity is that somehow we imagine we can get by without biodiversity or that it is somehow peripheral: the truth is we need it more than ever on a planet of six billion heading to over nine billion people by 2050.

*Achim Steiner*
*United Nations Under-Secretary General and Executive Director, United Nations Environment Programme*

# *Preface by the Executive Secretary of the CBD*

The third edition of *Global Biodiversity Outlook* (GBO-3) comes at a critical period in the history of the Convention on Biological Diversity. It coincides with the deadline agreed in Johannesburg by world leaders to substantially reduce the rate of biodiversity loss by 2010 as a contribution to poverty alleviation and to the benefit of all life on Earth. To this end the United Nations has designated 2010 as the International Year of Biodiversity. For the first time in its history, the United Nations General Assembly, during its 65th session, will convene a high level meeting on biodiversity with the participation of Heads of State and Government. Further during the tenth meeting of the Conference of Parties to the Convention, to be held in Nagoya, Aichi Prefecture, Japan, Parties will develop a new strategic plan for the coming decades including a 2050 vision and 2020 mission for biodiversity as well as means for implementation and mechanism to monitor and evaluate our progress towards our shared global objectives.

More than fifteen years after the Convention came into force, and when the international community is actively preparing for the Rio+20 summit, this is a time of reckoning for decision-makers committed to the global effort to safeguard the variety life on Earth and its contribution to human well-being. GBO-3 is a vital tool to inform decision-makers and the wider public, about the state of biodiversity in 2010, the implications of current trends, and our options for the future.

Drawing extensively from the approximately 120 national reports submitted by Parties to the Convention, GBO-3 makes it clear that we have much work to do over the months and years to come. No country has reported that it will completely meet the 2010 target, and a few Parties have unequivocally stated they will not meet it. Moreover, most Parties have reported that at least one, but in most cases several species and habitats within their national territories, were in a state of decline.

Most Parties have confirmed that five main pressures continue to affect biodiversity within their borders: habitat loss, the unsustainable use and overexploitation of resources, climate change, invasive alien species, and pollution. Many positive steps have been taken by the Parties to help address these issues. These include the development of new biodiversity-related legislation; the establishment of mechanisms for environmental impact assessment; participation in transboundary management or cooperation initiatives; and fostering community involvement in the management of biological resources.

At the same time, the fourth national reports give us a clear picture of the obstacles that need to be overcome to better implement the objectives of the Convention. These include limited capacity in both developed and developing nations, including financial, human and technical issues; the absence of, or difficulties in, accessing scientific information; limited awareness of biodiversity issues amongst the general public and decision makers; limited biodiversity mainstreaming; fragmented decision making and limited communication between different ministries or sectors; and the absence of economic valuation of biodiversity.

As this Outlook makes clear, it is essential that these obstacles are removed if we are to make progress in tackling biodiversity loss. It is increasingly urgent that we make such progress, as the consequences of current trends have implications that jeopardize many of the objectives shared by the wider UN family to change the world for the better. We have an opportunity, equipped with the knowledge and analysis contained in this document and its underlying sources, to move biodiversity into the mainstream of decision-making. Let us, individually and collectively, seize this opportunity, for the sake of current and future generations as indeed biodiversity is life, biodiversity is our life.

*Ahmed Djoghlaf*
*Assistant Secretary-General*
*and Executive Secretary*
*Convention on Biological Diversity*

# **Executive** Summary

The Bali Starling (*Leucopsar rothschildi*) is a critically endangered species endemic to the island of Bali, Indonesia. It suffered a drastic decline in population and range during the 20th century, due mainly to illegal poaching. In 1990 only around 15 birds were thought to survive in the wild. Conservation efforts coupled with the release of some captive-bred birds brought the estimated population to more than 100 individuals by 2008, but numbers continue to fluctuate from year to year.

***The target agreed by the world's Governments in 2002, "to achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on Earth", has not been met.***

There are multiple indications of continuing decline in biodiversity in all three of its main components — genes, species and ecosystems — including:

- ✤ Species which have been assessed for extinction risk are on average moving closer to extinction. Amphibians face the greatest risk and coral species are deteriorating most rapidly in status. Nearly a quarter of plant species are estimated to be threatened with extinction.

- ✤ The abundance of vertebrate species, based on assessed populations, fell by nearly a third on average between 1970 and 2006, and continues to fall globally, with especially severe declines in the tropics and among freshwater species.

- ✤ Natural habitats in most parts of the world continue to decline in extent and integrity, although there has been significant progress in slowing the rate of loss for tropical forests and mangroves, in some regions. Freshwater wetlands, sea ice habitats, salt marshes, coral reefs, seagrass beds and shellfish reefs are all showing serious declines.

- ✤ Extensive fragmentation and degradation of forests, rivers and other ecosystems have also led to loss of biodiversity and ecosystem services.

- ✤ Crop and livestock genetic diversity continues to decline in agricultural systems.

- ✤ The five principal pressures directly driving biodiversity loss (habitat change, overexploitation, pollution, invasive alien species and climate change) are either constant or increasing in intensity.

- ✤ The ecological footprint of humanity exceeds the biological capacity of the Earth by a wider margin than at the time the 2010 target was agreed.

**The loss of biodiversity is an issue of profound concern for its own sake. Biodiversity also underpins the functioning of ecosystems which provide a wide range of services to human societies. Its continued loss, therefore, has major implications for current and future human well-being.** The provision of food, fibre, medicines and fresh water, pollination of crops, filtration of pollutants, and protection from natural disasters are among those ecosystem services potentially threatened by declines and changes in biodiversity. Cultural services such as spiritual and religious values, opportunities for knowledge and education, as well as recreational and aesthetic values, are also declining.

**The existence of the 2010 biodiversity target has helped to stimulate important action to safeguard biodiversity,** such as creating more protected areas (both on land and in coastal waters), the conservation of particular species, and initiatives to tackle some of the direct causes of ecosystem damage, such as pollution and alien species invasions. Some 170 countries now have national biodiversity strategies and action plans. At the international level, financial resources have been mobilized and progress has been made in developing mechanisms for research, monitoring and scientific assessment of biodiversity.

**Many actions in support of biodiversity have had significant and measurable results in particular areas and amongst targeted species and ecosystems. This suggests that with adequate resources and political will, the tools exist for loss of biodiversity to be reduced at wider scales.** For example, recent government policies to curb deforestation have been followed by declining rates of forest loss in some tropical countries. Measures to control alien invasive species have helped a number of species to move to a lower extinction risk category. It has been estimated that at least 31 bird species (out of 9,800) would have become extinct in the past century, in the absence of conservation measures.

**However, action to implement the Convention on Biological Diversity has not been taken on a sufficient scale to address the pressures on biodiversity in most places. There has been insufficient integration of biodiversity issues into broader policies, strategies and programmes, and the underlying drivers of biodiversity loss have not been addressed significantly.** Actions to promote the conservation and sustainable use of biodiversity receive a tiny fraction of funding compared to activities aimed at promoting infrastructure and industrial developments. Moreover, biodiversity considerations are often ignored when such developments are designed, and opportunities to plan in ways that minimize unnecessary negative impacts on biodiversity are missed. Actions to address the underlying drivers of biodiversity loss, including demographic, economic, technological, socio-political and cultural pressures, in meaningful ways, have also been limited.

**Most future scenarios project continuing high levels of extinctions and loss of habitats throughout this century, with associated decline of some ecosystem services important to human well-being.**

For example:

✤ Tropical forests would continue to be cleared in favour of crops and pastures, and potentially for biofuel production.

✤ Climate change, the introduction of invasive alien species, pollution and dam construction would put further pressure on freshwater biodiversity and the services it underpins.

✤ Overfishing would continue to damage marine ecosystems and cause the collapse of fish populations, leading to the failure of fisheries.

**Changes in the abundance and distribution of species may have serious consequences for human societies. The geographical distribution of species and vegetation types is projected to shift radically due to climate change, with ranges moving from hundreds to thousands of kilometres towards the poles by the end of the 21st century.** Migration of marine species to cooler waters could make tropical oceans less diverse, while both boreal and temperate forests face widespread dieback at the southern end of their existing ranges, with impacts on fisheries, wood harvests, recreation opportunities and other services.

**There is a high risk of dramatic biodiversity loss and accompanying degradation of a broad range of ecosystem services if ecosystems are pushed beyond certain thresholds or tipping points. The poor would face the earliest and most severe impacts of such changes, but ultimately all societies and communities would suffer.**

Examples include:

✤ The Amazon forest, due to the interaction of deforestation, fire and climate change, could undergo a widespread dieback, with parts of the forest moving into a self-perpetuating cycle of more frequent fires and intense droughts leading to a shift to savanna-like vegetation. While there are large uncertainties associated with these scenarios, it is known that such dieback becomes much more likely to occur if deforestation exceeds 20 – 30% (it is currently above 17% in the Brazilian Amazon). It would lead to regional rainfall reductions, compromising agricultural production. There would also be global impacts through increased carbon emissions, and massive loss of biodiversity.

✤ The build-up of phosphates and nitrates from agricultural fertilizers and sewage effluent can shift freshwater lakes and other inland water ecosystems into a long-term, algae-dominated (eutrophic) state. This could lead to declining fish availability with implications for food security in many developing countries. There will also be loss of recreation opportunities and tourism income, and in some cases health risks for people and livestock from toxic algal blooms. Similar, nitrogen–in-

duced eutrophication phenomena in coastal environments lead to more oxygen-starved dead zones, with major economic losses resulting from reduced productivity of fisheries and decreased tourism revenues.

- The combined impacts of ocean acidification, warmer sea temperatures and other human-induced stresses make tropical coral reef ecosystems vulnerable to collapse. More acidic water — brought about by higher carbon dioxide concentrations in the atmosphere — decreases the availability of the carbonate ions required to build coral skeletons. Together with the bleaching impact of warmer water, elevated nutrient levels from pollution, overfishing, sediment deposition arising from inland deforestation, and other pressures, reefs worldwide increasingly become algae-dominated with catastrophic loss of biodiversity and ecosystem functioning, threatening the livelihoods and food security of hundreds of millions of people.

**There are greater opportunities than previously recognized to address the biodiversity crisis while contributing to other social objectives.** For example, analyses conducted for this Outlook identified scenarios in which climate change is mitigated while maintaining and even expanding the current extent of forests and other natural ecosystems (avoiding additional habitat loss from the widespread deployment of biofuels). Other opportunities include "rewilding" abandoned farmland in some regions, and the restoration of river basins and other wetland ecosystems to enhance water supply, flood control and the removal of pollutants.

**Well-targeted policies focusing on critical areas, species and ecosystem services are essential to avoid the most dangerous impacts on people and societies. Preventing further human-induced biodiversity loss for the near-term future will be extremely challenging, but biodiversity loss may be halted and in some aspects reversed in the longer term, if urgent, concerted and effective action is initiated now in support of an agreed long-term vision.** Such action to conserve biodiversity and use its components sustainably will reap rich rewards - through better health, greater food security, less poverty and a greater capacity to cope with, and adapt to, environmental change.

**Placing greater priority on biodiversity is central to the success of development and poverty-alleviation measures.** It is clear that continuing with "business as usual" will jeopardize the future of all human societies, and none more so than the poorest who depend directly on biodiversity for a particularly high proportion of their basic needs. The loss of biodiversity is frequently linked to the loss of cultural diversity, and has an especially high negative impact on indigenous communities.

**The linked challenges of biodiversity loss and climate change must be addressed by policy-makers with equal priority and in close co-ordination, if the most severe impacts of each are to be avoided.** Reducing the further loss of carbon-storing ecosystems such as tropical forests, salt marshes and peatlands will be a crucial step in limiting the build-up of greenhouse gases in the atmosphere. At the same time, reducing other pressures on ecosystems can increase their resilience, make them less vulnerable to those impacts of climate change which are already unavoidable, and allow them to continue to provide services to support people's livelihoods and help them adapt to climate change.

**Better protection of biodiversity should be seen as a prudent and cost-effective investment in risk-avoidance for the global community.** The consequences of abrupt ecosystem changes on a large scale affect human security to such an extent, that it is rational to minimize the risk of triggering them - even if we are not clear about the precise probability that they will occur. Ecosystem degradation, and the consequent loss of ecosystem services, has been identified as one of the main sources of disaster risk. Investment in resilient and diverse ecosystems, able to withstand the multiple pressures they are subjected to, may be the best-value insurance policy yet devised.

**Scientific uncertainty surrounding the precise connections between biodiversity and human well-being, and the functioning of ecosystems, should not be used as an excuse for inaction.** No one can predict with accuracy how close we are to ecosystem tipping points, and how much additional pressure might bring them about. What is known from past examples, however, is that once an ecosystem shifts to another state, it can be difficult or impossible to return it to the former conditions on which economies and patterns of settlement have been built for generations.

**Effective action to address biodiversity loss depends on addressing the underlying causes or indirect drivers of that decline.**

This will mean:

- ✤ Much greater efficiency in the use of land, energy, fresh water and materials to meet growing demand.
- ✤ Use of market incentives, and avoidance of perverse subsidies to minimize unsustainable resource use and wasteful consumption.
- ✤ Strategic planning in the use of land, inland waters and marine resources to reconcile development with conservation of biodiversity and the maintenance of multiple ecosystem services. While some actions may entail moderate costs or tradeoffs, the gains for biodiversity can be large in comparison.
- ✤ Ensuring that the benefits arising from use of and access to genetic resources and associated traditional knowledge, for example through the development of drugs and cosmetics, are equitably shared with the countries and cultures from which they are obtained.
- ✤ Communication, education and awareness-raising to ensure that as far as possible, everyone understands the value of biodiversity and what steps they can take to protect it, including through changes in personal consumption and behaviour.

**The real benefits of biodiversity, and the costs of its loss, need to be reflected within economic systems and markets.** Perverse subsidies and the lack of economic value attached to the huge benefits provided by ecosystems have contributed to the loss of biodiversity. Through regulation and other measures, markets can and must be harnessed to create incentives to safeguard and strengthen, rather than to deplete, our natural infrastructure. The re-structuring of economies and financial systems following the global recession provides an opportunity for such changes to be made. Early action will be both more effective and less costly than inaction or delayed action.

**Urgent action is needed to reduce the direct drivers of biodiversity loss.** The application of best practices in agriculture, sustainable forest management and sustainable fisheries should become standard practice, and approaches aimed at optimizing multiple ecosystem services instead of maximizing a single one should be promoted. In many cases, multiple drivers are combining to cause biodiversity loss and degradation of ecosystems. Sometimes, it may be more effective to concentrate urgent action on reducing those drivers most responsive to policy changes. This will reduce the pressures on biodiversity and protect its value for human societies in the short to medium-term, while the more intractable drivers are addressed over a longer time-scale. For example the resilience of coral reefs – and their ability to withstand and adapt to coral bleaching and ocean acidification – can be enhanced by reducing overfishing, land-based pollution and physical damage.

**Direct action to conserve biodiversity must be continued, targeting vulnerable as well as culturally-valued species and ecosystems, combined with steps to safeguard key ecosystem services, particularly those of importance to the poor.** Activities could focus on the conservation of species threatened with extinction,

those harvested for commercial purposes, or species of cultural significance. They should also ensure the protection of functional ecological groups – that is, groups of species that collectively perform particular, essential roles within ecosystems, such as pollination, control of herbivore numbers by top predators, cycling of nutrients and soil formation.

**Increasingly, restoration of terrestrial, inland water and marine ecosystems will be needed to re-establish ecosystem functioning and the provision of valuable services.** Economic analysis shows that ecosystem restoration can give good economic rates of return. However the biodiversity and associated services of restored ecosystems usually remain below the levels of natural ecosystems. This reinforces the argument that, where possible, avoiding degradation through conservation is preferable (and even more cost-effective) than restoration after the event.

**Better decisions for biodiversity must be made at all levels and in all sectors, in particular the major economic sectors, and government has a key enabling role to play.** National programmes or legislation can be crucial in creating a favourable environment to support effective "bottom-up" initiatives led by communities, local authorities, or businesses. This also includes empowering indigenous peoples and local communities to take responsibility for biodiversity management and decision-making; and developing systems to ensure that the benefits arising from access to genetic resources are equitably shared.

**We can no longer see the continued loss of and changes to biodiversity as an issue separate from the core concerns of society:** to tackle poverty, to improve the health, prosperity and security of our populations, and to deal with climate change. Each of those objectives is undermined by current trends in the state of our ecosystems, and each will be greatly strengthened if we correctly value the role of biodiversity in supporting the shared priorities of the international community. Achieving this will involve placing biodiversity in the mainstream of decision-making in government, the private sector, and other institutions from the local to international scales.

**The action taken over the next decade or two, and the direction charted under the Convention on Biological Diversity, will determine whether the relatively stable environmental conditions on which human civilization has depended for the past 10,000 years will continue beyond this century. If we fail to use this opportunity, many ecosystems on the planet will move into new, unprecedented states in which the capacity to provide for the needs of present and future generations is highly uncertain.**

# Introduction

*This Outlook presents some stark choices for human societies. On one hand it warns that the diversity of living things on the planet continues to be eroded as a result of human activities. The pressures driving the loss of biodiversity show few signs of easing, and in some cases are escalating. The consequences of current trends are much worse than previously thought, and place in doubt the continued provision of vital ecosystem services. The poor stand to suffer disproportionately from potentially catastrophic changes to ecosystems in coming decades, but ultimately all societies stand to lose.*

On the other hand, the Outlook offers a message of hope. The options for addressing the crisis are wider than was apparent in earlier studies. Determined action to conserve biodiversity and use it sustainably will reap rich rewards. It will benefit people in many ways - through better health, greater food security and less poverty. It will safeguard the variety of nature, an objective justified in its own right according to a range of belief systems and moral codes. It will help to slow climate change by enabling ecosystems to absorb and store more carbon; and it will help people adapt to climate change by adding resilience to ecosystems and making them less vulnerable.

Taking actions to ensure the maintenance and restoration of well-functioning ecosystems, underpinned by biodiversity and providing natural infrastructure for human societies, can provide economic gains worth trillions of dollars a year. The latest science suggests ever more strongly that better management, conservation and sustainable use of biodiversity is a prudent and cost-effective investment in social and economic security, and in risk reduction for the global community.

This Outlook shows that efforts to date have not been sufficient to reduce significantly the rate of biodiversity loss and analyses why; it assesses the potential for long-lasting or irreversible ecosystem changes to result from current trends and practices; and it concludes that concerted and targeted responses, with action applied at appropriate levels to address both direct pressures on biodiversity and their underlying causes, can in the long term stop or even reverse the continued decline in the variety of life on Earth.

***The action taken over the next two decades will determine whether the relatively stable environmental conditions on which human civilization has depended for the past 10,000 years will continue beyond this century. If we fail to use this opportunity, many ecosystems on the planet will move into new, unprecedented states in which the capacity to provide for the needs of present and future generations is highly uncertain.***

## BOX 1 Biodiversity, the CBD and the 2010 target

The word biodiversity, a contraction of the synonymous phrase 'biological diversity', is defined by the Convention on Biological Diversity (CBD) as 'the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems'. This is the definition used throughout this document.

The CBD is one of the three "Rio Conventions", emerging from the UN Conference on Environment and Development, also known as the Earth Summit, held in Rio de Janeiro in 1992. It came into force at the end of 1993, with the following objectives:

"The conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding."

There are currently 193 Parties to the Convention (192 countries and the European Union). In April 2002, the Parties to the Convention committed themselves to achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on Earth. This target was subsequently endorsed by the World Summit on Sustainable Development (the "Rio + 10" summit) in Johannesburg, 2002, and by the United Nations General Assembly. It was also incorporated as a new target under one of the Millennium Development Goals – Ensure Environmental Sustainability. The 2010 biodiversity target is therefore a commitment from all governments, including those not party to the CBD.

# Biodiversity in 2010

# Overview

***The 2010 biodiversity target has not been met at the global level. None of the twenty-one sub-targets accompanying the overall target of significantly reducing the rate of biodiversity loss by 2010 can be said definitively to have been achieved globally, although some have been partially or locally achieved. Despite an increase in conservation efforts, the state of biodiversity continues to decline, according to most indicators, largely because the pressures on biodiversity continue to increase. There is no indication of a significant reduction in the rate of decline in biodiversity, nor of a significant reduction in pressures upon it. However, negative trends have been slowed or reversed in some ecosystems. There are several indications that responses to biodiversity loss are increasing and improving, although not yet on a scale sufficient to affect overall negative trends in the state of biodiversity or the pressures upon it.***

When governments agreed to the 2010 target for significantly reducing the rate of biodiversity loss **[See Box 1]**, a number of tools were put in place within the Convention on Biological Diversity and other conventions to help focus action towards achieving the target, to monitor progress towards it, and eventually to determine whether it had in fact been achieved. Twenty-one sub-targets were defined, to be reached by 2010 towards eleven principal goals related to biodiversity.

While none of the sub-targets can be said definitively to have been met, some have been achieved partially or at regional or national scales **[See Table 1]**. In fact, the 2010 biodiversity target has inspired action at many levels. Some 170 countries now have national biodiversity strategies and action plans **[See Box 2 and Figure 1]**. Protected areas have been expanded in number and extent, on both land and in coastal waters. Environmental impact assessment is more widely applied with most countries reporting that they have some measures in place for its use.

Most countries are also undertaking activities related to communication, education and public awareness as well biodiversity monitoring, research and the development of databases. At the international level, financial resources have been mobilized and progress has been made in developing mechanisms for research, monitoring and scientific assessment of biodiversity.

The Torngat Mountains National Park of Canada, which is co-managed with the Labrador and Nunavik Inuit, is the 42nd national park to be established in the country. The park is located at the northern tip of Labrador and covers approximately 9,700 square kilometres of arctic ecosystems.

**TABLE 1** Status of agreed subsidiary targets to 2010 biodiversity target

| Goal | Target | Status |
|---|---|---|
| **Goal 1. Promote the conservation of the biological diversity of ecosystems, habitats and biomes** | | |
| | **1.1: At least 10% of each of the world's ecological regions effectively conserved.** | Not achieved globally, but more than half of terrestrial eco-regions meet the 10% target. However, management effectiveness is low for some protected areas. Marine and inland water systems lack protection, though this is increasing. |
| | **1.2: Areas of particular importance to biodiversity protected.** | Not achieved globally, but an increasing proportion of the sites of importance for conserving birds, and those holding the last remaining populations of threatened species, are being protected. |
| **Goal 2. Promote the conservation of species diversity** | | |
| | **2.1: Restore, maintain, or reduce the decline of populations of species of selected taxonomic groups.** | Not achieved globally as many species continue to decline in abundance and distribution. However, some efforts have resulted in the recovery of targeted species. |
| | **2.2: Status of threatened species improved.** | Not achieved globally, as species are on average at increasing risk of extinction. However some species have moved to lower risk categories as a result of actions taken. |
| **Goal 3. Promote the conservation of genetic diversity** | | |
| | **3.1: Genetic diversity of crops, livestock, and of harvested species of trees, fish and wildlife and other valuable species conserved, and associated indigenous and local knowledge maintained.** | Not achieved globally. Information on genetic diversity is fragmentary. Progress has been made towards conserving genetic diversity of crops through ex situ actions, however agricultural systems continue to be simplified. While the genetic diversity of wild species is more difficult to ascertain, the overall decline of biodiversity presented in this report strongly suggests that genetic diversity is not being maintained. Genetic resources in situ and traditional knowledge are protected through some projects, but continue to decline overall. |
| **Goal 4. Promote sustainable use and consumption** | | |
| | **4.1: Biodiversity-based products derived from sources that are sustainably managed, and production areas managed consistent with the conservation of biodiversity.** | Not achieved globally but progress for some components of biodiversity such as forests and some fisheries. Globally sustainable use does not account for a large share of total products and production areas. |
| | **4.2: Unsustainable consumption, of biological resources, or that impacts upon biodiversity, reduced.** | Not achieved globally. Unsustainable consumption has increased and continues to be a major cause of biodiversity loss. |
| | **4.3: No species of wild flora or fauna endangered by international trade.** | Not achieved globally. Wild flora and fauna continue to decline as a result of international trade, but successes achieved particularly through implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). |
| **Goal 5. Pressures from habitat loss, land use change and degradation, and unsustainable water use, reduced** | | |
| | **5.1: Rate of loss and degradation of natural habitats decreased.** | Not achieved globally as many biodiversity-sensitive regions continue to decline, but some progress in reducing the rate of loss in some areas. |
| **Goal 6. Control threats from invasive alien species** | | |
| | **6.1: Pathways for major potential alien invasive species controlled.** | Not achieved globally as the introduction of invasive alien species continues to increase as a result of greater transport, trade, and tourism. However, national action related to global agreements on plant protection and ballast water promises to reduce the risk of new invasions in some countries and ecosystems. |
| | **6.2: Management plans in place for major alien species that threaten ecosystems, habitats or species.** | Not achieved globally, though some management plans are in place. Most countries lack effective management programmes. |

**Goal 7. Address challenges to biodiversity from climate change, and pollution**

| Target | Status |
|---|---|
| **7.1: Maintain and enhance resilience of the components of biodiversity to adapt to climate change.** | Not achieved globally, as limited action has been taken to reduce other pressures and thus enhance the resilience of biodiversity in the face of climate change. However, the establishment of biodiversity corridors in some regions may help species to migrate and adapt to new climatic conditions. |
| **7.2: Reduce pollution and its impacts on biodiversity.** | Not achieved globally but mixed results. Measures to reduce the impacts of pollution on biodiversity have been taken, resulting in the recovery of some previously heavily degraded ecosystems. However, many previously pristine areas are being degraded. Nitrogen deposition continues to be major threat to biodiversity in many regions. |

**Goal 8. Maintain capacity of ecosystems to deliver goods and services and support livelihoods**

| Target | Status |
|---|---|
| **8.1: Capacity of ecosystems to deliver goods and services maintained.** | Not achieved globally, given the continuing and in some cases escalating pressures on ecosystems. However, there have been some actions taken, to ensure the continued provision of ecosystem services. |
| **8.2: Biological resources that support sustainable livelihoods, local food security and health care, especially of poor people.** | Not achieved globally, as many of the biological resources which sustain livelihoods, such as fish mammals, birds, amphibians and medicinal plants, are in decline, with the world's poor being particularly affected. |

**Goal 9. Maintain socio-cultural diversity of indigenous and local communities**

| Target | Status |
|---|---|
| **9.1: Protect traditional knowledge, innovations and practices.** | Not achieved globally, as long-term declines in traditional knowledge and rights continue, despite the actions taken to protect them in some areas. |
| **9.2: Protect the rights of indigenous and local communities over their traditional knowledge, innovations and practices, including their rights to benefit sharing.** | Not achieved globally but an increasing number of co-management systems and community-based protected areas have been established, with the greater protection of the rights of indigenous and local communities. |

**Goal 10. Ensure the fair and equitable sharing of benefits arising out of the use of genetic resources**

| Target | Status |
|---|---|
| **10.1: All transfers of genetic resources are in line with the Convention on Biological Diversity, the International Treaty on Plant Genetic Resources for Food and Agriculture and other applicable agreements.** | Not achieved globally but increasing number of material transfer agreements have been developed under the Treaty. |
| **10.2: Benefits arising from the commercial and other utilization of genetic resources shared with the countries providing such resources.** | Not achieved globally. There are few examples of the benefit arising from the commercial and other utilization of genetic resources being shared with the countries providing such resources. This can be partially attributed to the fact that the Access and Benefit Sharing Regime was being developed from 2002, when the biodiversity target was adopted, until 2010, the deadline set by the CBD for final agreement on this issue. |

**Goal 11. Parties have improved financial, human, scientific, technical and technological capacity to implement the Convention**

| Target | Status |
|---|---|
| **11.1: New and additional financial resources are transferred to developing country Parties, to allow for the effective implementation of their commitments under the Convention, in accordance with Article 20.** | Not achieved globally. While resources continue to be lacking there have been modest increases in official development assistance related to biodiversity. |
| **11.2: Technology is transferred to developing country Parties, to allow for the effective implementation of their commitments under the Convention, in accordance with its Article 20, paragraph 4.** | Not achieved globally. From country reports it is clear that some developing countries have mechanisms and programmes in place for technology transfer. However, it is also clear that the limited access to technology is an obstacle to implementation of the Convention and reaching the 2010 biodiversity target in many developing countries. |

Not achieved globally

Not achieved globally but some progress

Not achieved globally but significant progress

## **BOX 2** National action on biodiversity

Over 170 countries (87% of the Parties to the Convention) have developed national biodiversity strategies and action plans (NBSAPs). A further 14 Parties are preparing them, and 9 have either not started to draw up a strategy or had not announced their intention to do so by the time this Outlook went to press.

An overwhelming majority of governments, in other words, have been through the process of codifying their approach to protecting the biodiversity within their own territory. In many countries, the preparation of strategies has stimulated the development of additional laws and programmes, and spurred action on a broad range of issues, including: the eradication or control of alien invasive species; using biodiversity sustainably; the protection of traditional knowledge and rules to ensure local communities share benefits from bio-prospecting which might result in patents or sales of new drugs, foods or cosmetics; the safe use of biotechnology; and maintaining the diversity of plants and animals used in agriculture.

Relatively few Parties have fully integrated the 2010 biodiversity target into their national strategies. Moreover, few countries are using NBSAPs as effective tools for integrating biodiversity into broader national strategies, policies and planning processes. More than 80% of Parties, in their latest national reports to the CBD, concede that limited biodiversity mainstreaming, fragmented decision making and/or limited communication among government ministries or sectors is a challenge to meeting the goals of the Convention.

However, recently developed and updated national biodiversity strategies tend to be more strategic than the first generation of NBSAPs, they have a stronger emphasis on mainstreaming, and give greater recognition to broader national development objectives.

NBSAPs should catalyze a number of strategic actions in countries, including:

- **Mainstreaming** – biodiversity will be best protected if it is a significant factor in decisions made across a wide range of sectors, departments and economic activities, systems for planning the use of land, freshwater and sea areas (spatial planning), and policies to reduce poverty and adapt to climate change.
- **Communication and involvement** – strategies will only be effective if they genuinely involve the people closest to the resources they are designed to protect. Often the best solutions will be driven by local demand, using legal and institutional frameworks set at a higher level.
- **Tools for implementation** – particular approaches, such as making integrated decisions based on maintaining and improving the overall health of ecosystems, or introducing policies on payments for the use of hitherto “free” ecosystem services, can aid in the protection of biodiversity.
- **Knowledge** – for good decisions to be made, the best available information about the biodiversity of a country or region must be accessible to the right people at the right time. The Clearing-House Mechanism, a system of compiling, co-ordinating and providing access to relevant and up-to-date knowledge, is a key tool provided by the CBD framework.
- **Monitoring** – assessing and communicating progress towards the objectives and targets set by a biodiversity strategy is an important way to improve its effectiveness and visibility.
- **Financing and capacity** – co-ordinating action to support biodiversity will only be meaningful if there is money to do it and there are people who know how to do it.

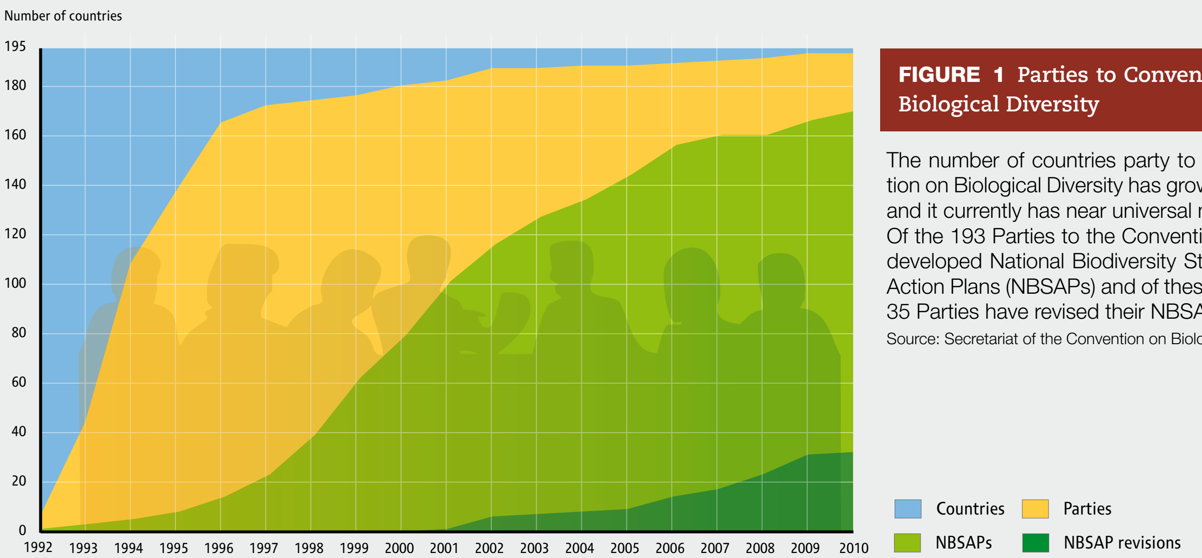



**FIGURE 1** Parties to Convention on Biological Diversity

The number of countries party to the Convention on Biological Diversity has grown over time, and it currently has near universal membership. Of the 193 Parties to the Convention 170 have developed National Biodiversity Strategies and Action Plans (NBSAPs) and of these, more than 35 Parties have revised their NBSAP.

Source: Secretariat of the Convention on Biological Diversity

There is no single measurement that captures the current status or trends in global biodiversity. Therefore a range of indicators was developed for the Convention on Biological Diversity, to provide scientifically rigorous assessments of trends in the state of the various components of biodiversity (genes, populations, species, ecosystems); the pressures being imposed upon it; and the responses being adopted to address biodiversity loss. Ten of the fifteen headline indicators show trends unfavourable for biodiversity **[See Table 2]**. Yet, for certain indicators the amount and coverage of data is not sufficient to make statements with confidence. The assessment of status and trends of biodiversity on the following pages therefore relies on multiple lines of evidence, including scientific literature and recent assessments, as well as national reports from the Parties to the Convention. Not a single government in the latest reports submitted to the CBD claims that the 2010 biodiversity target has been completely met at the national level. Around one in five governments state explicitly that they have missed the target.

Although the evidence does not show a significant decline in the rate of biodiversity loss, some interventions have had a measurable, positive impact by making the decline less severe than it would otherwise have been. For example, it is estimated that 31 bird species, out of a total of some 9,800, would have become extinct in the absence of conservation actions.

Missing the 2010 target has serious implications for human societies. Biodiversity underpins a wide range of services that support economies, food production systems and secure living conditions **[See Box 3]**. The loss of biodiversity (at the genetic, species and ecosystem levels) also affects human health in many ways.

Projections of the impacts of continued biodiversity loss, some associated costs and how they might be avoided, are outlined in this synthesis. First, the current status and trends of biodiversity, the pressures upon it and responses to its loss are described in more detail.

Coastal ecosystems, as well as supporting a wide range of species, often provide vital barriers that protect human communities from the full force of onshore waves and storms.

## TABLE 2 Trends shown by agreed indicators of progress towards the 2010 biodiversity target

**Status and trends of the components of biological diversity**

| | | |
|---|---|---|
| ↙ | **Trends in extent of selected biomes, ecosystems, and habitats** | Most habitats in most parts of the world are declining in extent, although forest area expands in some regions, and the loss of mangroves has slowed significantly, except in Asia. ❋❋ |
| ↙ | **Trends in abundance and distribution of selected species** | Most species with limited population size and distribution are being further reduced, while some common and invasive species become more common. ❋❋❋ (but limited number of taxa assessed) |
| ↙ | **Change in status of threatened species** | The risk of extinction increases for many threatened species, although some species recovery programmes have been very successful. ❋❋❋ (for those species assessed) |
| ↙ | **Trends in genetic diversity of domesticated animals, cultivated plants, and fish species of major socio-economic importance** | It is likely that the genetic variety of cultivated species is declining, but the extent of such decline and its overall impacts are not well understood. ❋ (although many case studies with a high degree of certainty are available) |
| ↗ | **Coverage of protected areas** | There has been a significant increase in coverage of protected areas, both terrestrial and marine, over the past decade. However, many ecological regions, particularly in marine ecosystems, remain underprotected, and the management effectiveness of protected areas remains variable. ❋❋❋ |

**Ecosystem integrity and ecosystem goods and services**

| | | |
|---|---|---|
| ⤢ | **Marine Trophic Index** | Despite intense pressure the Marine Trophic Index has shown a modest increase globally since 1970. However there is substantial regional variation with declines being recorded in half of the marine areas with data. Although the global increases may indicate a recovery it is more likely a consequence of fishing fleets expanding their areas of activity, thus encountering fish stocks in which larger predators have not yet been removed in large numbers. ❋❋❋ |
| ↙ | **Connectivity – fragmentation of ecosystems** | Most terrestrial and aquatic ecosystems are becoming increasingly fragmented, despite an increased recognition of the value of corridors and connections, especially in climate change adaptation. ❋❋❋ |
| ⤢ | **Water quality of aquatic ecosystems** | Most parts of the world are likely to be suffering from declines in water quality, although quality in some areas has improved through control of point-source pollution. ❋❋ |

**Threats to biodiversity**

| | | |
|---|---|---|
| ↗ | **Nitrogen deposition** | Human activity has doubled the rate of creation of reactive nitrogen on the planet's surface. Pressure on biodiversity from nutrient pollution continues to increase, although some measures to use nutrients more efficiently, to reduce their release into water and the atmosphere, are beginning to show positive effects. ❋❋❋ |
| ↗ | **Trends in invasive alien species** | The number and rate of spread of alien species is increasing in all continents and all ecosystem types. ❋❋ (although many case studies with a high degree of certainty are available) |

**Sustainable use**

| | | |
|---|---|---|
| ⤢ | **Area of forest, agricultural and aquaculture ecosystems under sustainable management** | There are considerable efforts under way to increase the extent of areas of land under sustainable management. Regional efforts on sustainable forest management are expected to contribute to this. Traditional agricultural practices are being maintained and revitalized as the demand for ethical and healthy products increases. However, these are still relatively small niches and major efforts are required to substantially increase the areas under sustainable management. ❋ |
| ↗ | **Ecological footprint and related concepts** | The ecological footprint of humanity is increasing. Efforts at increasing resource efficiency are more than compensated by increased consumption by a growing and more prosperous human population. ❋❋❋ |

**Status of traditional knowledge, innovations and practices**

| | | |
|---|---|---|
| ↘ | **Status and trends of linguistic diversity and numbers of speakers of indigenous languages** | A large number of minority languages are believed in danger of disappearing, and linguistic diversity is very likely declining. ❋ (although case studies with a high degree of certainty are available) |

**Status of access and benefit sharing**

| | | |
|---|---|---|
| ? | **Indicator of access and benefit-sharing to be developed** | The need and possible options for additional indicators are being examined by the Ad Hoc Open-ended Working Group on Access and Benefit-sharing. |

**Status of resources transfers**

| | | |
|---|---|---|
| ↗ | **Official development assistance (ODA) provided in support of the Convention** | The volume of ODA for biodiversity has increased over the past few years. ❋❋❋ |

↗ ↙ Negative changes   ↗ Positive changes   ⤢ No clear global trend. Positive and negative changes are occurring depending on the region or biome considered   ? Insufficient information to reach a definitive conclusion.

Degree of certainty: ❋ Low   ❋❋ Medium   ❋❋❋ High

**BOX 3** Why biodiversity matters

Biodiversity is the variation that exists not just between the species of plants, animals, micro-organisms and other forms of life on the planet – but also within species, in the form of genetic diversity, and at the level of ecosystems in which species interact with one another and with the physical environment.

This diversity is of vital importance to people, because it underpins a wide range of ecosystem services on which human societies have always depended, although their importance has often been greatly undervalued or ignored. When elements of biodiversity are lost, ecosystems become less resilient and their services threatened. More homogeneous, less varied landscapes or aquatic environments are often more vulnerable to sudden external pressures such as disease and climatic extremes.

Ecosystem services can be divided into four categories:

- **provisioning services,** or the supply of goods of direct benefit to people, and often with a clear monetary value, such as timber from forests, medicinal plants, and fish from the oceans, rivers and lakes.

- **regulating services**, the range of vital functions carried out by ecosystems which are rarely given a monetary value in conventional markets. They include regulation of climate through the storing of carbon and control of local rainfall, the removal of pollutants by filtering the air and water, and protection from disasters such as landslides and coastal storms.

- **cultural services**, not providing direct material benefits, but contributing to wider needs and desires of society, and therefore to people's willingness to pay for conservation. They include the spiritual value attached to particular ecosystems such as sacred groves, and the aesthetic beauty of landscapes or coastal formations that attract tourists.

- **supporting services**, not of direct benefit to people but essential to the functioning of ecosystems and therefore indirectly responsible for all other services. Examples are the formation of soils and the processes of plant growth.

# Species populations and extinction risks

**Changes in the abundance and distribution of species may have serious consequences for human societies**

***The population of wild vertebrate species fell by an average of nearly one- third (31%) globally between 1970 and 2006, with the decline especially severe in the tropics (59%) and in freshwater ecosystems (41%).***

Trends in the average size of species populations, as measured by the Living Planet Index (LPI), vary greatly between temperate and tropical regions, and between types of species **[See Figure 2]**. Temperate species populations actually increased on average since 1970, and the steady global decline since that date is accounted for entirely by a sharp fall in the tropics. This does not necessarily mean tropical biodiversity is in a worse state than in temperate regions: if the index were to extend back centuries rather than decades, populations of temperate species may have declined by an equal or greater amount. Moreover, the increase in wild animal populations in temperate regions may be linked to widespread afforestation of former cropland and pasture, and does not necessarily reflect richer diversity of species. However, the current rates of decline in global species abundance represent a severe and ongoing loss of biodiversity in tropical ecosystems.

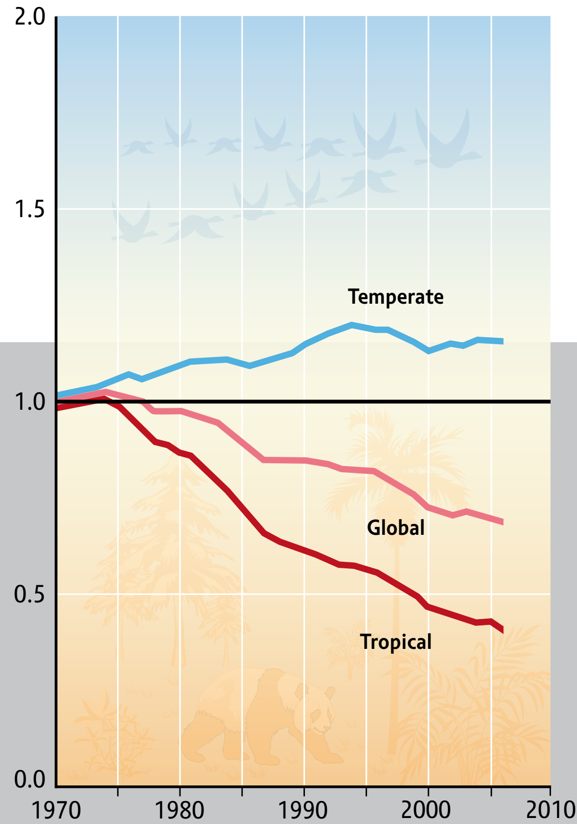
Observed trends in populations of wild species include:

- Farmland bird populations in Europe have declined by on average 50% since 1980.
- Bird populations in North American grasslands declined by nearly 40% between 1968 and 2003, showing a slight recovery over the past five years; those in North American drylands have declined by nearly 30% since the late 1960s.
- Of the 1,200 waterbird populations with known trends, 44% are in decline.
- 42% of all amphibian species and 40% of bird species are declining in population.

**FIGURE 2** Living Planet Index

The global Living Planet Index (LPI), shown here by the middle line, has declined by more than 30% since 1970, suggesting that on average, vertebrate populations fell by nearly one-third during that period. The Tropical LPI (bottom line) shows a sharper decline, of almost 60%. The Temperate LPI showed an increase of 15%, reflecting the recovery of some species populations in temperate regions after substantial declines in the more distant past.

Source: WWF/ Zoological Society of London




The LPI monitors more than 7,100 populations of over 2,300 species of mammals, birds, reptiles, amphibians and fish from around the globe. The change in the size of these populations, relative to 1970 (1970 =1.0) is plotted over time. A stable Living Planet value would indicate that there is no overall change in average species abundance, a necessary but not sufficient condition to indicate a halt in biodiversity loss.

**Most future scenarios project continuing high levels of extinctions and loss of habitats throughout this century**

***Species in all groups with known trends are, on average, being driven closer to extinction, with amphibians facing the greatest risk and warm water reef-building corals showing the most rapid deterioration in status. Among selected vertebrate, invertebrate and plant groups, between 12% and 55% of species are currently threatened with extinction. Species of birds and mammals used for food and medicine are on average facing a greater extinction risk than those not used for such purposes. Preliminary assessments suggest that 23% of plant species are threatened.***

Conservation interventions have reduced the extinction risk for some species, but they are outnumbered by those species that are moving closer towards extinction. The Red List Index (RLI), which tracks the average extinction risk of species over time, shows that all groups that have been fully assessed for extinction risk are becoming more threatened. **[See Box 4 and Figures 3, 4 and 5].**

The most severe recent increase in extinction risk has been observed among coral species, probably due in large part to the widespread bleaching of tropical reef systems in 1998, a year of exceptionally-high sea temperatures. Amphibians are on average the group most threatened with extinction, due to a combination of habitat modification, changes in climate and the fungal disease chytridiomycosis.

Regional trends regarding the extinction risk of species include:

- Bird species have faced an especially steep increase in extinction risk in South-East Asia, on the Pacific Islands, polar regions and in marine and coastal ecosystems.
- Mammals have also suffered the steepest increase in risk of extinction in South and South-East Asia, due to the combined impact of hunting and loss of habitat. Between ecosystem types, marine mammals have faced the steepest increase in risk, although freshwater mammals remain the most threatened.
- Amphibians have deteriorated in status fastest, and are in absolute terms at greatest risk of extinction, in South and Central America and the Caribbean.

Flamingoes congregating on Lake Naivasha in the Kenyan Rift Valley. They are among more than 300 bird species supported by this freshwater habitat, which is designated for protection under the Ramsar Convention on Wetlands. Among the threats facing the lake are over-abstraction of water, linked partly to irrigation of nearby flower farms. The lake has also suffered from nutrient and pesticide pollution, introduction of invasive alien species and overfishing.

## BOX 4 How extinction risk is assessed

The IUCN Red list categories reflect the likelihood that a species may become extinct if current conditions persist. The risk status of species is based on information generated from the work of thousands of species scientists from around the world.

Assessments follow a rigorous system which classifies species into one of eight categories: Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable, Near Threatened, Least Concern and Data Deficient. Those species that are classified as Critically Endangered, Endangered or Vulnerable are considered to be threatened.

Species are assigned to categories of extinction risk using criteria with quantitative thresholds for population size and structure, rate of population decline, range size and structure, and extinction risk as determined by modeling of population viability.

As of 2009, 47,677 species had been assessed and of these 36% are considered threatened with extinction; while of the 25,485 species in completely assessed groups (mammals, birds, amphibians, corals, freshwater crabs, cycads and conifers) 21% are considered threatened. Of 12,055 plant species assessed, 70% are threatened. However, plant species with a higher average extinction risk are over-represented in this sample.

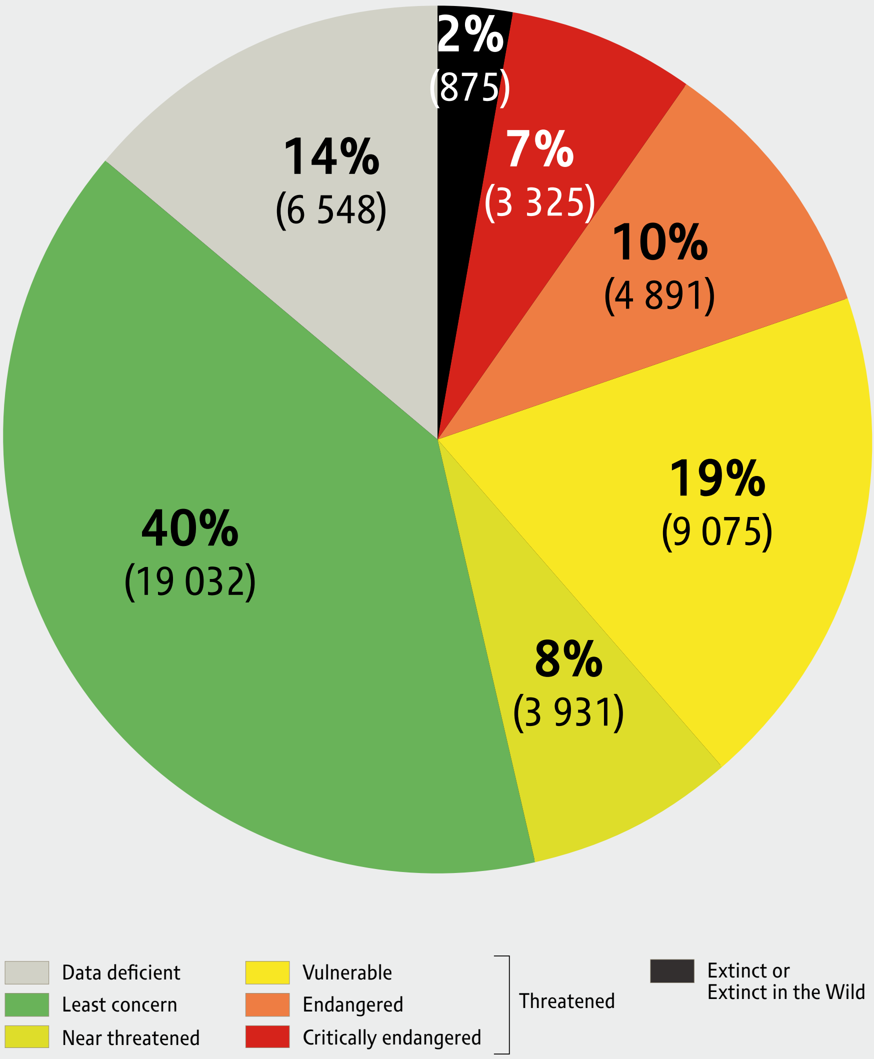



**FIGURE 3** Proportion of species in different threat categories

Proportion of all assessed species in different categories of extinction risk on the IUCN Red List, based on data from 47,677 species.
Source: IUCN

**FIGURE 4** Threat status of species in comprehensively assessed taxonomic groups

The number and proportion of species in different extinction risk categories in those taxonomic groups that have been comprehensively assessed, or (for dragonflies and reptiles) estimated from a randomized sample of 1,500 species each. For corals, only warm water reef-building species are included in the assessment.

Source: IUCN

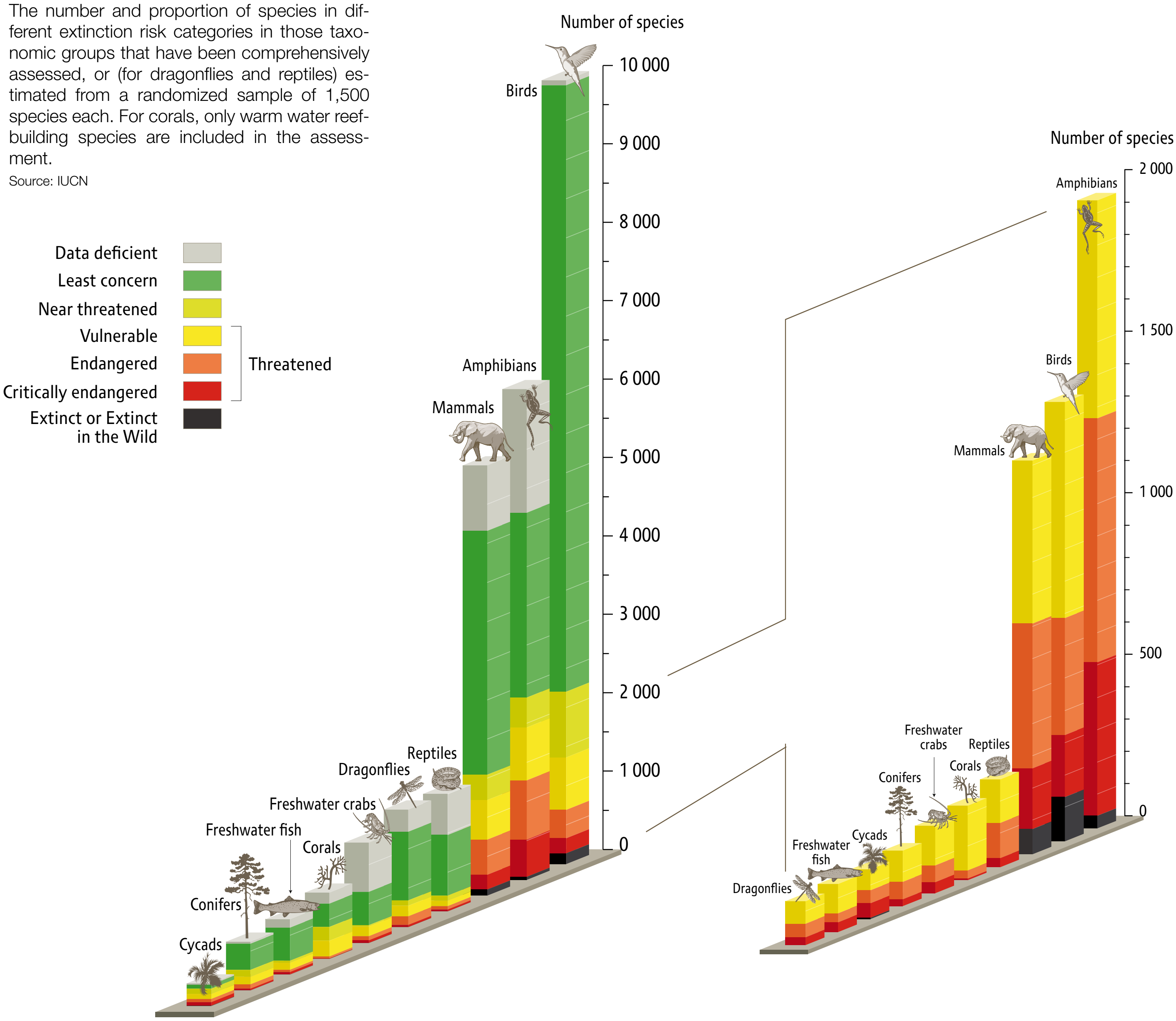
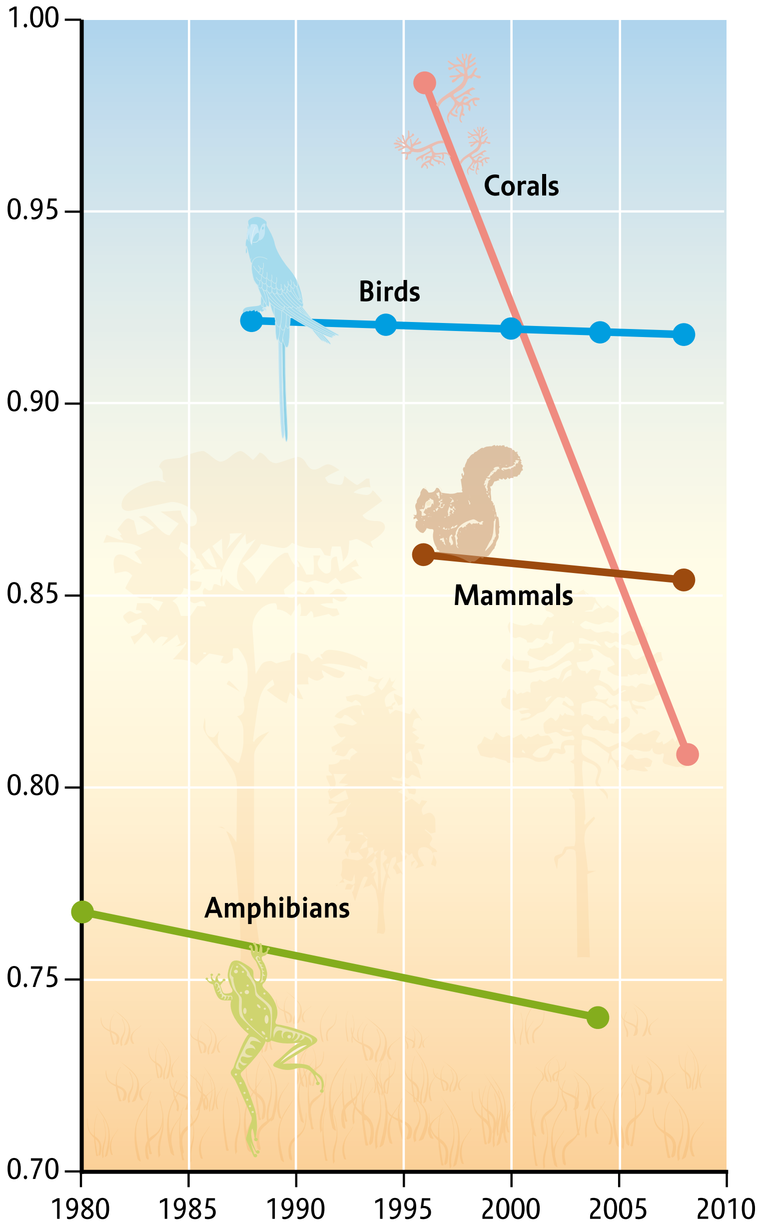



**FIGURE 5** Red List Index




The proportion of warm-water coral, bird, mammal and amphibian species expected to survive into the near future without additional conservation actions has declined over time. The Red List Index (RLI) for all these species groups is decreasing. Coral species are moving most rapidly towards greater extinction risk, while amphibians are, on average, the group most threatened.

A Red List Index value of 1.0 indicates that all species in a group would be considered as being of Least Concern, that is not expected to become extinct in the near future. At the other extreme, a value of 0 indicates that all species in a group have gone extinct. A constant level of the index over time implies that the extinction risk of species is constant, and if the rate of biodiversity loss were reducing, the lines on this figure would show an upward slope.

Source: IUCN

Species of birds and mammals used for food and medicines are on average facing a greater extinction risk than species as a whole, through a combination of over-exploitation, habitat loss and other factors. Species of bird, mammal and amphibians that are exploited for food and medicines are also moving more quickly into a higher risk category. This emphasizes the threat posed by biodiversity loss to the health and well-being of millions of people directly dependent on the availability of wild species. For example the World Health Organization has estimated that 60% of children suffering from fever in Ghana, Mali, Nigeria and Zambia are treated at home with herbal medicines while in one part of Nepal, 450 plant species are commonly used locally for medicinal purposes.

Globally some 80 per cent of people in developing countries rely on traditional medicines, the majority of which are derived from plants. Although global data for plants are not available, medicinal plants face a high risk of extinction in those parts of the world where people are most dependent on them for health care and income from wild collection – namely Africa, Asia, the Pacific and South America [**See Figure 6**].

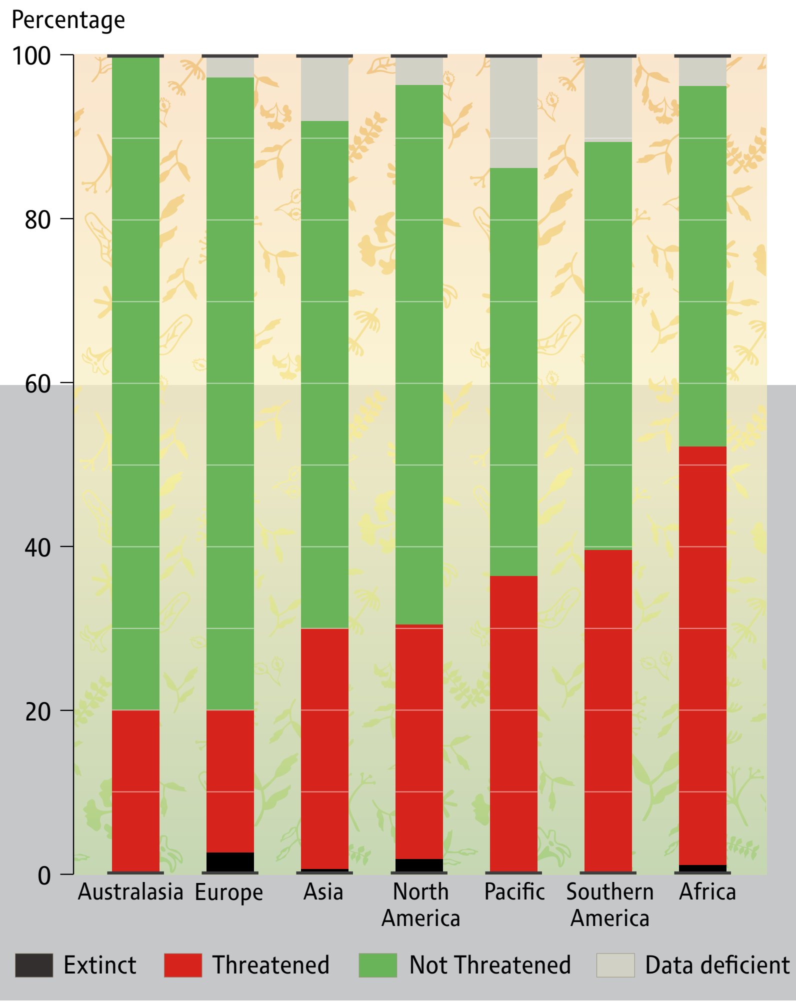



**FIGURE 6** Conservation status of medicinal plant species in different geographic regions

The greatest risk of extinction occurs in those regions, Africa, South America and the Pacific, where medicinal plants are most widely used.
Source: IUCN

The use of herbal medicine has a long tradition amongst all mountain communities in the Himalayan region. It involves a diversity of indigenous knowledge and cultural beliefs and constitutes an important basis for the development of society.

Cultivation of Himalayan mayapple (*Podophyllum hexandrum*) in Zhongdian, Yunnan Province, China. The species was scientifically validated to contain anti-cancerous compounds which led to high demand and large-scale collection from the wild. A few villagers embarked on cultivation of the species but economic benefits turned out to be limited.

# Terrestrial ecosystems

**Well-targeted policies focusing on critical areas, species and ecosystem services are essential to avoid the most dangerous impacts on people and societies**

***Tropical forests continue to be lost at a rapid rate, although deforestation has recently slowed in some countries. Net loss of forests has slowed substantially in the past decade, largely due to forest expansion in temperate regions.***

The best information on terrestrial habitats relates to forests, which currently occupy approximately 31 per cent of the Earth's land surface. Forests are estimated to contain more than half of terrestrial animal and plant species, the great majority of them in the tropics, and account for more than two-thirds of net primary production on land – the conversion of solar energy into plant matter.

Deforestation, mainly conversion of forests to agricultural land, is showing signs of decreasing in several tropical countries **[See Box 5 and Figure 7]**, but continues at an alarmingly high rate. Just under 130,000 square kilometres of forest were converted to other uses or lost through natural causes each year from 2000 to 2010, compared to nearly 160,000 square kilometres per year in the 1990s. The net loss of forests has slowed substantially, from approximately 83,000 square kilometres per year in the 1990s to just over 50,000 square kilometres per year from 2000-2010. This is mainly due to large-scale planting of forests in temperate regions and to natural expansion of forests. Since newly-planted forests often have low biodiversity value and may only include a single tree species, a slowing of net forest loss does not necessarily imply a slowing in the loss of global forest biodiversity. Between 2000 and 2010, the global extent of primary forest (that is, substantially undisturbed) declined by more than 400,000 square kilometres, an area larger than Zimbabwe.

South America and Africa continued to have the largest net loss of forests in 2000-2010. Oceania also reported a net loss of forests, while the area of forest in North and Central America (treated as a single region) was estimated to be almost the same in 2010 as in 2000. The forest area in Europe continued to expand, although at a slower rate than in the 1990s. Asia, which had a net loss in the 1990s, reported a net gain of forests in the period 2000–2010, primarily due to large-scale afforestation reported by China, and despite continued high rates of net loss of forests in many countries in South and Southeast Asia.

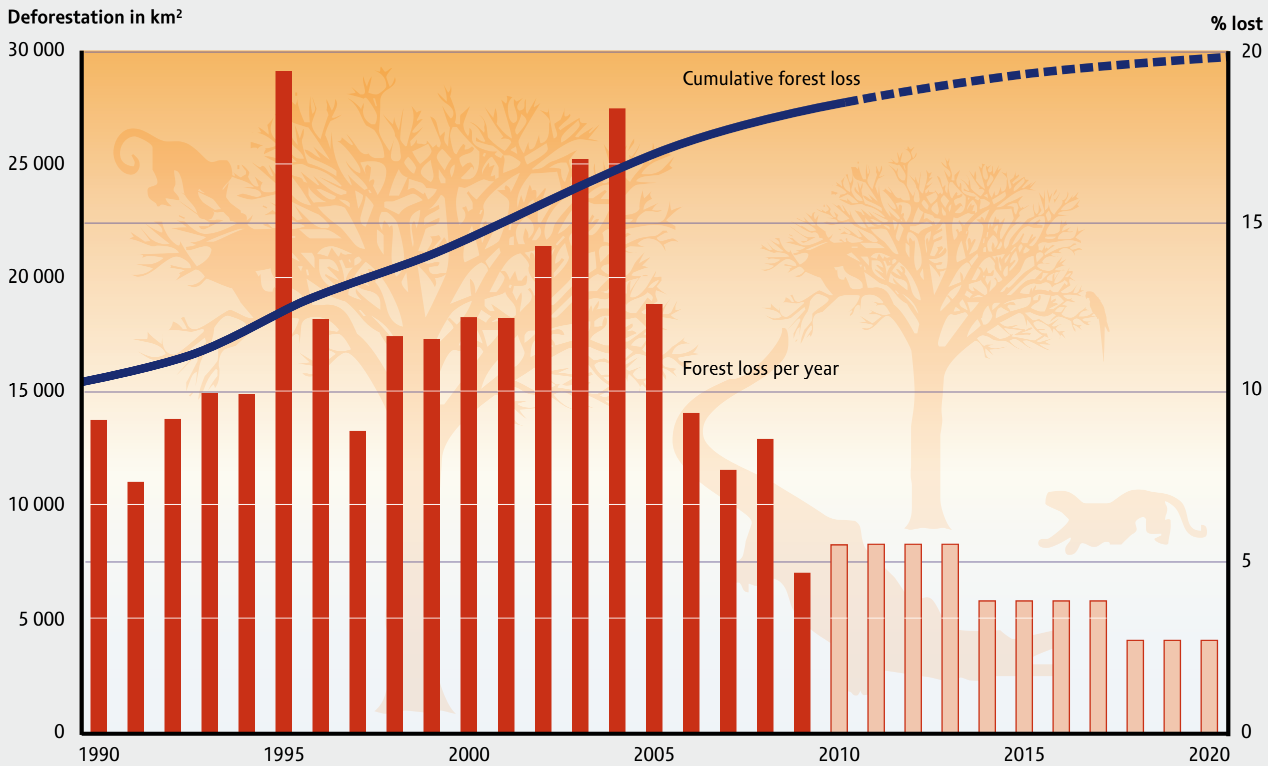
The conifer-dominated boreal forests of high Northern latitudes have remained broadly stable in extent in recent years. However, there are signs in some regions that they have become degraded. In addition, both temperate and boreal forests have become more vulnerable to outbreaks of pests and diseases, due in part to an increase in winter temperatures. For example an unprecedented outbreak of the mountain pine beetle has devastated more than 110,000 square kilometres of forest in Canada and the Western United States since the late 1990s.

## BOX 5 The Brazilian Amazon – a slowing trend for deforestation

The most recent satellite data suggest that annual deforestation of the Brazilian portion of the Amazon has slowed significantly, from a peak of more than 27,000 square kilometres in 2003-4 to just over 7,000 square kilometres in 2008-9, a decrease of over 74 per cent.

However, the same satellite images indicate that a growing area of the Amazon forest is becoming degraded. The 2008-9 deforestation figure, the lowest since satellite monitoring began in 1988, may have been influenced by the economic recession, as well as by actions taken by the government, private sector and civil society organizations to control deforestation; but the average from 2006-9 was more than 40 per cent below the average for the previous decade, indicating a significant slowing of the trend. Cumulative deforestation of the Brazilian Amazon is nevertheless substantial, reaching more than 17 per cent of the original forest area, and even achievement of the existing government target of an 80 per cent reduction in annual deforestation by 2020 (from the 1996-2005 average) would bring the cumulative loss of forest to nearly 20 per cent. According to a recent study co-ordinated by the World Bank, 20% Amazon deforestation would be sufficient to trigger significant dieback of forest in some parts of the biome by 2025, when coupled with other pressures such as climate change and forest fires.

## FIGURE 7 Annual and cumulative deforestation of the Brazilian Amazon




The darker bars represent the actual area of the Brazilian portion of the Amazon deforested each year between 1990 and 2009 (figures on left vertical axis), as observed from satellite images analysed by the National Space Research Agency (INPE). The lighter bars represent the projected average annual rate required to fulfill the Brazilian government target to reduce deforestation by 80% by 2020 (from the average between 1996 and 2005). The solid line shows cumulative total deforestation (figures on right vertical axis) as a percentage of the estimated original extent of the Brazilian Amazon (4.1 million km²).

Source: Brazilian National Space Research Agency (INPE)

***Savannas and grasslands, while less well documented, have also suffered severe declines.***

The extent of other terrestrial habitats is less well documented. It is estimated that more than 95 per cent of North American grasslands have been lost. Cropland and pasture have replaced nearly half of the *cerrado*, the woodland-savanna biome of Central Brazil which has an exceptionally rich variety of endemic plant species. Between 2002 and 2008, the *cerrado* was estimated to have lost more than 14,000 square kilometres per year, or 0.7% of its original extent annually, well above the current rate of loss in the Amazon.

The Miombo woodlands of Southern Africa, another savanna region with significant plant diversity, are also experiencing continued deforestation. Stretching from Angola to Tanzania and covering an area of 2.4 million square kilometres (the size of Algeria), the Miombo provide firewood, building material and extensive supplies of wild food and medicinal plants to local communities across the region. The woodlands are threatened by clearing land for agriculture, extraction of wood to make charcoal, and uncontrolled bush fires.

## BOX 6 Traditional managed landscapes and biodiversity

Agricultural landscapes maintained by farmers and herders using locally adapted practices not only maintain relatively high crop and livestock genetic diversity, but may also support distinctive wild biodiversity. These types of landscapes are found worldwide and are maintained through the application of a wide array of traditional knowledge and cultural practices which have evolved in parallel, creating landscapes with globally significant agricultural biodiversity.

Examples of these types of systems include:

**Rice-fish agriculture practiced in China** has been used since at least the Han Dynasty, 2,000 years ago. In this system, fish are kept in wet rice fields providing fertilizer, softening soils and eating larvae and weeds, while the rice provides shade and food for the fish. The high quality of the fish and rice produced from this system directly benefits farmers through high nutrition, lower labour costs and reducing the need for chemical fertilizers, herbicides and pesticides.

**In the valleys of Cusco and Puno in Peru** the Quechua and the Aymara peoples employ a form of terracing which allow them to grow various crops, such as maize and potatoes, as well as graze animals on steep slopes at altitudes ranging from 2,800 to 4,500 meters. This system supports as many as 177 varieties of potato, domesticated over many generations. It also helps to control soil erosion.

**Japan's Satoyama landscapes** are small mosaics composed of various types of ecosystems including secondary woodlands, irrigation ponds, rice paddies, pastures and grasslands, from which landholders have traditionally harvested resources including plants, fish, fungi, leaf litter and wood, in a sustainable way. Satoyama landscapes have evolved out of the long term interaction between people and the environment. Activities such as the periodic clearing of forests and the harvesting of forest litter, prevent the system from being dominated by a few species and allow for a greater diversity of species to exist in the system.

***Abandonment of traditional agricultural practices may cause loss of cultural landscapes and associated biodiversity.***

Traditional techniques of managing land for agriculture, some dating back thousands of years, have served an important function in keeping human settlements in harmony with the natural resources on which people depend **[See Box 6]**. In many parts of the world, these systems are being lost, due partly to the intensification of production, and partly to abandonment linked to migration from rural to urban areas. In some cases, this trend may create opportunities for biodiversity through the re-establishment of natural ecosystems on abandoned farmland. However, the changes may also involve important losses of distinctive biodiversity, among both domesticated and wild species, and of ecosystem services provided by managed landscapes.

***Terrestrial habitats have become highly fragmented, threatening the viability of species and their ability to adapt to climate change.***

Ecosystems across the planet, including some with exceptionally high levels of biodiversity, have become severely fragmented, threatening the long-term viability of many species and ecosystem services. Global data regarding this process are hard to obtain, but some well-studied ecosystems provide illustrations of the scale of fragmentation and its impacts. For example, the remaining South American Atlantic Forest, estimated to contain up to eight per cent of all terrestrial species, is largely composed of fragments less than one square kilometre in size. More than 50 per cent lies within 100 metres of the forest edge.

When ecosystems become fragmented they may be too small for some animals to establish a breeding territory, or force plants and animals to breed with close relatives. The in-breeding of species can increase vulnerability to disease by reducing the genetic diversity of populations. A study in the central Amazon region of Brazil found that forest fragments of less than one square kilometre lost half of their bird species in less than fifteen years. In addition, isolated fragments of habitat make species vulnerable to climate change, as their ability to migrate to areas with more favourable conditions is limited.

***One-quarter of the world's land is becoming degraded.***

The condition of many terrestrial habitats is deteriorating. The Global Analysis of Land Degradation and Improvement estimated that nearly one quarter (24%) of the world's land area was undergoing degradation, as measured by a decline in primary productivity, over the period 1980-2003. Degrading areas included around 30% of all forests, 20% of cultivated areas and 10% of grasslands. Geographically they were found mainly in Africa south of the Equator, South-East Asia and southern China, north-central Australia, the Pampas grasslands in South America, and parts of the Siberian and North American boreal forests. Around 16 per cent of land was found to be improving in productivity, the largest proportion (43%) being in rangelands.

The areas where a degrading trend was observed barely overlapped with the 15% of land identified as degraded in 1991, indicating that new areas are being affected and that some regions of historical degradation remain at stubbornly low levels of productivity. About 1.5 billion people directly depend on ecosystem services provided by areas that are undergoing degradation. The decline in fixation of carbon from the atmosphere associated with this degradation is estimated at nearly a billion tonnes from 1980 to 2003, (almost the equivalent of annual carbon dioxide emissions from the European Union) and emissions from the loss of soil carbon are likely to have been many times greater.

***Despite more than 12 per cent of land now being covered by protected areas, nearly half (44%) of terrestrial eco-regions fall below 10 per cent protection, and many of the most critical sites for biodiversity lie outside protected areas. Of those protected areas where effectiveness of management has been assessed, 13% were judged to be clearly inadequate, while more than one fifth demonstrated sound management, and the remainder were classed as "basic".***

An increasing proportion of global land surface has been designated as protected areas **[See Box 7 and Figure 8]**. In total, some 12.2% enjoys legal protection, made up of more than 120,000 protected areas. However, the target of protecting at least 10% of each the world's ecological regions – aimed at conserving a representative sample of biodiversity – is very far from being met. Of the 825 terrestrial ecoregions, areas containing a large proportion of shared species and distinct habitat types, only 56% have 10% or more of their area protected **[See Figure 10]**.

The existing protected area network also excludes many locations of special importance to biodiversity. For example, complete legal protection is given to only 26% of Important Bird Areas (IBAs), sites with significant populations of species that are threatened, have restricted geographical ranges, are confined to a single biome, or congregate in large numbers to feed or breed. Of nearly 11,000 IBAs in 218 countries, on average some 39% of their area is included in protected areas. Similarly, only 35% of sites holding the entire population of one or more highly threatened species are fully covered by protected areas **[See Box 8 and Figure 9]**. However, the proportion of both of these categories of sites under legal protection has increased significantly in recent years.

## BOX 7 Terrestrial protected areas

Of the governments that have recently reported to the CBD, 57% say they now have protected areas equal to or above the 10% of their land areas.

A few countries have made a disproportionate contribution towards the growth of the global protected area network: of the 700,000 square kilometres designated as protected areas since 2003, nearly three-quarters lie in Brazil, largely the result of the Amazon Region Protected Areas (ARPA) programme. ARPA involves a partnership between Brazilian federal and state authorities, the Worldwide Fund for Nature (WWF), the German Government and the Global Environment Facility (GEF). It aims to consolidate 500,000 square kilometres of protected areas in the Brazilian Amazon over a period of 10 years, at an estimated cost of US$ 390 million.

Other very significant increases have occurred in Canada, where more than 210,000 square kilometres have been added to the protected areas network since 2002, and in Madagascar, where the size of protected areas has gone up from 17,000 square kilometres to 47,000 square kilometres since 2003.

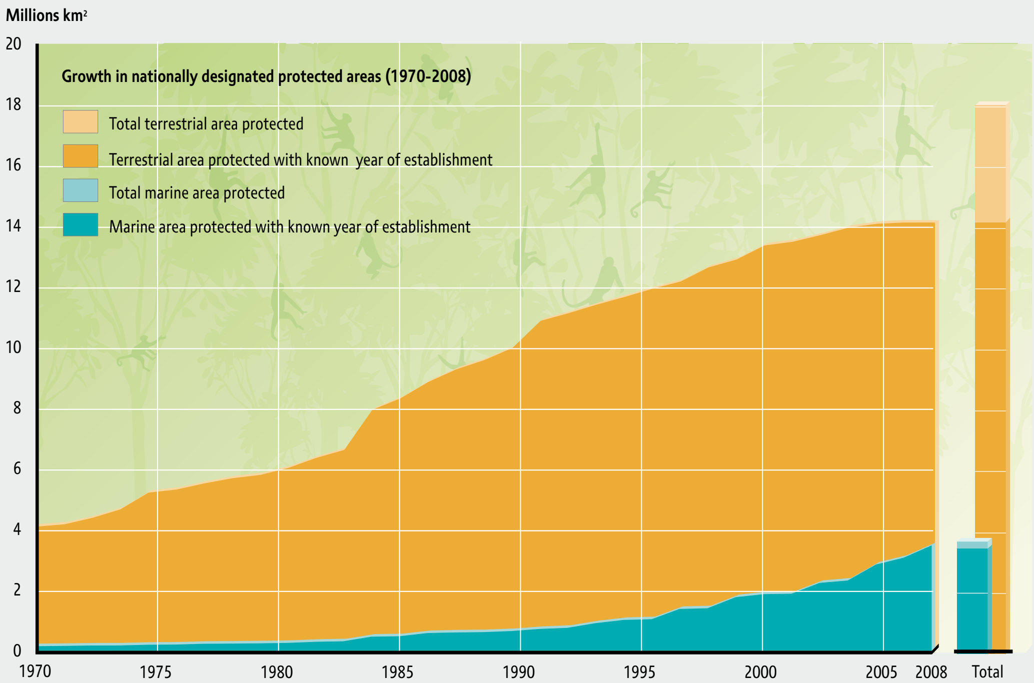



**FIGURE 8** Extent of nationally designated protected areas

The surface area of land and ocean designated as protected areas has steadily increased since 1970. While the extent of terrestrial protected areas is still much greater than that of marine protected areas, the latter have expanded significantly in recent years, concentrated in coastal waters.

Only protected areas with a known year of establishment are represented in this graph. An additional 3.9 million square kilometres of land and 100,000 square kilometres of ocean are covered by protected areas whose date of establishment is not known. This brings the total coverage of protected areas to more than 21 million square kilometres.

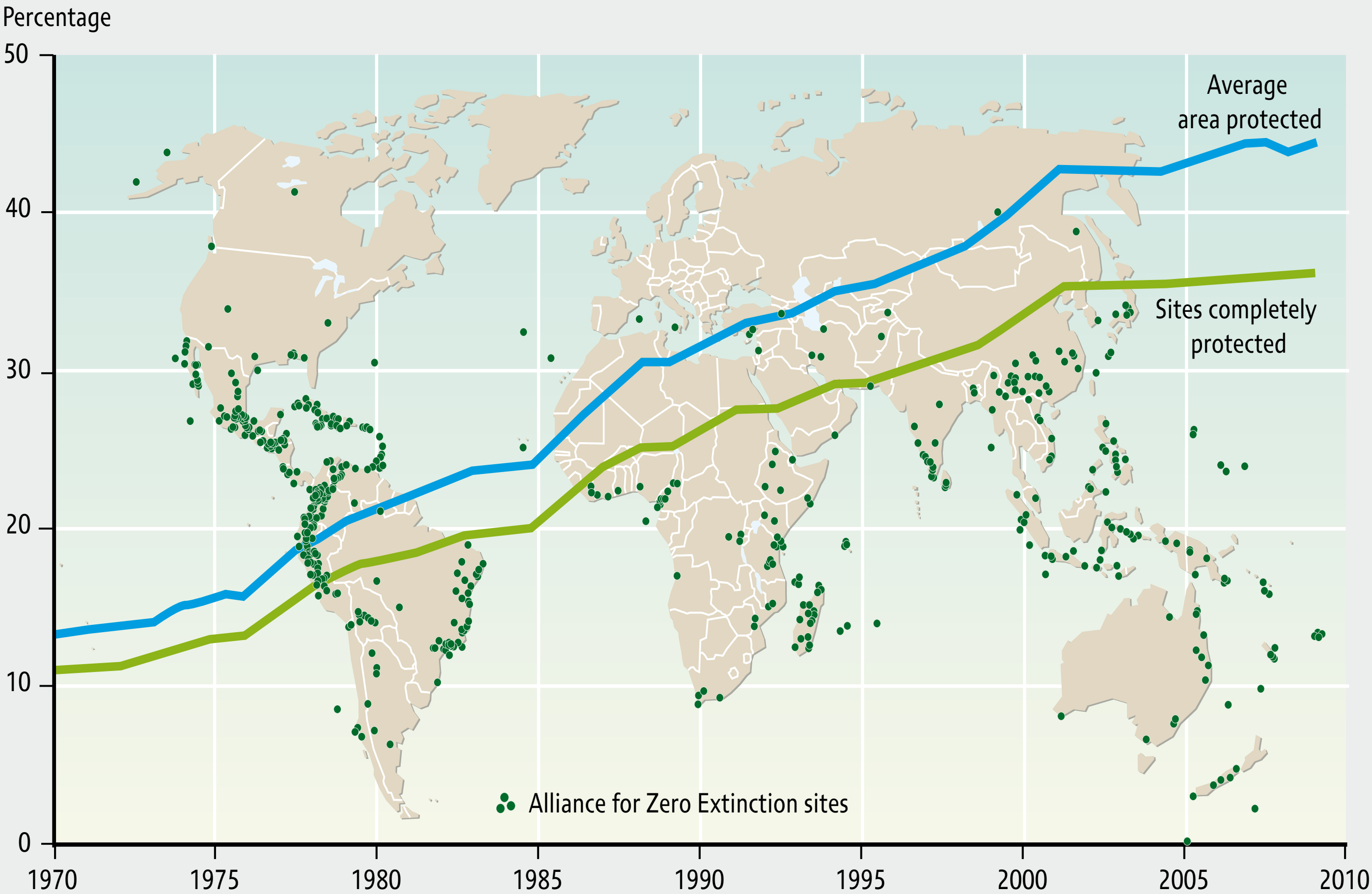
Source: UNEP-WCMC

## BOX 8 Protecting the Noah's arks of biodiversity

The Alliance for Zero Extinction (AZE) has identified 595 sites worldwide whose protection is critical to the survival of hundreds of species. The sites contain the entire global population of 794 Critically Endangered or Endangered species of mammals, birds, selected reptiles, amphibians and conifers. These species are considered likely to become extinct unless direct and urgent action is taken at these sites. The sites are concentrated in tropical forests, islands and mountainous ecosystems. Most are surrounded by intensive human development, and all are small, making them vulnerable to human activities.

Only about one-third (36%) are fully contained in gazetted protected areas, and on average, 44% of the area covered by these sites was protected by 2009. More than half of AZE sites (53%) lack any legal protection, representing a significant gap in the protection of sites critical to biodiversity. However, the current level of protection is significantly better than in 1992, when only a third of the area of AZE sites was protected, and just over a quarter of sites (27%) enjoyed full legal protection.

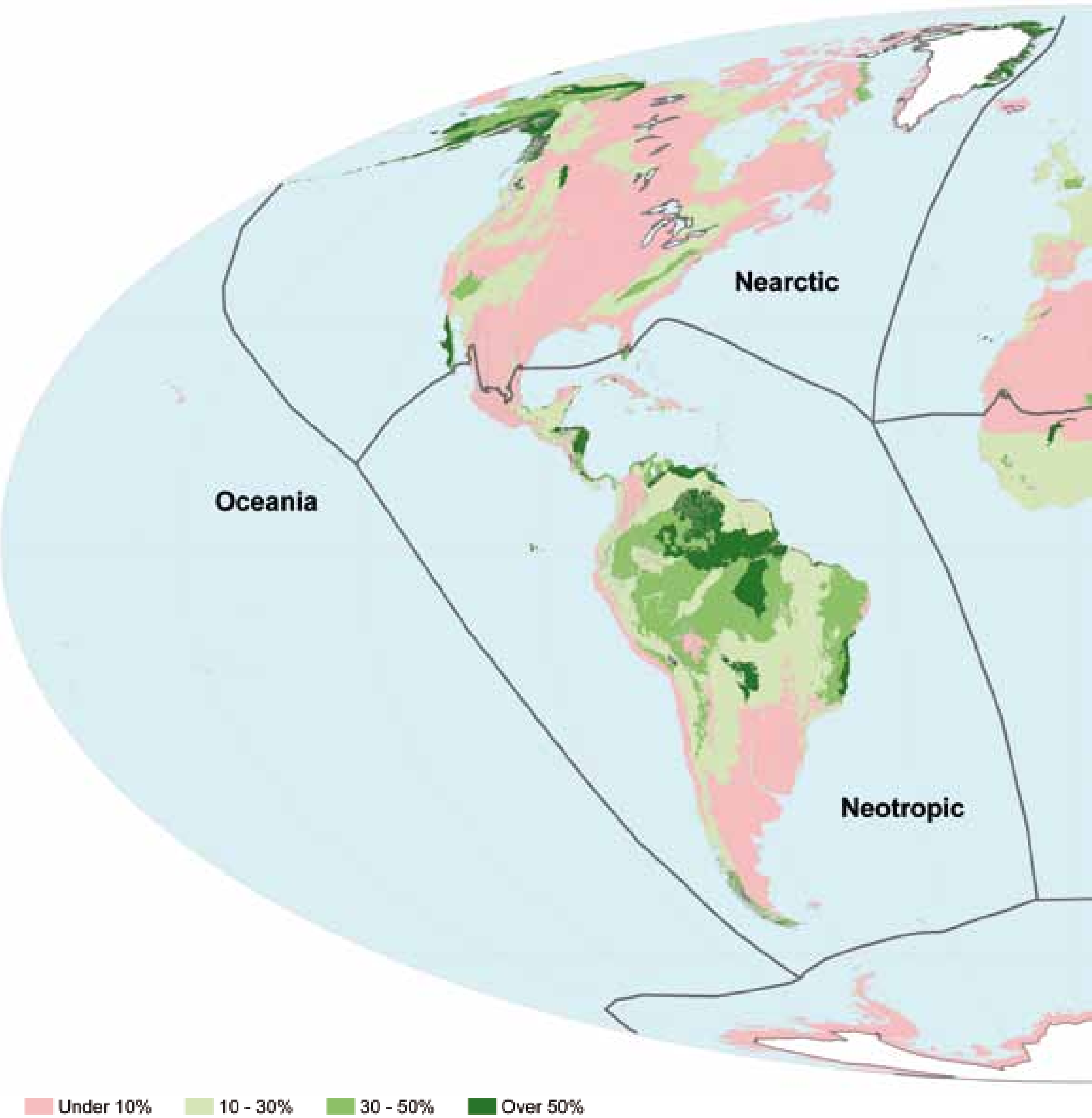
### FIGURE 9 Protection of critical biodiversity sites



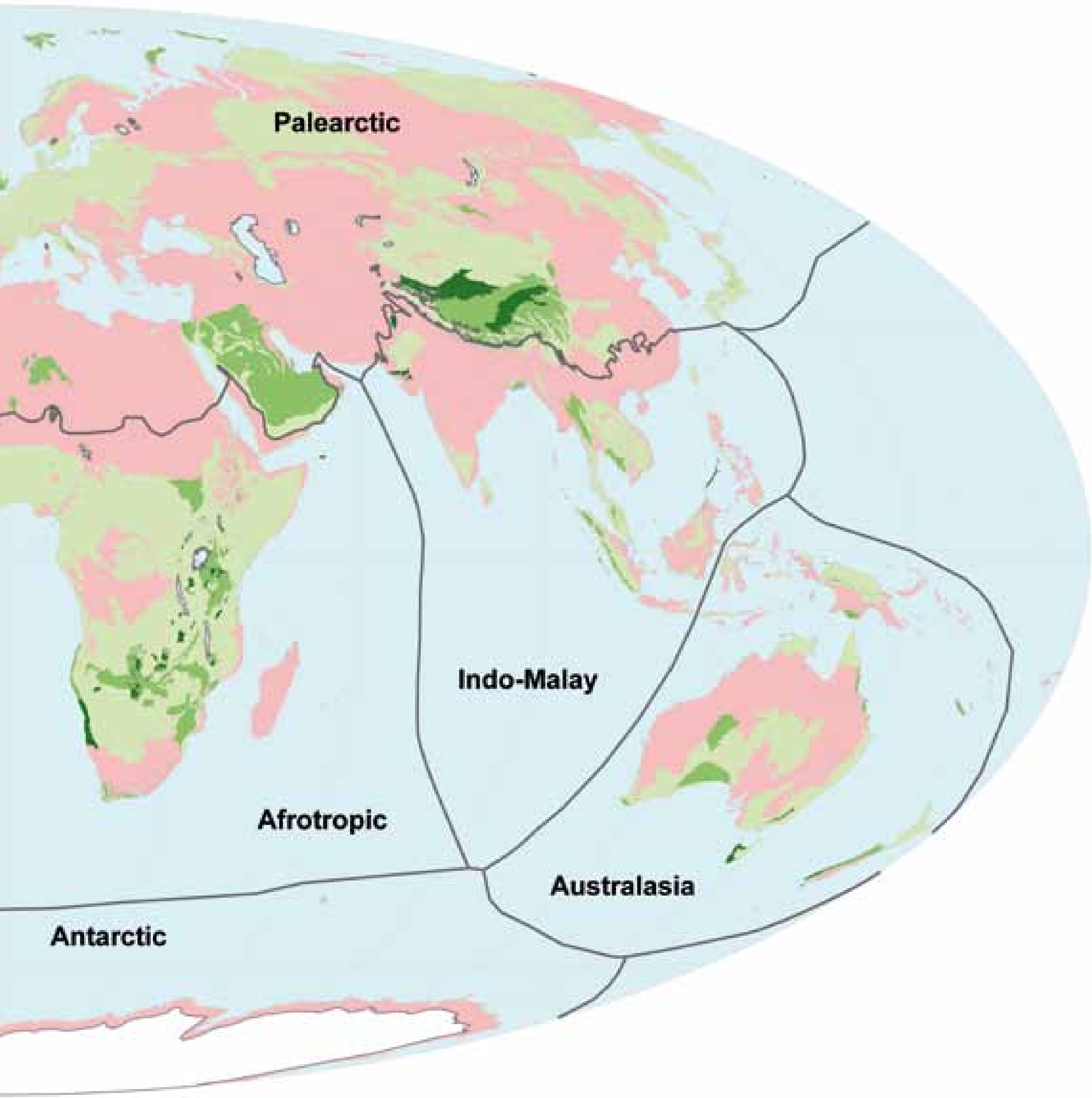

The average proportion of AZE sites within protected areas, and the number of AZE sites completely protected, have increased steadily since the 1970s. However, the majority of the area covered by the AZE sites remains outside protected areas.

Source: Alliance for Zero Extinction

**FIGURE 10** Coverage of terrestrial protected areas by ecoregion




Note: Antarctica is a special case with an international treaty strictly regulating human activities, and the light colouring shown on this map should not be interpreted as implying a low level of actual protection.




Fifty-six per cent of 825 terrestrial ecoregions (regions with areas containing a large proportion of shared species and distinct habitat types) have 10% or more of their area included in protected areas, the proportion set as a sub-target towards achieving the 2010 biodiversity target. The lighter colouring on the map represents ecoregions with relatively low levels of protection.
Source: UNEP-WCMC

Clearly, the benefit to biodiversity from protected areas depends critically on how well they are managed. A recent global assessment of management effectiveness has found that of 3,080 protected areas surveyed, only 22% were judged "sound", 13% "clearly inadequate", and 65% demonstrated "basic" management. Common weaknesses identified in the assessment were lack of staff and resources, inadequate community engagement and programmes for research, monitoring and evaluation. Aspects relating to basic establishment of the reserves and maintaining the values of the protected area were found to be quite strong.

***Indigenous and local communities play a significant role in conserving very substantial areas of high biodiversity and cultural value.***

In addition to officially-designated protected areas, there are many thousand Community Conserved Areas (CCAs) across the world, including sacred forests, wetlands, and landscapes, village lakes, catchment forests, river and coastal stretches and marine areas **[See Box 9]**. These are natural and/or modified ecosystems of significant value in terms of their biodiversity, cultural significance and ecological services. They

## BOX 9 Cultural and biological diversity

Cultural and biological diversity are closely intertwined. Biodiversity is at the centre of many religions and cultures, while worldviews influence biodiversity through cultural taboos and norms which influence how resources are used and managed. As a result for many people biodiversity and culture cannot be considered independently of one another. This is particularly true for the more than 400 million indigenous and local community members for whom the Earth's biodiversity is not only a source of wellbeing but also the foundation of their cultural and spiritual identities. The close association between biodiversity and culture is particularly apparent in sacred sites, those areas which are held to be of importance because of their religious or spiritual significance. Through the application of traditional knowledge and customs unique and important biodiversity has often been protected and maintained in many of these areas over time. For example:

- In the Kodagu district of Karnataka State, India, sacred groves maintain significant populations of threatened trees such as *Actinodaphne lawsonii* and *Hopea ponga*. These groves are also home to unique microfungi.
- In central Tanzania a greater diversity of woody plants exists in sacred groves than in managed forests.
- In Khawa Karpo in the eastern Himalayas trees, found in sacred sites have a greater overall size than those found outside such areas.
- Coral reefs near Kakarotan and Muluk Village in Indonesia are periodically closed to fishing by village elders or chiefs. The reef closures ensure that food resources are available during periods of social significance. The average length and biomass of fish caught in both areas has been found to be greater than that at control sites.
- Strict rituals, specific harvesting requirements and locally enshrined enforcement of permits regulate the amount of bark collected from *Rytigynia kigeziensis (right)*, an endemic tree in the Albertine Rift of western Uganda which plays a central role in local medicine. This keeps bark collection within sustainable limits.

are voluntarily conserved by indigenous and local communities, through customary laws or other effective means, and are not usually included in official protected area statistics.

Globally, four to eight million square kilometres (the larger estimate is an area bigger than Australia) are owned or administered by communities. In 18 developing countries with the largest forest cover, over 22% of forests are owned by or reserved for communities. In some of these countries (for example Mexico and Papua New Guinea) the community forests cover 80% of the total. By no means all areas under community control effectively conserved, but a substantial portion are. In fact, some studies show that levels of protection are actually higher under community or indigenous management than under government management alone.

**BOX 10 What is at stake?**

*Some estimated values of terrestrial biodiversity*

- The Southern Africa tourism industry, based to a large extent on wildlife viewing, was estimated to be worth US$ 3.6 billion in 2000.
- It has been estimated that the real income of poor people in India rises from US$ 60 to $95 when the value of ecosystem services such as water availability, soil fertility and wild foods is taken into account – and that it would cost US$ 120 per capita to replace lost livelihood if these services were denied.
- Insects that carry pollen between crops, especially fruit and vegetables, are estimated to be worth more than US$ 200 billion per year to the global food economy.
- Water catchment services to New Zealand's Otago region (pictured below) provided by tussock grass habitats in the 22,000 hectare Te Papanui Conservation Park are valued at more than US$ 95 million, based on the cost of providing water by other means.

# Inland water ecosystems

**Increasingly, restoration of ecosystems will be needed to re-establish ecosystem functioning and the provision of valuable services**

***Inland water ecosystems have been dramatically altered in recent decades. Wetlands throughout the world have been and continue to be lost at a rapid rate.***

Rivers and their floodplains, lakes and wetlands have undergone more dramatic changes than any other type of ecosystem, due to a combination of human activities including drainage for agriculture, abstraction of water for irrigation, industrial and household use, the input of nutrients and other pollutants, introduction of alien species and the damming of rivers.

Verifiable global data for loss of inland water habitats as a whole are not available, but it is known that shallow-water wetlands such as marshes, swamps and shallow lakes have declined significantly in many parts of the world. Documented examples of loss include:

- Between 56% and 65% of inland water systems suitable for use in intensive agriculture in Europe and North America had been drained by 1985. The respective figures for Asia and South America were 27% and 6%.
- 73% of marshes in northern Greece have been drained since 1930.
- 60% of the original wetland area of Spain has been lost.
- The Mesopotamian marshes of Iraq lost more than 90% of their original extent between the 1970s and 2002, following a massive and systematic drainage project. Following the fall of the former Iraqi regime in 2003 many drainage structures have been dismantled, and the marshes were reflooded to approximately 58% of their former extent by the end of 2006, with a significant recovery of marsh vegetation.

***Water quality shows variable trends, with improvements in some regions and river basins being offset by serious pollution in many densely-populated areas.***

Water quality in freshwater ecosystems, an important biodiversity indicator, shows variable trends, and global data are very incomplete. Relevant information about pollution loads and changes in water quality is lacking precisely where water use is most intense – in densely populated developing countries. As a result, the serious impacts of polluting activities on the health of people and ecosystems remain largely unreported.

The Lower Jordan River Basin has been drastically altered by abstractions for irrigation and growing cities: 83% of its flow is consumed before it reaches the Dead Sea.

In some areas, depletion and pollution of economically important water resources have gone beyond the point of no return, and coping with a future without reliable water resources systems is now a real prospect in parts of the world. UNESCO's Third World Water Development Report predicts that nearly half of humanity will be living in areas of high water stress by 2030.

Pollution control through sewage treatment and regulation of industrial effluent has had significant success in improving water quality in many inland water ecosystems **[See Figure 11]**, although such progress has so far been very limited in developing countries. Pollution originating from diffuse or non-point sources (particularly from agriculture) remains a significant and growing problem in many parts of the world.

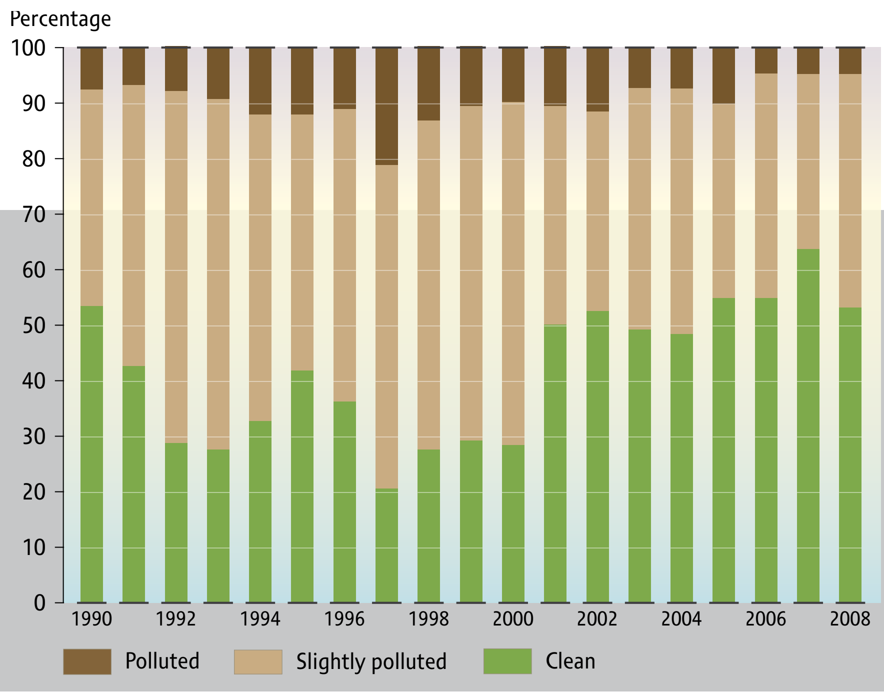
***Of 292 large river systems, two-thirds have become moderately or highly fragmented by dams and reservoirs.***

Rivers are becoming increasingly fragmented, often with severe disruption to their flows. The most fragmented rivers are in industrialized regions like much of the United States and Europe, and in heavily-populated countries such as China and India. Rivers in arid regions also tend to be highly fragmented, as scarce water supplies have often been managed through the use of dams and reservoirs. Rivers flow most freely in the less-populated areas of Alaska, Canada and Russia, and in small coastal basins in Africa and Asia.

This fragmentation is important because so much of the variety of freshwater life is determined by the connections formed between different parts of a river basin, as water, sediments and nutrients flow in dynamic rhythms of flood and interaction with tidal zones on the coast. More than 40% of the global river discharge is now intercepted by large dams and one-third of sediment destined for the coastal zones no longer arrives. These large-scale disruptions have had a major impact on fish migration, freshwater biodiversity more generally and the services it provides. They also have a significant influence on biodiversity in terrestrial, coastal and marine ecosystems.

***Inland water ecosystems are often poorly served by the terrestrial protected areas network, which rarely takes account of upstream and downstream impacts. Governments are reporting increased concern about the ecological condition of wetland sites of international importance (Ramsar sites).***

**FIGURE 11** Malaysia river basin quality




Since 1997, the proportion of river basins in Malaysia classified as clean has been increasing.
Source: Malaysia Department of Environment

Assessing the proportion of inland water biodiversity covered effectively by the existing network of protected areas is difficult. The Millennium Ecosystem Assessment estimated that 12% of the area of the world's inland waters was included within protected areas. This does not, however, give an accurate indication of the proportion of the world's river basins that enjoy protection, since the state of freshwater biodiversity at a particular location will often depend on activities far upstream or downstream – such as pollution, abstraction of water, the building of dams and deforestation.

Governments of 159 countries have ratified the Ramsar Convention on Wetlands, currently committed to conserving 1,880 wetlands of international importance, covering over 1.8 million square kilometres, and to the sustainable use of wetland resources generally. The condition of these wetland protected areas continues to deteriorate, with the majority of governments reporting an increased need to address adverse ecological changes in 2005-8, compared with the previous three-year period. The countries reporting the greatest concern about the condition of wetlands were in the Americas and Africa.

In many countries, steps are being taken to restore wetlands, often involving reversals in land-use policies by re-wetting areas that were drained in the relatively recent past. A single freshwater ecosystem can often provide multiple benefits such as purification of water, protection from natural disasters, food and materials for local livelihoods and income from tourism. There is a growing recognition that restoring or maintaining the natural functions of freshwater systems can be a cost-effective alternative to building physical infrastructure for flood defenses or costly water treatment facilities.

In Denmark, 40 square kilometres of meadow and marsh in the Skjern River Valley were drained in the 1960s for agriculture. Since 2002, more than half of the area has been restored, making the site nationally important for migratory birds. The benefits from improved salmon fishing, greater carbon sequestration, nutrient removal and recreation have offset the US$ 46 million cost of the project.

**BOX 11 What is at stake?**

*Some estimated values of inland water biodiversity*

- The Muthurajawela Marsh, a coastal wetland located in a densely populated area of Northern Sri Lanka, is estimated to be worth US$150 per hectare for its services related to agriculture, fishing and firewood; US$ 1,907 per hectare for preventing flood damage, and US$ 654 per hectare for industrial and domestic wastewater treatment.

- The Okavango Delta in Southern Africa (pictured below) is estimated to generate US$ 32 million per year to local households in Botswana through use of its natural resources, sales and income from the tourism industry. The total economic output of activities associated with the delta is estimated at more than US$ 145 million, or some 2.6% of Botswana's Gross National Product.

# Marine and coastal ecosystems

***Coastal habitats such as mangroves, seagrass beds, salt marshes and shellfish reefs continue to decline in extent, threatening highly valuable ecosystem services including the removal of significant quantities of carbon dioxide from the atmosphere; but there has been some slowing in the rate of loss of mangrove forests, except in Asia.***

Some of the best-studied examples of recent decline in the extent and integrity of marine habitats are in coastal ecosystems of great importance to human societies and economies. Coastal habitats have come under pressure from many forms of development including tourism and urban infrastructure, shrimp farming and port facilities including dredging. This is compounded by sea level rise, creating what might be termed a "coastal squeeze".

Mangrove forests are highly-productive ecosystems in the inter-tidal zones of many tropical coastlines. They not only provide wood for local communities, but also act as nursery areas for a wide range of commercially-valuable fish and crustacean stocks, and act as vital energy barriers, protecting low-lying coastal communities from offshore storms. The FAO estimates that about one-fifth of the world's mangroves, covering 36,000 square kilometres, were lost between 1980 and 2005. The rate at which mangroves are declining globally seems to have reduced more recently, although the loss is still disturbingly high. During the 1980s, an average of 1,850 square kilometres was lost each year. In the 1990s the annual average dropped to 1,185 square kilometres, and from 2000-2005 it was 1,020 square kilometres – a 45% reduction in the annual rate of loss. The trend of reduced rate of loss has not been observed in Asia, which holds a larger proportion of remaining mangroves than any other region.

Seagrass beds or meadows, fringing coastlines throughout the world, perform a number of vital but under recognized ecosystem functions, including support for commercial fisheries, a food source for species such as manatees and dugongs, and the stabilization of sediments. It is estimated that some 29% of seagrass habitats have disappeared since the 19th century, with a sharp acceleration in recent decades. Since 1980, the loss of seagrass beds has averaged approximately 110 square kilometres per year, a rate of loss comparable to mangroves, coral reefs and tropical forests.

Salt marshes, important as natural storm barriers and as habitats for shorebirds, have lost some 25% of the area they originally covered globally, and current rates of loss are estimated to be between one and two per cent per year. Salt marshes are especially important ecosystems for removing carbon dioxide from the atmosphere. For example in the United States they are estimated to account for more than one-fifth of the carbon absorbed by all ecosystems, despite covering a relatively small area.

Shellfish reefs are an even more threatened coastal habitat, and play an important role in filtering seawater and providing food and habitat for fish, crabs and seabirds. It is estimated that 85% of oyster reefs have been lost globally, and that they are functionally extinct in 37% of estuaries and 28% of ecoregions.

The quantity of carbon buried each year by vegetated coastal habitats such as mangroves, salt marshes and seagrass beds has been estimated at between 120 and 329 million tonnes. The higher estimate is almost equal to the annual greenhouse gas emissions of Japan.

***Tropical coral reefs have suffered a significant global decline in biodiversity since the 1970s. Although the overall extent of living coral cover has remained roughly in balance since the 1980s, it has not recovered to earlier levels. Even where local recovery has occurred, there is evidence that the new reef structures are more uniform and less diverse than the ones they replaced.***

Tropical coral reefs contribute significantly to the livelihoods and security of coastal regions in the areas where they occur, including through tourism based on their aesthetic beauty, income and nutrition from the fish species they support, and protection of coastlines from storms and waves.

Although they cover just 1.2% of the world's continental shelves, it is estimated that between 500 million and more than one billion people rely on coral reefs as a food resource. Around 30 million people in the poorest and most vulnerable coastal and inland communities are entirely dependent on resources derived from coral reefs for their wellbeing. They also support between one and three million species, including approximately 25% of all marine fish species.

Coral reefs face multiple threats including from overfishing, pollution from land-based sources, dynamiting of reefs, disease outbreaks, "bleaching" from warmer sea temperatures as a result of climate change, and ocean acidification linked to higher concentrations of dissolved carbon dioxide as a consequence of human-induced atmospheric emissions **[See Box 12]**.

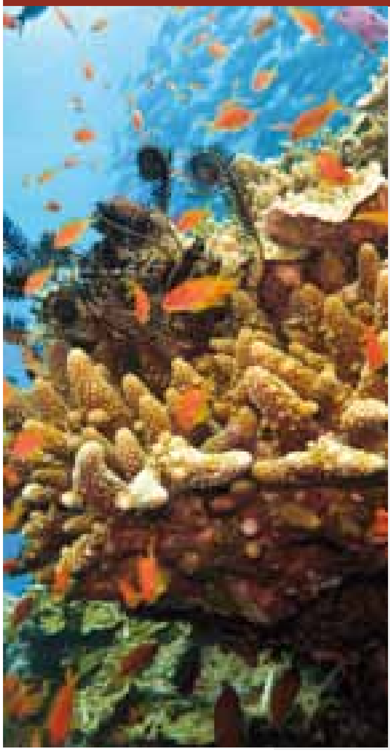
In the Indo-Pacific region, where the vast majority of corals occur, living coral cover fell rapidly from an estimated 47.7% of reef areas in 1980 to 26.5% in 1989, an average loss of 2.3% per year. Between 1990 and 2004 it remained relatively stable on many monitored reefs, averaging 31.4%. An indication of the long-term decline of Indo-Pacific reefs is a drastic reduction in the proportion of reefs with at least half of their area covered by living coral – it fell from nearly two-thirds in the early 1980s to just four per cent in 2004.

Living coral cover in Caribbean reefs dropped by nearly half (from 38.2% to 20.8% living coral cover) between 1972 and 1982, with a decline of almost one-quarter (24.9%) occurring in a single year, 1981, a collapse presumed to be linked with the outbreak of "white-band" coral disease and the impacts of Hurricane Allen in Jamaica. The overall decline of Caribbean reefs in the 1970s and early 80s has been followed by a period of stable living coral cover, with declines in some areas being roughly balanced by recovery in others. As in the Indo-Pacific region, there is no sign of long-term recovery to earlier levels of coral cover at the regional scale. It is also worth noting that recovering coral communities appear to produce more simplified reef structures, suggesting a decline in their biodiversity, as more complex structures tend to harbour a greater variety of species.

***There are increasing grounds for concern about the condition and trends of biodiversity in deep-water habitats, although data are still scarce.***

The condition of deep-water habitats such as sea mounts and cold-water corals has started to cause concern, as awareness increases of the impacts of modern fishing technology, especially bottom-trawling, on previously inaccessible ecosystems. Bottom-trawling and use of other mobile fishing gear can have an impact on seabed habitats equivalent to the clear-cutting of

### BOX 12 The Great Barrier Reef – a struggle for ecosystem resilience



Although it is among the healthiest and best-protected coral reef systems in the world, Australia's Great Barrier Reef has shown significant signs of decline and decreased resilience. The ecosystem continues to be exposed to increased levels of sediments, nutrients and pesticides, which are having significant effects inshore close to developed coasts, such as causing die-backs of mangroves and increasing algae on coral reefs.

There are no records of extinctions, but some species, such as dugongs, marine turtles, seabirds, black teatfish and some sharks, have declined significantly. Disease in corals and pest outbreaks of crown-of-thorns starfish and cyanobacteria appear to be becoming more frequent and more serious. Coral reef habitats are gradually declining, especially inshore as a result of poor water quality and the compounding effects of climate change. Coral bleaching resulting from increasing sea temperature and lower rates of calcification in skeleton-building organisms, such as corals, because of ocean acidification, are already evident.

While significant improvements have been made in reducing the impacts of fishing in the Great Barrier Reef, such as bycatch reduction devices, effort controls and closures, important risks to the ecosystem remain from the targeting of predators, the death of incidentally caught species of conservation concern, illegal fishing and poaching. The effects of losing predators, such as sharks and coral trout, as well further reducing populations of herbivores, such as the threatened dugong, are largely unknown but have the potential to alter food web interrelationships and reduce resilience across the ecosystem.

Even with the recent management initiatives to improve resilience, the overall outlook for the Great Barrier Reef is poor and catastrophic damage to the ecosystem may not be averted. Further building the resilience of the Great Barrier Reef by improving water quality, reducing the loss of coastal habitats and increasing knowledge about fishing and its effects, will give it the best chance of adapting to and recovering from the serious threats ahead, especially those related to climate change.

rainforests. Species from the deep ocean have become increasingly targeted as more accessible fish stocks become depleted and more strictly regulated. For example preliminary estimates suggest that between 30-50 % of the cold-water coral reefs in the Exclusive Economic Zone of Norway (that is, within 200 nautical miles of the Norwegian coast) have been impacted or damaged by bottom trawling. Other documented cases of damage caused by reef trawling have been observed in the Faroe Islands, Denmark and Iceland. All three countries have now closed some coral areas to trawling.

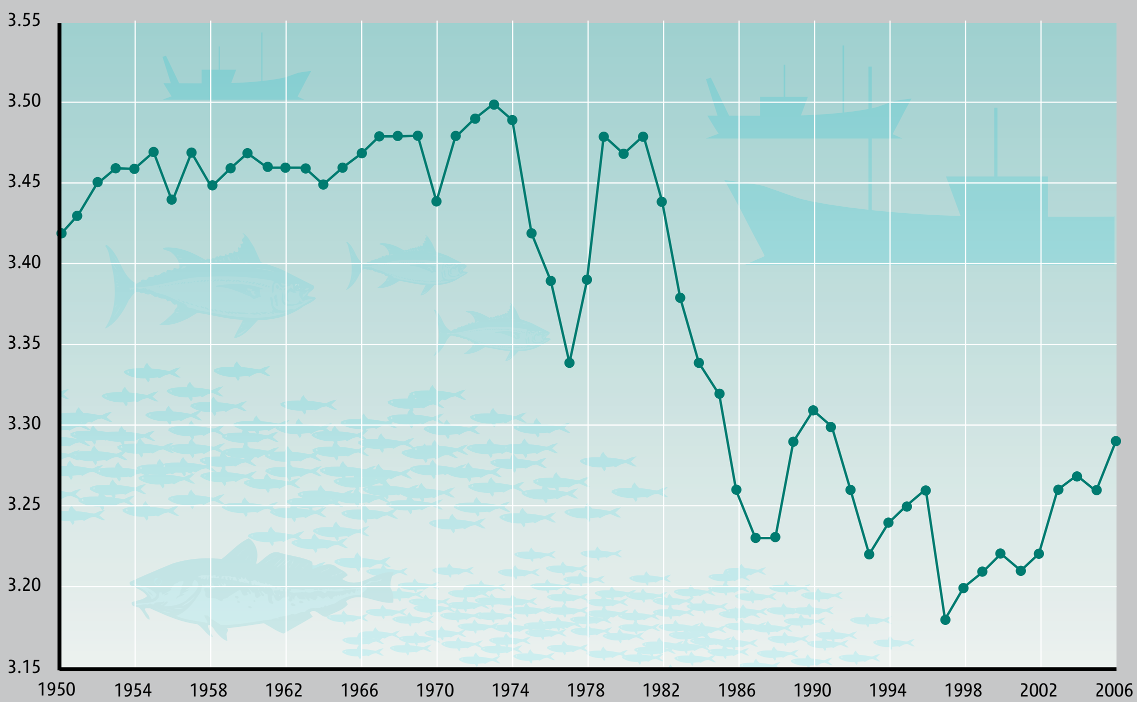
Deep-water habitats are considered especially vulnerable because species of the deep ocean tend to be slow-growing and long-lived. Cold-water corals are also considered in some studies to be particularly susceptible to impacts from ocean acidification, as the combination of cold and acidity presents a double handicap in the formation of calcified structures. However, knowledge of these systems is still very limited, and data on their global status is not yet available.

***About 80 percent of the world marine fish stocks for which assessment information is available are fully exploited or overexploited.***

Fish stocks assessed since 1977 have experienced an 11% decline in total biomass globally, with considerable regional variation. The average maximum size of fish caught declined by 22% since 1959 globally for all assessed communities. There is also an increasing trend of stock collapses over time, with 14% of assessed stocks collapsed in 2007.

In some ocean fisheries, larger predators have been caught preferentially in such numbers that their stocks do not recover, and there has been a tendency for catches to become dominated by smaller fish and invertebrates, a phenomenon known as "fishing down the food web". In the long term, this compromises the capacity of marine ecosystems to provide for the needs of human communities.

**FIGURE 12** China's Marine Trophic Index




Since the mid 1990s, China's Marine Trophic Index has shown signs of an increase. This follows a steep decline during the 1980s and early 1990s, resulting from overfishing. The figures suggest that although the marine food web off China may be recovering to some extent, it has not returned to its former condition.

Source: Chinese Ministry of Environmental Protection

Decades of catch records enable trends to be recorded in the average position of caught fish in the food web (the Marine Trophic Index), and thus to monitor the ecological integrity of marine ecosystems, over time **[See Figure 12]**. Despite the intense pressure on fish stocks, the Index has shown an increase of 3% globally since 1970. However there is substantial regional variation in the Marine Trophic Index, with declines being recorded since 1970 in half of the marine areas with data, including in the world's coastal areas and the North Atlantic and in the Southeast Pacific, Southeast Atlantic and Antarctic Indian Oceans. The largest proportional increases are in the Mediterranean and Black Seas, West Central Pacific and Southwest Pacific. Although these increases may indicate a recovery of higher predator species, they are more likely a consequence of fishing fleets expanding their areas of activity, thus encountering fish stocks in which larger predators have not yet been removed in such numbers.

***While the extent of marine protected areas has grown significantly, a small proportion (less than a fifth) of marine ecoregions meet the target of having at least 10% of their area protected.***

Protection of marine and coastal areas still lags far behind the terrestrial protected area network, although it is growing rapidly. Marine Protected Areas (MPAs) cover approximately half of one per cent of the total ocean area, and 5.9 per cent of territorial seas (to 12 nautical miles offshore). The open ocean is virtually unrepresented in the protected area network reflecting the difficulty of establishing MPAs on the high seas outside exclusive economic zones. Of 232 marine ecoregions, only 18% meet the target for protected area coverage of at least 10%, while half have less than 1% protection.

In various coastal and island regions, the use of community-based protected areas, in which local and indigenous peoples are given a stake in conservation of marine resources, are becoming increasingly widespread, and have shown promising results **[See Box 13]**.

**BOX 13** **Locally managed marine areas (LMMAs)**

In the past decade, more than 12,000 square kilometres in the South Pacific have been brought under a community-based system of marine resource management known as Locally-Managed Marine Areas.

The initiative involves 500 communities in 15 Pacific Island States. It has helped achieve widespread livelihood and conservation objectives based on traditional knowledge, customary tenure and governance, combined with local awareness of the need for action and likely benefits. These benefits includes recovery of natural resources, food security, improved governance, access to information and services, health benefits, improved security of tenure, cultural recovery, and community organization

Results of LMMA implementation in Fiji since 1997 have included: a 20-fold increase in clam density in the *tabu* areas where fishing is banned; an average of 200-300% increase in harvest in adjacent areas; a tripling of fish catches; and 35-45% increase in household income.

## BOX 14 What is at stake?

*Some estimated values of marine and coastal biodiversity*

✤ The world's fisheries employ approximately 200 million people, provide about 16% of the protein consumed worldwide and have a value estimated at US$ 82 billion.

✤ The value of the ecosystem services provided by coral reefs ranges from more than US$ 18 million per square kilometer per year for natural hazard management, up to US$ 100 million for tourism, more than US$ 5 million for genetic material and bioprospecting and up to US$ 331,800 for fisheries.

✤ The annual economic median value of fisheries supported by mangrove habitats in the Gulf of California has been estimated at US$ 37,500 per hectare of mangrove fringe. The value of mangroves as coastal protection may be as much as US$ 300,000 per kilometre of coastline.

✤ In the ejido (communally owned land) of Mexcaltitan, Nayarit, Mexico, the direct and indirect value of mangroves contribute to 56% of the ejido's annual wealth increase.

# *Genetic diversity*

***Genetic diversity is being lost in natural ecosystems and in systems of crop and livestock production. Important progress is being made to conserve plant genetic diversity, especially using ex situ seed banks.***

The decline in species populations, combined with the fragmentation of landscapes, inland water bodies and marine habitats, have necessarily led to an overall significant decline in the genetic diversity of life on Earth.

While this decline is of concern for many reasons, there is particular anxiety about the loss of diversity in the varieties and breeds of plants and animals used to sustain human livelihoods. A general homogenization of landscapes and agricultural varieties can make rural populations vulnerable to future changes, if genetic traits kept over thousands of years are allowed to disappear.

An example of the reduction in crop diversity can be found in China, where the number of local rice varieties being cultivated has declined from 46,000 in the 1950s to slightly more than 1,000 in 2006. In some 60 to 70 per cent of the areas where wild relatives of rice used to grow, it is either no longer found or the area devoted to its cultivation has been greatly reduced.

Significant progress has been made in *ex situ* conservation of crops, that is the collection of seeds from different genetic varieties for cataloguing and storage for possible future use. For some 200 to 300 crops, it is estimated that over 70% of genetic diversity is already conserved in gene banks, meeting the target set under the Global Strategy for Plant Conservation. The UN Food and Agriculture Organization (FAO) has also recognized the leading role played by plant and animal breeders, as well as the curators of ex situ collections, in conservation and sustainable use of genetic resources.

However, major efforts are still needed to conserve genetic diversity on farms, to allow continued adaptation to climate change and other pressures. Additional measures are also required to protect the genetic diversity of other species of social and economic importance, including medicinal plants, non-timber forest products, local landraces (varieties adapted over time to particular conditions) and the wild relatives of crops.

***Standardized and high-output systems of animal husbandry have led to an erosion of the genetic diversity of livestock. At least one-fifth of livestock breeds are at risk of extinction. The availability of genetic resources better able to support future livelihoods from livestock may be compromised.***

Twenty-one per cent of the world's 7,000 livestock breeds (amongst 35 domesticated species of birds and mammal) are classified as being at risk, and the true figure is likely to be much higher as a further 36 per cent are of unknown risk status **[See Figure 13]**. More than 60 breeds are reported to have become extinct during the first six years of this century alone.

The reduction in the diversity of breeds has so far been greatest in developed countries, as widely-used, high-output varieties such as Holstein-Friesian cattle come to dominate. In many developing countries, changing market demands, urbanization and other factors are leading to a rapid growth of more intensive animal production systems. This has led to the

**The continued loss of biodiversity has major implications for current and future human well-being**

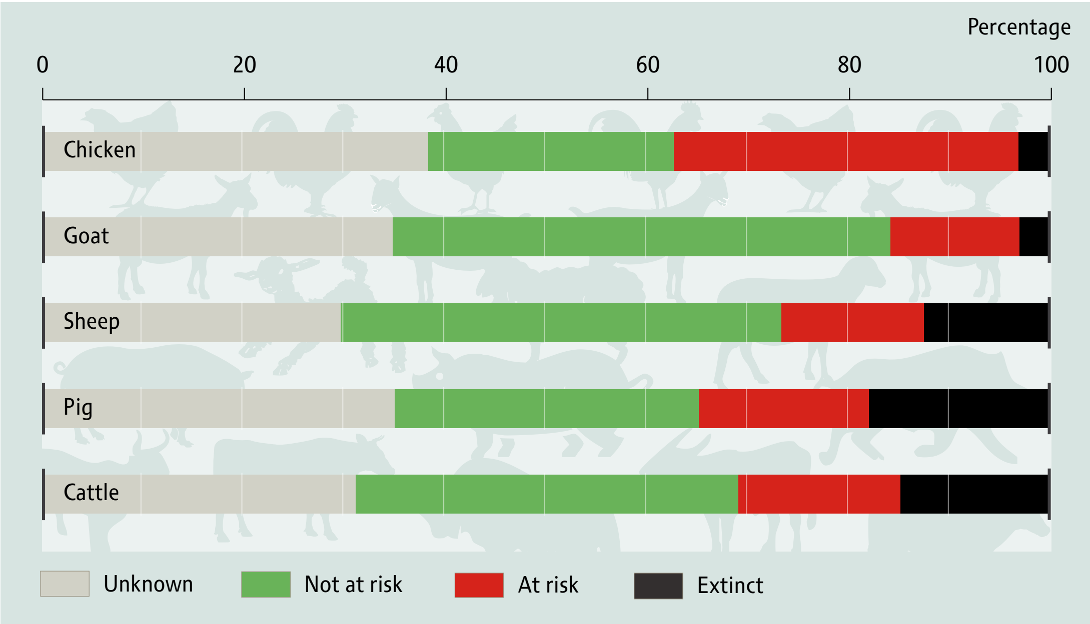
increased use of non-local breeds, largely from developed countries, and it is often at the expense of local genetic resources.

Government policies and development programmes can make matters worse, if poorly planned. A variety of direct and indirect subsidies tend to favour large-scale production at the expense of small-scale livestock-keeping, and the promotion of "superior" breeds will further reduce genetic diversity. Traditional livestock keeping, especially in drylands, is also threatened by degradation of pastures, and by the loss of traditional knowledge through pressures such as migration, armed conflict and the effects of HIV/AIDS.

The loss of genetic diversity in agricultural systems is of particular concern as rural communities face ever-greater challenges in adapting to future climate conditions. In drylands, where production is often operating at the limit of heat and drought tolerances, this challenge is particularly stark. Genetic resources are critically important for the development of farming systems that capture more carbon and emit lower quantities of greenhouse gases, and for underpinning the breeding of new varieties. A breed or variety of little significance now may prove to be very valuable in the future. If it is allowed to become extinct, options for future survival and adaptation are being closed down forever.

Seed banks play an important role in conserving the diversity of plant species and crop varieties for future generations. Among the most ambitious programmes for *ex situ* conservation are the Millennium Seed Bank Partnership, initiated by the Royal Botanic Gardens Kew and its partners worldwide, which now includes nearly 2 billion seeds from 30,000 wild plant species, mainly from drylands; and the complementary Svalbard Global Seed Vault, which has been constructed in Norway, close to the Arctic Circle, to provide the ultimate safety net against accidental loss of agricultural diversity in traditional gene banks. The vault has capacity to conserve 4.5 million crop seed samples.

**FIGURE 13** Extinction risk of livestock breeds




Large numbers of breeds of the five major species of livestock are at risk from extinction. More generally, among 35 domesticated species, more than one-fifth of livestock breeds, are classified as being at risk of extinction.

Source: FAO

Holstein-Friesian cattle are one of a small number of livestock breeds that are becoming increasingly dominant worldwide, often replacing traditional breeds and reducing genetic diversity.

Kennecott Utah Copper's Bingham Canyon Mine is the world's largest man-made excavation. It is almost 4.5 kilometres across and more than a kilometre deep. Open pit mining has been an important cause of habitat destruction in some regions. It is the type of activity increasingly subjected to environmental impact assessment. The Convention on Biological Diversity recently agreed voluntary guidelines on the inclusion of biodiversity factors in such assessments.

# *Current pressures on biodiversity and responses*

***The persistence and in some cases intensification of the five principal pressures on biodiversity provide more evidence that the rate of biodiversity loss is not being significantly reduced. The overwhelming majority of governments reporting to the CBD cite these pressures or direct drivers as affecting biodiversity in their countries.***

***They are:***

- ***Habitat loss and degradation***
- ***Climate change***
- ***Excessive nutrient load and other forms of pollution***
- ***Over-exploitation and unsustainable use***
- ***Invasive alien species***

## *Habitat loss and degradation*

***Habitat loss and degradation create the biggest single source of pressure on biodiversity worldwide. For terrestrial ecosystems, habitat loss is largely accounted for by conversion of wild lands to agriculture, which now accounts for some 30% of land globally. In some areas, it has recently been partly driven by the demand for biofuels.***

The IUCN Red List assessments show habitat loss driven by agriculture and unsustainable forest management to be the greatest cause of species moving closer towards extinction. The sharp decline of tropical species populations shown in the Living Planet Index mirrors widespread loss of habitat in those regions. For example, in one recent study the conversion of forest to oil palm plantations was shown to lead to the loss of 73-83% of the bird and butterfly species of the ecosystem. As noted above, birds face an especially high risk of extinction in South-east Asia, the region that has seen the most extensive development of oil palm plantations, driven in part by the growing demand for biofuel.

Infrastructure developments, such as housing, industrial developments, mines and transport networks, are also an important contributor to conversion of terrestrial habitats, as is afforestation of non-forested lands. With more than half of the world's population now living in urban areas, urban sprawl has also led to the disappearance of many habitats, although the higher population density of cities can also reduce the negative impacts on biodiversity by requiring the direct conversion of less land for human habitation than more dispersed settlements.

Even though there are no signs at the global level that habitat loss is declining significantly as a driver of biodiversity loss, some countries have shown that, with determined action, historically persistent negative trends can be reversed. An example of global significance is the recent reduction in the rate of deforestation in the Brazilian Amazon, mentioned above.

***For inland water ecosystems, habitat loss and degradation is largely accounted for by unsustainable water use and drainage for conversion to other land uses, such as agriculture and settlements.***

The major pressure on water availability is abstraction of water for irrigated agriculture, which uses approximately 70 per cent of the world's withdrawals of fresh water, but water demands for cities, energy and industry are rapidly growing. The construction of dams and flood levees on rivers also causes habitat loss and fragmentation, by converting free-flowing rivers to reservoirs, reducing connectivity between different parts of river basins, and cutting off rivers from their floodplains.

***In coastal ecosystems, habitat loss is driven by a range of factors including some forms of mariculture, especially shrimp farms in the tropics where they have often replaced mangroves.***

Coastal developments, for housing, recreation, industry and transportation have had important impacts on marine ecosystems, through dredging, landfilling and disruption of currents, sediment flow and discharge through construction of jetties and other physical barriers. As noted above, use of bottom-trawling fishing gear can cause significant loss of seabed habitat.

# Climate Change

**The linked challenges of biodiversity loss and climate change must be addressed by policymakers with equal priority and in close co-ordination**

***Climate change is already having an impact on biodiversity, and is projected to become a progressively more significant threat in the coming decades. Loss of Arctic sea ice threatens biodiversity across an entire biome and beyond. The related pressure of ocean acidification, resulting from higher concentrations of carbon dioxide in the atmosphere, is also already being observed.***

Ecosystems are already showing negative impacts under current levels of climate change (an increase of 0.74ºC in global mean surface temperature relative to pre-industrial levels), which is modest compared to future projected changes (2.4-6.4 ºC by 2100 without aggressive mitigation actions). In addition to warming temperatures, more frequent extreme weather events and changing patterns of rainfall and drought can be expected to have significant impacts on biodiversity.

Impacts of climate change on biodiversity vary widely in different regions of the world. For example, the highest rates of warming have been observed in high latitudes, around the Antarctic peninsula and in the Arctic, and this trend is projected to continue. The rapid reduction in the extent, age and thickness of Arctic sea ice, exceeding even recent scientific forecasts, has major biodiversity implications **[See Box 15 and Figure 14]**.

Already, changes to the timing of flowering and migration patterns as well as to the distribution of species have been observed worldwide. In Europe, over the last forty years, the beginning of the growing season has advanced by 10 days on average. These types of changes can alter food chains and create mismatches within ecosystems where different species have evolved synchronized inter-dependence, for example between nesting and food availability, pollinators and fertilization. Climate change is also projected to shift the ranges of disease-carrying organisms, bringing them into contact with potential hosts that have not developed immunity. Freshwater habitats and wetlands, mangroves, coral reefs, Arctic and alpine ecosystems, dry and sub-humid lands and cloud forests are particularly vulnerable to the impacts of climate change.

Some species will benefit from climate change. However, an assessment looking at European birds found that of 122 widespread species assessed, about three times as many were losing population as a result of climate change as those that were gaining numbers.

Climate change is projected to cause species to migrate to higher latitudes (ie towards the poles) and to higher altitudes, as average temperatures rise. In high-altitude habitats where species are already at the extreme of their range, local or global extinction becomes more likely as there are no suitable habitats to which they can migrate.

## BOX 15 Arctic sea ice and biodiversity

The annual thawing and refreezing of sea ice in the Arctic Ocean has seen a drastic change in pattern during the first years of the 21st century. At its lowest point in September 2007, ice covered a smaller area of the ocean than at any time since satellite measurements began in 1979, 34% less than the average summer minimum between 1979-2000. Sea ice extent in September 2008 was the second-lowest on record, and although the level rose in 2009, it remained below the long-term average.

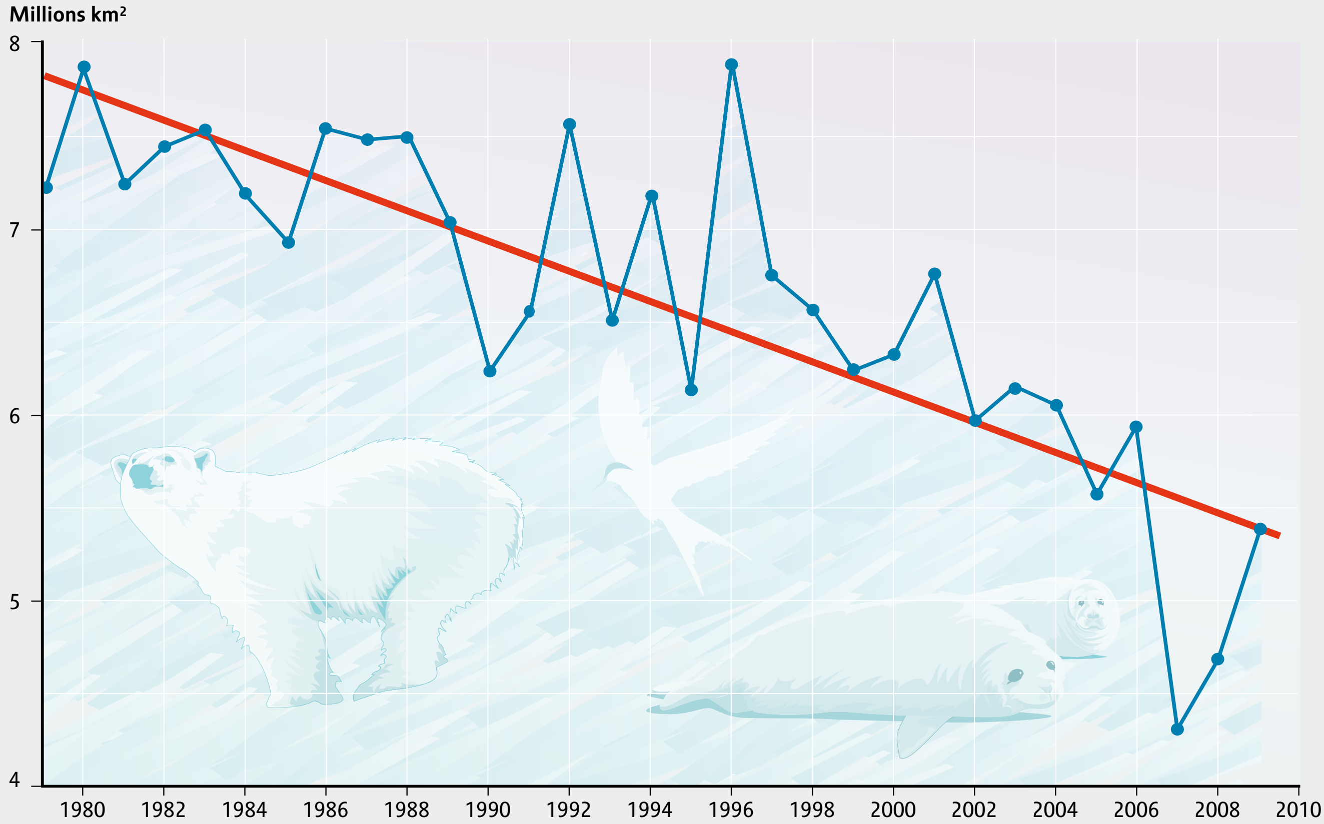
As well as shrinking in extent, Arctic sea ice has become significantly thinner and newer: at its maximum extent in March 2009, only 10% of the Arctic Ocean was covered by ice older than two years, compared with an average of 30% during 1979-2000. This increases the likelihood of continued acceleration in the amount of ice-free water during summers to come.

The prospect of ice-free summers in the Arctic Ocean implies the loss of an entire biome. Whole species assemblages are adapted to life on top of or under ice – from the algae that grow on the underside of multi-year ice, forming up to 25% of the Arctic Ocean's primary production, to the invertebrates, birds, fish and marine mammals further up the food chain.

Many animals also rely on sea ice as a refuge from predators or as a platform for hunting. Ringed seals, for example, depend on specific ice conditions in the spring for reproduction, and polar bears live most of their lives travelling and hunting on the ice, coming ashore only to den. Ice is, literally, the platform for life in the Arctic Ocean – and the source of food, surface for transportation, and foundation of cultural heritage of the Inuit peoples.

The reduction and possible loss of summer and multi-year ice has biodiversity implications beyond the sea-ice biome. Bright white ice reflects sunlight. When it is replaced by darker water, the ocean and the air heat much faster, a feedback that accelerates ice melt and heating of surface air inland, with resultant loss of tundra. Less sea ice leads to changes in seawater temperature and salinity, leading to changes in primary productivity and species composition of plankton and fish, as well as large-scale changes in ocean circulation, affecting biodiversity well beyond the Arctic.

### FIGURE 14 Arctic sea ice




The extent of floating sea ice in the Arctic Ocean, as measured at its annual minimum in September, showed a steady decline between 1980 and 2009.

Source: National Snow and Ice Data Center

**Action to implement the Convention on Biological Diversity has not been taken on a sufficient scale to address the pressures on biodiversity**

The specific impacts of climate change on biodiversity will largely depend on the ability of species to migrate and cope with more extreme climatic conditions. Ecosystems have adjusted to relatively stable climate conditions, and when those conditions are disrupted, the only options for species are to adapt, move or die.

It is expected that many species will be unable to keep up with the pace and scale of projected climate change, and as a result will be at an increased risk of extinction, both locally and globally. In general climate change will test the resilience of ecosystems, and their capacity for adaptation will be greatly affected by the intensity of other pressures that continue to be imposed. Those ecosystems that are already at, or close to, the extremes of temperature and precipitation tolerances are at particularly high risk.

Over the past 200 years, the oceans have absorbed approximately a quarter of the carbon dioxide produced from human activities, which would otherwise have accumulated in the atmosphere. This has caused the oceans (which on average are slightly alkaline) to become more acidic, lowering the average pH value of surface seawater by 0.1 units. Because pH values are on a logarithmic scale, this means that water is 30 per cent more acidic.

The impact on biodiversity is that the greater acidity depletes the carbonate ions, positively-charged molecules in seawater, which are the building blocks needed by many marine organisms, such as corals, shellfish and many planktonic organisms, to build their outer skeletons. Concentrations of carbonate ions are now lower than at any time during the last 800,000 years. The impacts on ocean biological diversity and ecosystem functioning will likely be severe, though the precise timing and distribution of these impacts are uncertain.

# *Pollution and nutrient load*

***Pollution from nutrients (nitrogen and phosphorous) and other sources is a continuing and growing threat to biodiversity in terrestrial, inland water and coastal ecosystems.***

Modern industrial processes such as the burning of fossil fuels and agricultural practices, in particular the use of fertilizers, have more than doubled the quantity of reactive nitrogen - nitrogen in the form that is available to stimulate plant growth - in the environment compared with pre-industrial times. Put another way, humans now add more reactive nitrogen to the environment than all natural processes, such as nitrogen-fixing plants, fires and lightning.

In terrestrial ecosystems, the largest impact is in nutrient-poor environments, where some plants that benefit from the added nutrients out-compete many other species and cause significant changes in plant composition. Typically, plants such as grasses and sedges will benefit at the expense of species such as dwarf shrubs, mosses and lichens.

Nitrogen deposition is already observed to be the major driver of species change in a range of temperate ecosystems, especially grasslands across Europe and North America, and high levels of nitrogen have also been recorded in southern China and parts of South and South-east Asia. Biodiversity loss from this source may be more serious than first thought in other ecosystems including high-latitude boreal forests, Mediterranean systems, some tropical savannas and montane forests. Nitrogen has also been observed to be building up at significant levels in biodiversity hotspots, with potentially serious future impacts on a wide variety of plant species.

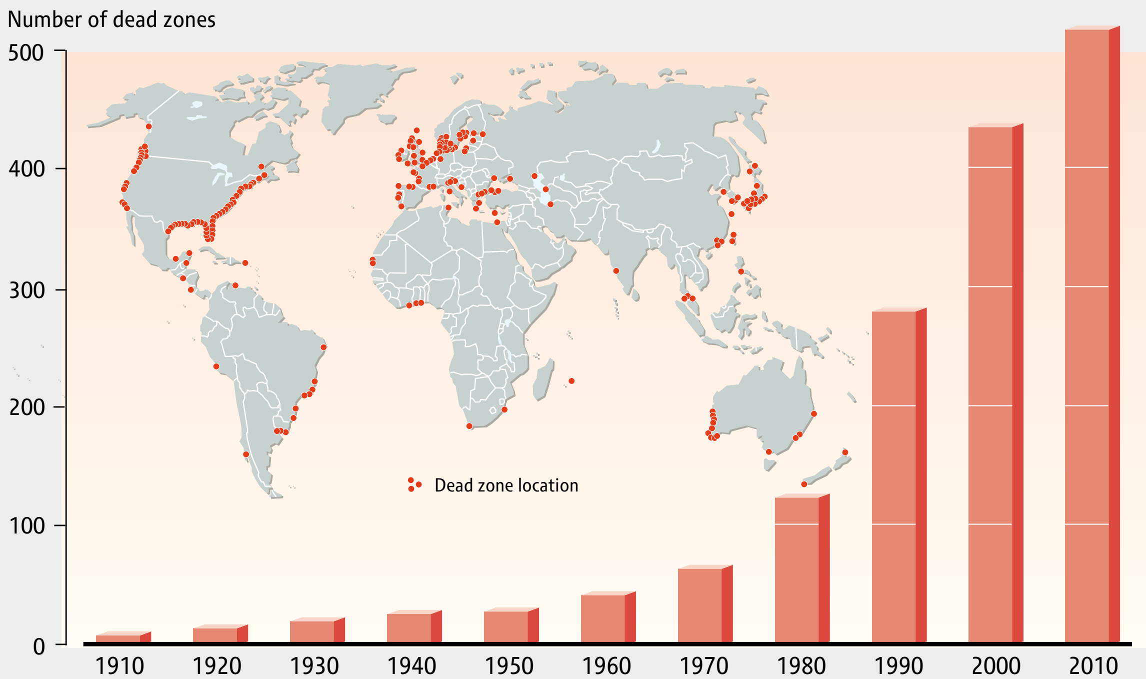
**Investment in resilient and diverse ecosystems, able to withstand the multiple pressures they are subjected to, may be the best-value insurance policy yet devised**

Large parts of Latin America and Africa, as well as Asia, are projected to experience elevated levels of nitrogen deposition in the next two decades. Although the impacts have mainly been studied in plants, nitrogen deposition may also affect animal biodiversity by changing the composition of available food.

In inland water and coastal ecosystems, the buildup of phosphorous and nitrogen, mainly through run-off from cropland and sewage pollution, stimulates the growth of algae and some forms of bacteria, threatening valuable ecosystem services in systems such as lakes and coral reefs, and affecting water quality. It also creates "dead zones" in oceans, generally where major rivers reach the sea. In these zones, decomposing algae use up oxygen in the water and leave large areas virtually devoid of marine life. The number of reported dead zones has been roughly doubling every ten years since the 1960s, and by 2007 had reached around 500 **[See Figure 15]**.

While the increase in nutrient load is among the most significant changes humans are making to ecosystems, policies in some regions are showing that this pressure can be controlled and, in time, reversed. Among the most comprehensive measures to combat nutrient pollution is the European Union's Nitrates Directive **[See Box 16 and Figure 16]**.

**FIGURE 15** Marine "dead zones"




The number of observed "dead zones", coastal sea areas where water oxygen levels have dropped too low to support most marine life, has roughly doubled each decade since the 1960s. Many are concentrated near the estuaries of major rivers, and result from the buildup of nutrients, largely carried from inland agricultural areas where fertilizers are washed into watercourses. The nutrients promote the growth of algae that die and decompose on the seabed, depleting the water of oxygen and threatening fisheries, livelihoods and tourism.

Source: Updated from Diaz and Rosenberg (2008). Science

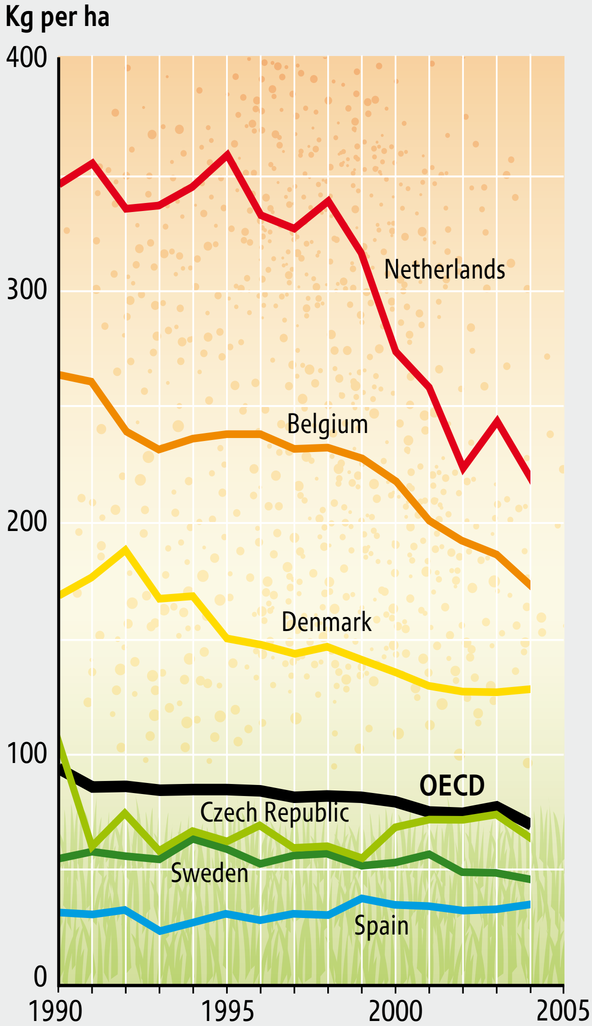
## BOX 16 The European Union's Nitrates Directive

The European Union has attempted to address the problem of nitrogen buildup in ecosystems by tackling diffuse sources of pollution, largely from agriculture, which can be much more difficult to control than point-source pollution from industrial sites.

The Nitrates Directive promotes a range of measures to limit the amount of nitrogen leaching from land into watercourses. They include:

- Use of crop rotations, soil winter cover and catch crops – fast-growing crops grown between successive planting of other crops in order to prevent flushing of nutrients from the soil. These techniques are aimed at limiting the amount of nitrogen leaching during wet seasons.
- Limiting application of fertilizers and manures to what is required by the crop, based on regular soil analysis.
- Proper storage facilities for manure, so that it is made available only when the crops need nutrients.
- The use of the "buffer" effect of maintaining non-fertilized grass strips and hedges along watercourses and ditches.
- Good management and restriction of cultivation on steeply sloping soils, and of irrigation.

Recent monitoring of inland water bodies within the European Union suggests that nitrate and phosphate levels are declining, although rather slowly. While nutrient levels are still considered too high, the improvements in quality, partly as a result of the Directive, have helped in the ecological recovery of some rivers.




### FIGURE 16 Nitrogen balance in Europe

The average nitrogen balance per hectare of agricultural land (the amount of nitrogen added to land as fertilizer, compared with the amount used up by crops and pasture) for selected European countries. The reduction over time in some countries implies improved efficiency in the use of fertilizer, and therefore a reduced risk of damage to biodiversity through nutrient run-off.

Source: OECD

# Overexploitation and unsustainable use

**The poor face the earliest and most severe impacts of biodiversity loss, but ultimately all societies and communities would suffer**

***Overexploitation and destructive harvesting practices are at the heart of the threats being imposed on the world's biodiversity and ecosystems, and there has not been significant reduction in this pressure. Changes to fisheries management in some areas are leading to more sustainable practices, but most stocks still require reduced pressure in order to rebuild. Bushmeat hunting, which provides a significant proportion of protein for many rural households, appears to be taking place at unsustainable levels.***

Overexploitation is the major pressure being exerted on marine ecosystems, with marine capture fisheries having quadrupled in size from the early 1950s to the mid 1990s. Total catches have fallen since then despite increased fishing effort, an indication that many stocks have been pushed beyond their capacity to replenish.

The FAO estimates that more than a quarter of marine fish stocks are overexploited (19%), depleted (8%) or recovering from depletion (1%) while more than half are fully exploited. Although there have been some recent signs that fishing authorities are imposing more realistic expectations on the size of catches that can safely be taken out of the oceans, some 63% of assessed fish stocks worldwide require rebuilding. Innovative approaches to the management of fisheries, such as those that give fishermen a stake in maintaining healthy stocks, are proving to be effective where they are applied **[See Box 17]**.

### BOX 17 Managing marine food resources for the future

Various management options have emerged in recent years that aim to create more secure and profitable livelihoods by focusing on the long-term sustainability of fisheries, rather than maximizing short-term catches. An example is the use of systems that allocate to individual fishermen, communities or cooperatives a dedicated share of the total catch of a fishery. It is an alternative to the more conventional system of quota-setting, in which allocations are expressed in terms of tonnes of a particular stock.

This type of system, sometimes known as Individual Transferable Quotas (ITQ), gives fishing businesses a stake in the integrity and productivity of the ecosystem, since they will be entitled to catch and sell more fish if there are more fish to be found. It should therefore deter cheating, and create an incentive for better stewardship of the resource.

A study of 121 ITQ fisheries published in 2008 found that they were about half as likely to face collapse than fisheries using other management methods. However, the system has also been criticized in some areas for concentrating fishing quotas in the hands of a few fishing enterprises.

Recent studies on the requirements for fish stock recovery suggest that such approaches need to be combined with reductions in the capacity of fishing fleets, changes in fishing gear and the designation of closed areas.

The benefits of more sustainable use of marine biodiversity were shown in a study of a programme in Kenya aimed at reducing pressure on fisheries associated with coral reefs. A combination of closing off areas to fishing, and restrictions on the use of seine nets that capture concentrated schools of fish, led to increased incomes for local fishermen.

Certification schemes such as the Marine Stewardship Council are aimed at providing incentives for sustainable fishing practices, by signaling to the consumer that the end-product derives from management systems that respect the long-term health of marine ecosystems. Seafood fulfilling the criteria for such certification can gain market advantages for the fishermen involved.

Wild species are being over-exploited for a variety of purposes in terrestrial, inland water and marine and coastal ecosystems. Bushmeat hunting, which provides a significant proportion of protein for many rural households in forested regions such as Central Africa, appears to be taking place at unsustainable levels. In some areas this has contributed to the so-called "empty forest syndrome", in which apparently healthy forests become virtually devoid of animal life. This has potentially serious impacts on the resilience of forest ecosystems, as some 75% of tropical trees depend on animals to disperse their seeds.

Freshwater snakes in Cambodia have been found to be suffering from unsustainable hunting for sale to crocodile farms, restaurants and the fashion trade, with low-season catches per hunter falling by more than 80% between 2000 and 2005. A wide variety of other wild species have also declined in the wild as a result of overexploitation, ranging from high profile species such as tigers and sea turtles to lesser-known species such as *Encephalartos brevifoliolatus*, a cycad which is now extinct in the wild as a result of over harvesting for use in horticulture.

# Invasive alien species

***Invasive alien species continue to be a major threat to all types of ecosystems and species. There are no signs of a significant reduction of this pressure on biodiversity, and some indications that it is increasing. Intervention to control alien invasive species has been successful in particular cases, but it is outweighed by the threat to biodiversity from new invasions.***

In a sample of 57 countries, more than 542 alien species, including vascular plants, marine and freshwater fish, mammals, birds and amphibians, with a demonstrated impact on biodiversity have been found, with an average of over 50 such species per country (and a range from nine to over 220). This is most certainly an underestimate, as it excludes many alien species whose impact has not yet been examined, and includes countries known to lack data on alien species.

It is difficult to get an accurate picture of whether damage from this source is increasing, as in many areas attention has only recently been focused on the problem, so a rise in known invasive species impacts may partly reflect improved knowledge and awareness. However, in Europe where introduction of alien species has been recorded for many decades, the cumulative number continues to increase and has done so at least since the beginning of the 20th century. Although these are not necessarily invasive, more alien species present in a country means that in time, more may become invasive. It has been estimated that of some 11,000 alien species in Europe, around one in ten has ecological impacts and a slightly higher proportion causes economic damage **[See Box 18]**. Trade patterns worldwide suggest that the European picture is similar elsewhere and, as a consequence, that the size of the invasive alien species problem is increasing globally.

**BOX 18** Documenting Europe's alien species

The Delivering Alien Invasive Species Inventories for Europe (DAISIE) project provides consolidated information aimed at creating an inventory of invasive species that threaten European biodiversity. This can be used as the basis for the prevention and control of biological invasions, to assess the ecological and socio-economic risks associated with most widespread invasive species, and to distribute data and experience to member states as a form of early warning system.

Currently about 11,000 alien species have documented by DAISIE. Examples include Canada geese, zebra mussels, brook trout, the Bermuda buttercup and coypu (nutria). A recent study based on information provided by DAISIE indicated that of the 11,000 alien species in Europe, 1,094 have documented ecological impacts and 1,347 have economic impacts. Terrestrial invertebrates and terrestrial plants are the two taxonomic groups causing the greatest impacts.

Eleven bird species (since 1988), five mammal species (since 1996) and one amphibian (since 1980) have substantially had their risk of extinction reduced due primarily to the successful control or eradication of alien invasive species. Without such actions, it is estimated that the average survival chances, as measured by the Red List Index, would have been more than 10% worse for bird species and almost 5% worse for mammals **[See Box 19]**. However, the Red List Index also shows that almost three times as many birds, almost twice as many mammals, and more than 200 times the number of amphibian species, have deteriorated in conservation status due largely to increased threats from invasive animals, plants or micro-organisms. Overall, birds, mammals and amphibian species have on average become more threatened due to invasive alien species. While other groups have not been fully assessed, it is known that invasive species are the second leading cause for extinction for freshwater mussels and more generally among endemic species.

### BOX 19 Successful control of alien invasive species

- The Black vented Shearwater (*Puffinus opisthomelas*) breeds on six islands off the Pacific coast of Mexico, one of which is Natividad. Predation from approximately 20 feral cats reduced the population of the bird by more than 1,000 birds per month while introduced herbivores such as donkeys, goats sheep and rabbits damaged habitat of importance to the bird. With the assistance of a local fishing community goats and sheep were removed from the island in 1997-1998 while cats were controlled in 1998 and eventually eradicated in 2006. As a result the pressure on this species has decreased, the population has begun to recover and the species was reclassified from Vulnerable to Near Threatened in the IUCN Red List of 2004.

- The Western Brush Wallaby (*Macropus irma*) is endemic to south western Australia. During the 1970 the wallaby began to decline as a result of a dramatic increase in the Red Fox (*Vulpes vulpes*) population. Surveys conducted in 1970 and 1990 suggested that population had declined from approximately 10 individuals per 100 kilometers to about 1 per 100 kilometers. Since the introduction of fox control measures the wallaby population has recovered and currently stands at approximately 100,000 individuals. As a result the Western Brush Wallaby has been reclassified from Near Threatened to Least Concern on the IUCN Red List of 2004.

# *Combined pressures and underlying causes of biodiversity loss*

**Effective action to address biodiversity loss depends on addressing the underlying causes or indirect drivers of that decline**

***The direct drivers of biodiversity loss act together to create multiple pressures on biodiversity and ecosystems. Efforts to reduce direct pressures are challenged by the deep-rooted underlying causes or indirect drivers that determine the demand for natural resources and are much more difficult to control. The ecological footprint of humanity exceeds the biological capacity of the Earth by a wider margin than at the time the 2010 target was agreed.***

The pressures or drivers outlined above do not act in isolation on biodiversity and ecosystems, but frequently, with one pressure exacerbating the impacts of another. For example:

- Fragmentation of habitats reduces the capacity of species to adapt to climate change, by limiting the possibilities of migration to areas with more suitable conditions.

- Pollution, overfishing, climate change and ocean acidification all combine to weaken the resilience of coral reefs and increase the tendency for them to shift to algae-dominated states with massive loss of biodiversity.

- Increased levels of nutrients combined with the presence of invasive alien species can promote the growth of hardy plants at the expense of native species. Climate change can further exacerbate the problem by making more habitats suitable for invasive species.

- Sea level rise caused by climate change combines with physical alteration of coastal habitats, accelerating change to coastal biodiversity and associated loss of ecosystem services.

An indication of the magnitude of the combined pressures we are placing on biodiversity and ecosystems is provided by humanity's ecological footprint, a calculation of the area of biologically-productive land and water needed to provide the resources we use and to absorb our waste. The ecological footprint for 2006, the latest year for which the figure is available, was estimated to exceed the Earth's biological capacity by 40 per cent. This "overshoot" has increased from some 20 per cent at the time the 2010 biodiversity target was agreed in 2002.

As suggested above, specific measures can and do have an impact in tackling the direct drivers of biodiversity loss: alien species control, responsible management of farm waste and habitat protection and restoration are some examples. However, such measures must compete with a series of powerful underlying causes of biodiversity loss. These are even more challenging to control, as they tend to involve long-term social, economic and cultural trends. Examples of underlying causes include:

- ✤ Demographic change
- ✤ Economic activity
- ✤ Levels of international trade
- ✤ Per capita consumption patterns, linked to individual wealth
- ✤ Cultural and religious factors
- ✤ Scientific and technological change

Indirect drivers primarily act on biodiversity by influencing the quantity of resources used by human societies. So for example population increase, combined with higher per capita consumption, will tend to increase demand for energy, water and food – each of which will contribute to direct pressures such as habitat conversion, over-exploitation of resources, nutrient pollution and climate change. Increased world trade has been a key indirect driver of the introduction of invasive alien species.

Indirect drivers can have positive as well as negative impacts on biodiversity. For example, cultural and religious factors shape society's attitudes towards nature and influence the level of funds available for conservation. The loss of traditional knowledge can be particularly detrimental in this regard, as for many local and indigenous communities biodiversity is a central component of belief systems, worldviews and identity. Cultural changes such as the loss of indigenous languages can therefore act as indirect drivers of biodiversity loss by affecting local practices of conservation and sustainable use **[See Box 20]**. Equally, scientific and technological change can provide new opportunities for meeting society's demands while minimizing the use of natural resources – but can also lead to new pressures on biodiversity and ecosystems.

Strategies for decreasing the negative impacts of indirect drivers are suggested in the final section of this synthesis. They centre on "decoupling" indirect from direct drivers of biodiversity loss, primarily by using natural resources much more efficiently; and by managing ecosystems to provide a range of services for society, rather than only maximizing individual services such as crop production or hydro-electric power.

***The trends from available indicators suggest that the state of biodiversity is declining, the pressures upon it are increasing, and the benefits derived by humans from biodiversity are diminishing, but that the responses to address its loss are increasing [See Figure 17]. The overall message from these indicators is that despite the many efforts taken around the world to conserve biodiversity and use it sustainably, responses so far have not been adequate to address the scale of biodiversity loss or reduce the pressure.***

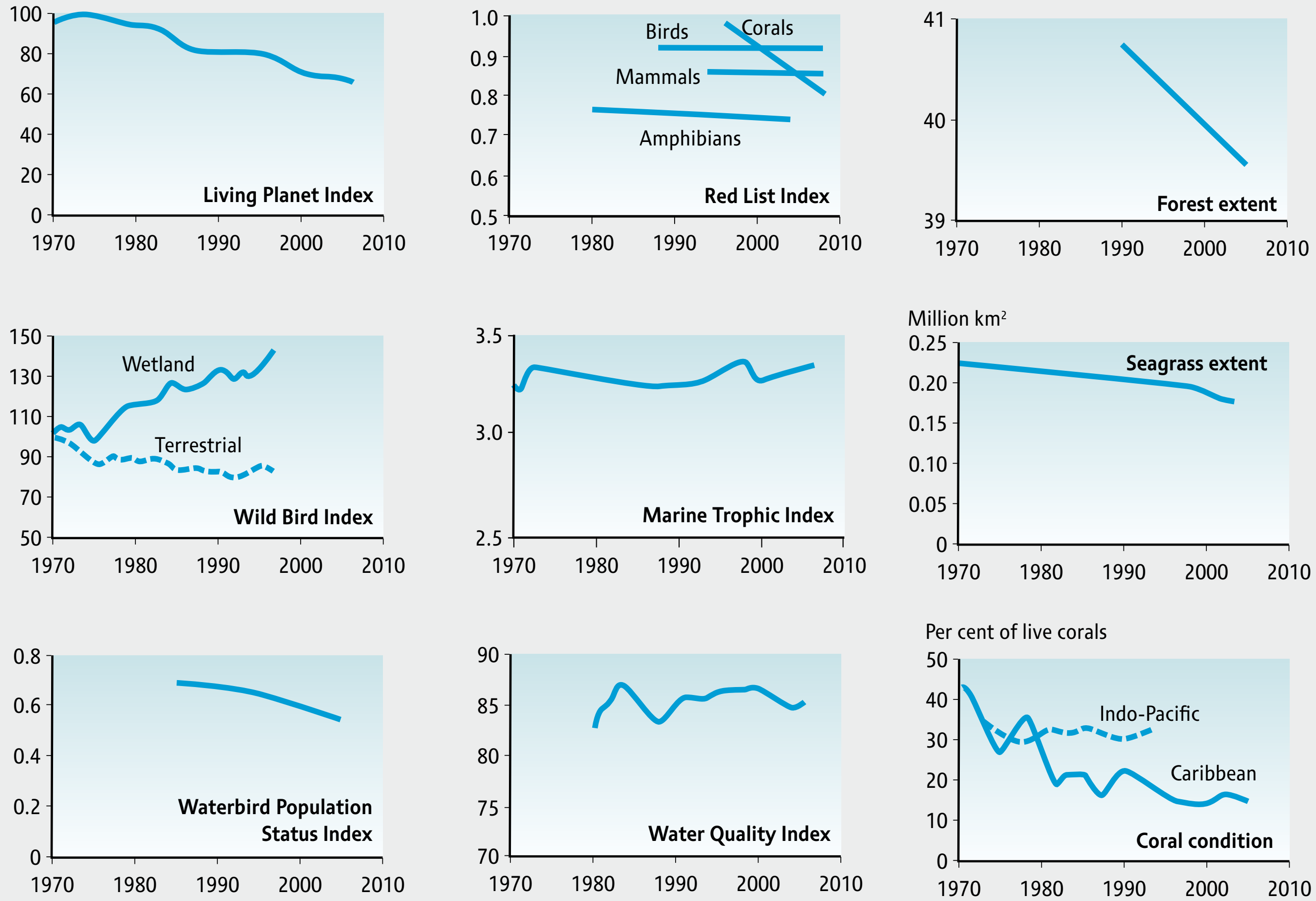
### BOX 20 Trends in indigenous languages

Indigenous languages transmit specialized knowledge about biodiversity, the environment and about practices to manage natural resources. However, determining the status and trends of indigenous languages at the global level is complicated by the lack of standardized methodologies, the absence of shared definitions for key concepts and limited information. Where such information exists there is evidence that the extinction risk for the most endangered languages, those with few speakers, has increased. For example:

- ✤ Between 1970 and 2000, 16 of 24 indigenous languages spoken by less than 1,000 people in Mexico lost speakers.
- ✤ In the Russian Federation, between 1950 and 2002, 15 of 27 languages spoken by less than 10,000 people lost speakers.
- ✤ In Australia, 22 of 40 languages lost speakers between 1996 and 2006.
- ✤ In an assessment of 90 languages used by different indigenous peoples in the Arctic, it was determined that 20 languages have become extinct since the 19th century. Ten of these extinctions have occurred since 1989, suggesting an increasing rate of language extinctions. A further 30 languages are considered to be critically endangered while 25 are severely endangered.

**FIGURE 17** Summary of biodiversity indicators

## STATE




These graphs help to summarize the message from the available indicators on biodiversity: that the state of biodiversity is declining, the pressures upon it are increasing, and the benefits derived by humans from biodiversity are diminishing, but that the responses to address its loss are increasing. They reinforce the conclusion that the 2010 biodiversity target has not been met.

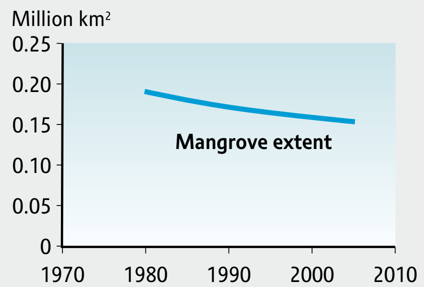
Most indicators of the state of biodiversity show negative trends, with no significant reduction in the rate of decline.

There is no evidence of a slowing in the increase of pressures upon biodiversity, based on the trend shown by indicators of humanity's ecological footprint, nitrogen deposition, alien species introductions, overexploited fish stocks and the impact of climate change on biodiversity.

The limited indicators of the benefits derived by humans from biodiversity also show negative trends.

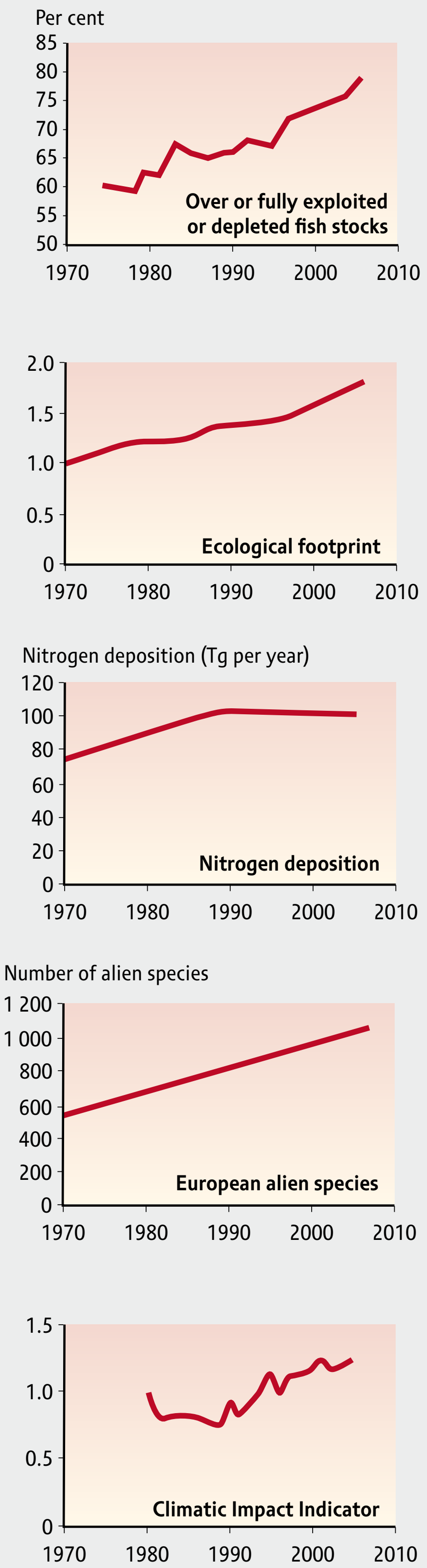
In contrast, all indicators of the responses to address biodiversity loss are moving in a positive direction. More areas are being protected for biodiversity, more policies and laws are being introduced to avoid damage from invasive alien species, and more money is being spent in support of the Convention on Biological Diversity and its objectives.

The overall message from these indicators is that despite the many efforts taken around the world to conserve biodiversity and use it sustainably, responses so far have not been adequate to address the scale of biodiversity loss or reduce the pressures.



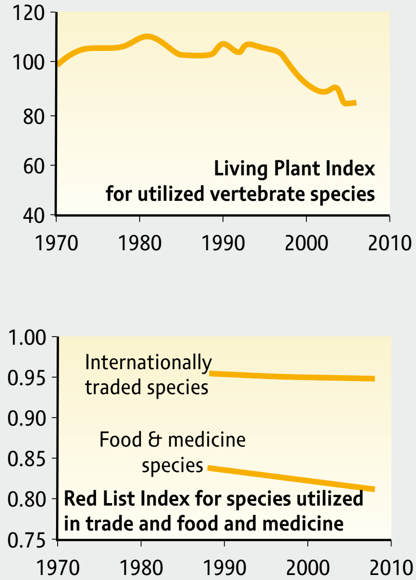

Source: Adapted from Butchart etal. (2010). Science

## PRESSURE




## RESPONSES


## BENEFITS



# **Biodiversity Futures**
# for the 21$^{st}$ Century

***Continuing species extinctions far above the historic rate, loss of habitats and changes in the distribution and abundance of species are projected throughout this century according to all scenarios analyzed for this Outlook. There is a high risk of dramatic biodiversity loss and accompanying degradation of a broad range of ecosystem services if the Earth system is pushed beyond certain thresholds or tipping points. The loss of such services is likely to impact the poor first and most severely, as they tend to be most directly dependent on their immediate environments; but all societies will be impacted. There is greater potential than was recognized in earlier assessments to address both climate change and rising food demand without further widespread loss of habitats.***

For the purposes of this Outlook, scientists from a wide range of disciplines came together to identify possible future outcomes for biodiversity change during the rest of the 21st century. The results summarized here are based on a combination of observed trends, models and experiments. They draw upon and compile all previous relevant scenario exercises conducted for the Millennium Ecosystem Assessment, the Global Environment Outlook and earlier editions of the Global Biodiversity Outlook, as well as scenarios being developed for the next assessment report of the Intergovernmental Panel on Climate Change (IPCC). They pay particular attention to the relationship between biodiversity change and its impacts on human societies. In addition to the analysis of existing models and scenarios, a new assessment was carried out of potential "tipping points" that could lead to large, rapid and potentially irreversible changes. The analysis reached four principal conclusions:

- *Projections of the impact of global change on biodiversity show continuing and often accelerating species extinctions, loss of natural habitat, and changes in the distribution and abundance of species, species groups and biomes over the 21st century.*

- *There are widespread thresholds, amplifying feedbacks and time-lagged effects leading to "tipping points", or abrupt shifts in the state of biodiversity and ecosystems. This makes the impacts of global change on biodiversity hard to predict, difficult to control once they begin, and slow, expensive or impossible to reverse once they have occurred* **[See Box 21 and Figure 18]**.

- *Degradation of the services provided to human societies by functioning ecosystems are often more closely related to changes in the abundance and distribution of dominant or keystone species, rather than to global extinctions; even moderate biodiversity change globally can result in disproportionate changes for some groups of species (for example top predators) that have a strong influence on ecosystem services.*

- *Biodiversity and ecosystem changes could be prevented, significantly reduced or even reversed (while species extinctions cannot be reversed, diversity of ecosystems can be restored) if strong action is applied urgently, comprehensively and appropriately, at international, national and local levels. This action must focus on addressing the direct and indirect factors driving biodiversity loss, and must adapt to changing knowledge and conditions.*

The projections, potential tipping points, impacts and options for achieving better outcomes are summarized on the following pages:

There is a high risk of dramatic biodiversity loss and accompanying degradation of a broad range of ecosystem services if ecosystems are pushed beyond certain thresholds or tipping points

**BOX 21** What is a tipping point?

A tipping point is defined, for the purposes of this Outlook, as a situation in which an ecosystem experiences a shift to a new state, with significant changes to biodiversity and the services to people it underpins, at a regional or global scale. Tipping points also have at least one of the following characteristics:

✤ The change becomes self-perpetuating through so-called positive feedbacks, for example deforestation reduces regional rainfall, which increases fire-risk, which causes forest dieback and further drying.

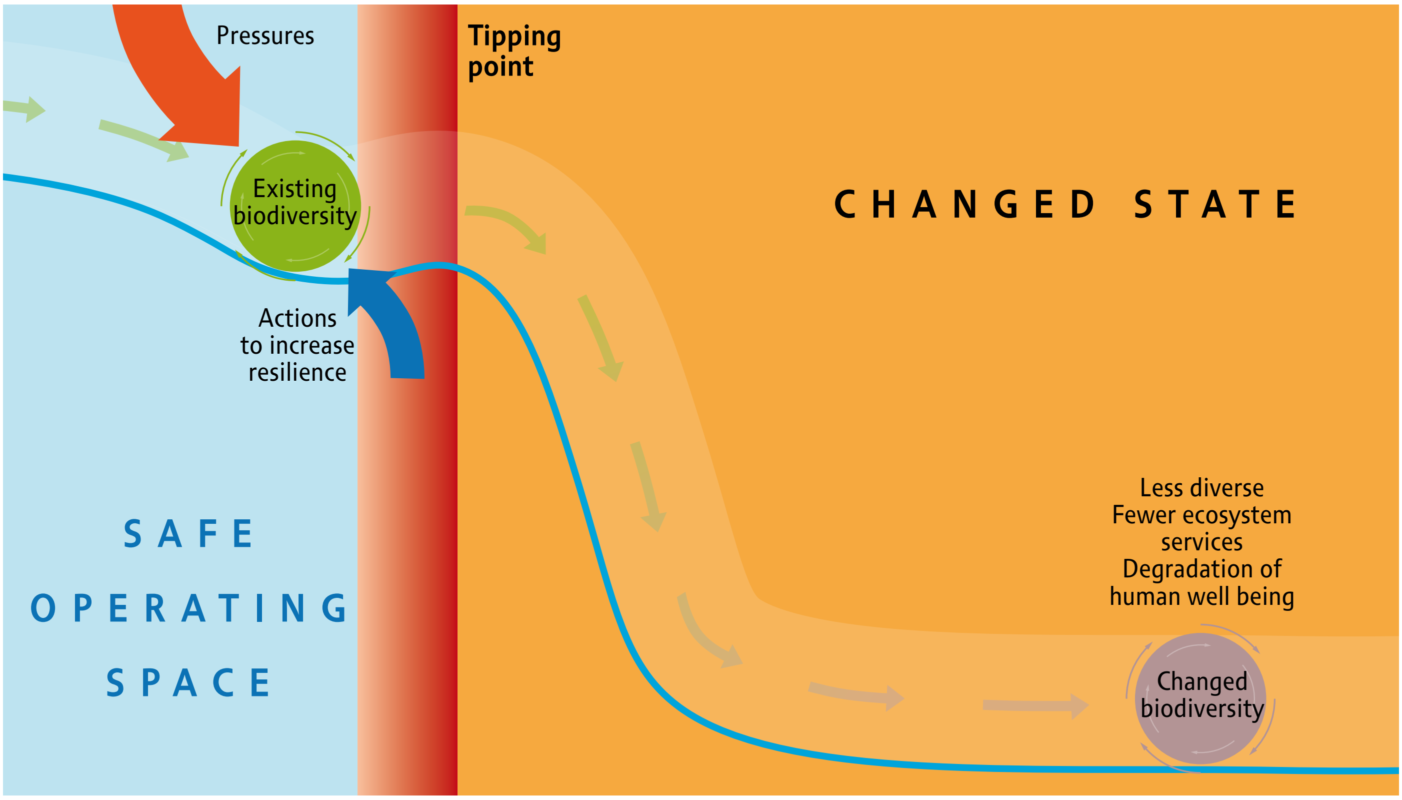
✤ There is a threshold beyond which an abrupt shift of ecological states occurs, although the threshold point can rarely be predicted with precision.

✤ The changes are long-lasting and hard to reverse.

✤ There is a significant time lag between the pressures driving the change and the appearance of impacts, creating great difficulties in ecological management.

Tipping points are a major concern for scientists, managers and policy–makers, because of their potentially large impacts on biodiversity, ecosystem services and human well-being. It can be extremely difficult for societies to adapt to rapid and potentially irreversible shifts in the functioning and character of an ecosystem on which they depend. While it is almost certain that tipping points will occur in the future, the dynamics in most cases cannot yet be predicted with enough precision and advance warning to allow for specific and targeted approaches to avoid them, or to mitigate their impacts. Responsible risk management may therefore require a precautionary approach to human activities known to drive biodiversity loss.

**FIGURE 18** Tipping points – an illustration of the concept




The mounting pressures on biodiversity risks pushing some ecosystems into new states, with severe ramifications for human wellbeing as tipping points are crossed. While the precise location of tipping points is difficult to determine, once an ecosystem moves into a new state it can be very difficult, if not impossible, to return it to its former state.

Source: Secretariat of the Convention on Biological Diversity

# *Terrestrial ecosystems to 2100*

## *Current path:*

Land-use change continues as the main short-term threat, with climate change, and the interactions between these two drivers, becoming progressively important. Tropical forests continue to be cleared, making way for crops and biofuels. Species extinctions many times more frequent than the historic "background rate" - the average rate at which species are estimated to have gone extinct before humans became a significant threat to species survival - and loss of habitats continue throughout the 21st century. Populations of wild species fall rapidly, with especially large impacts for equatorial Africa and parts of South and South-East Asia. Climate change causes boreal forests to extend northwards into tundra, and to die back at their southern margins giving way to temperate species. In turn, temperate forests are projected to die back at the southern and low-latitude edge of their range. Many species suffer range reductions and/or move close to extinction as their ranges shift several hundred kilometres towards the poles. Urban and agricultural expansion further limits opportunities for species to migrate to new areas in response to climate change.

## *Impacts for people:*

The large-scale conversion of natural habitats to cropland or managed forests will come at the cost of degradation of biodiversity and the ecosystem services it underpins, such as nutrient retention, clean water supply, soil erosion control and ecosystem carbon storage, unless sustainable practices are used to prevent or reduce these losses. Climate-induced changes in the distribution of species and vegetation-types will have important impacts on the services available to people, such as reduced wood harvests and recreation opportunities.

***In addition, there is a high risk of dramatic loss of biodiversity and degradation of services from terrestrial ecosystems if certain thresholds are crossed. Plausible scenarios include:***

- The **Amazon forest,** due to the interaction of deforestation, fire and climate change, undergoes a widespread dieback, changing from rainforest to savanna or seasonal forest over wide areas, especially in the East and South of the biome. The forest could move into a self-perpetuating cycle in which fires become more frequent, drought more intense and dieback accelerates. Dieback of the Amazon will have global impacts through increased carbon emissions, accelerating climate change. It will also lead to regional rainfall reductions that could compromise the sustainability of regional agriculture.

- The **Sahel** in Africa, under pressure from climate change and over-use of limited land resources, shifts to alternative, degraded states, further driving desertification. Severe impacts on biodiversity and agricultural productivity result. Continued degradation of the Sahel has caused and could continue to cause loss of biodiversity and shortages of food, fibre and water in Western Africa.

- **Island ecosystems** are afflicted by a cascading set of extinctions and ecosystem instabilities, due to the impact of invasive alien species. Islands are particularly vulnerable to such invasions as communities of species have evolved in isolation and often lack defences against predators and disease organisms. As the invaded communities become increasingly altered and impoverished, vulnerability to new invasions may increase.

BEFORE

## *Alternative paths:*

*Alleviating pressure from land use changes in the tropics is essential, if the negative impacts of loss of terrestrial biodiversity and associated ecosystem services are to be minimized. This involves a combination of measures, including an increase in productivity from existing crop and pasture lands, reducing post-harvest losses, sustainable forest management and moderating excessive and wasteful meat consumption.*

*Full account should be taken of the greenhouse gas emissions associated with large-scale conversion of forests and other ecosystems into cropland. This will prevent perverse incentives for the destruction of biodiversity through large-scale deployment of biofuel crops, in the name of climate change mitigation* ***[See Figures 19 and 20]****. When emissions from land-use change rather than just energy emissions are factored in, plausible development pathways emerge that tackle climate change without widespread biofuel use. Use of payments for ecosystem services, such as Reducing Emissions from Deforestation and Degradation (REDD) mechanisms may help align the objectives of addressing biodiversity loss and climate change. However, these systems must be carefully designed, as conserving areas of high carbon value will not necessarily conserve areas of high conservation importance – this is being recognized in the development of so-called "REDD-Plus" mechanisms.*

*Tipping points are most likely to be avoided if climate change mitigation to keep average temperature increases below 2 degrees Celsius is accompanied by action to reduce other factors pushing the ecosystem towards a changed state. For example, in the Amazon it is estimated that keeping deforestation below 20% of the original forest extent will greatly reduce the risk of widespread dieback. As current trends will likely take cumulative deforestation to 20% of the Brazilian Amazon at or near 2020, a programme of significant forest restoration would be a prudent measure to build in a margin of safety. Better forest management options in the Mediterranean, including the greater use of native broad-leaf species in combination with improved spatial planning, could make the region less fire-prone. In the Sahel, better governance, poverty alleviation and assistance with farming techniques will provide alternatives to current cycles of poverty and land degradation.*

*Avoiding biodiversity loss in terrestrial areas will also involve new approaches to conservation, both inside designated protected areas and beyond their boundaries. In particular, greater attention must be given to the management of biodiversity in human-dominated landscapes, because of the increasingly important role these areas will play as biodiversity corridors as species and communities migrate due to climate change.*

*There are opportunities for rewilding landscapes from farmland abandonment in some regions – in Europe, for example, about 200 000 square kilometers of land are expected to be freed up by 2050. Ecological restoration and reintroduction of large herbivores and carnivores will be important in creating self-sustaining ecosystems with minimal need for further human intervention.*

AFTER

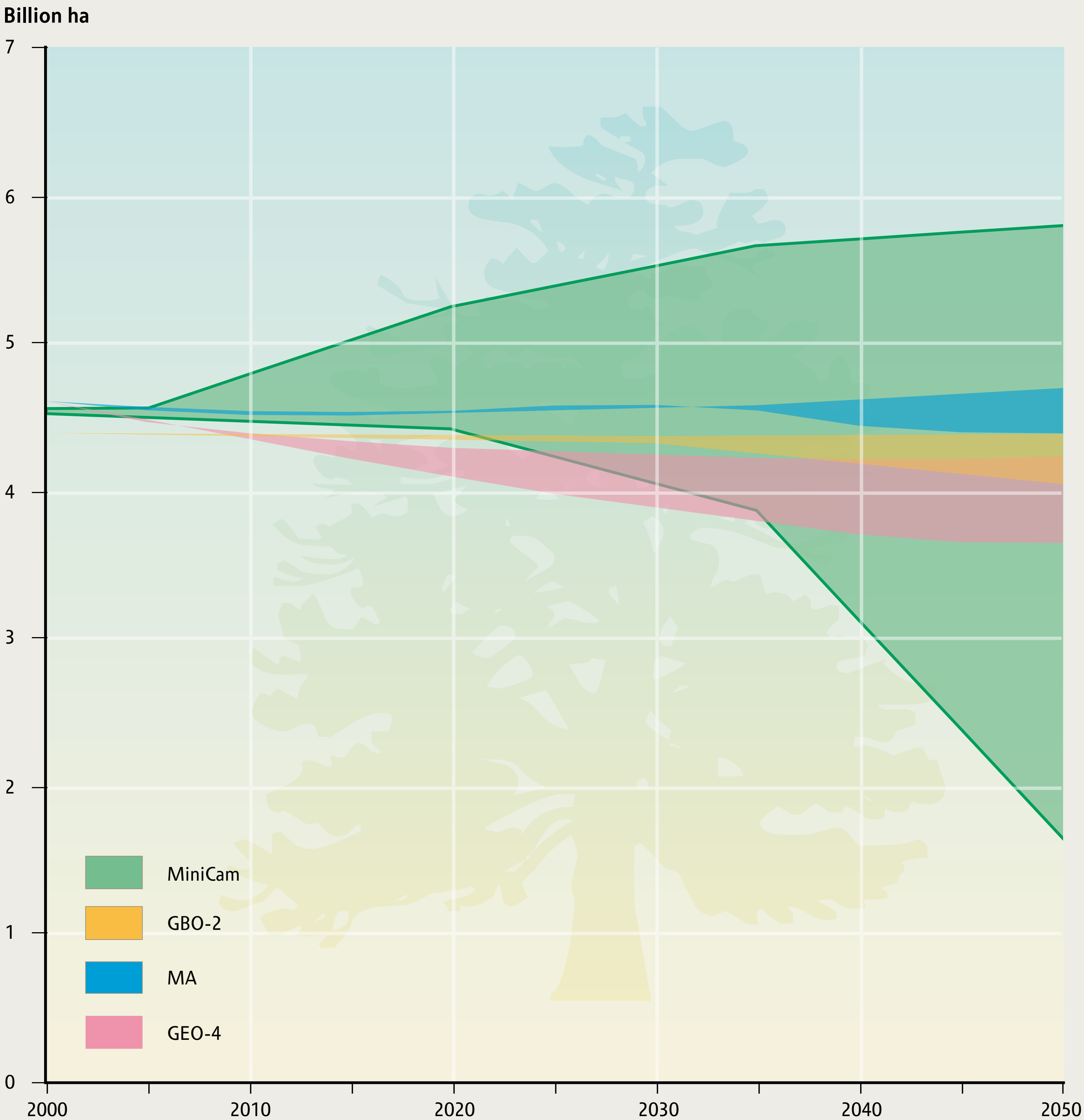
Amazon forest

BEFORE

AFTER

Island ecosystems

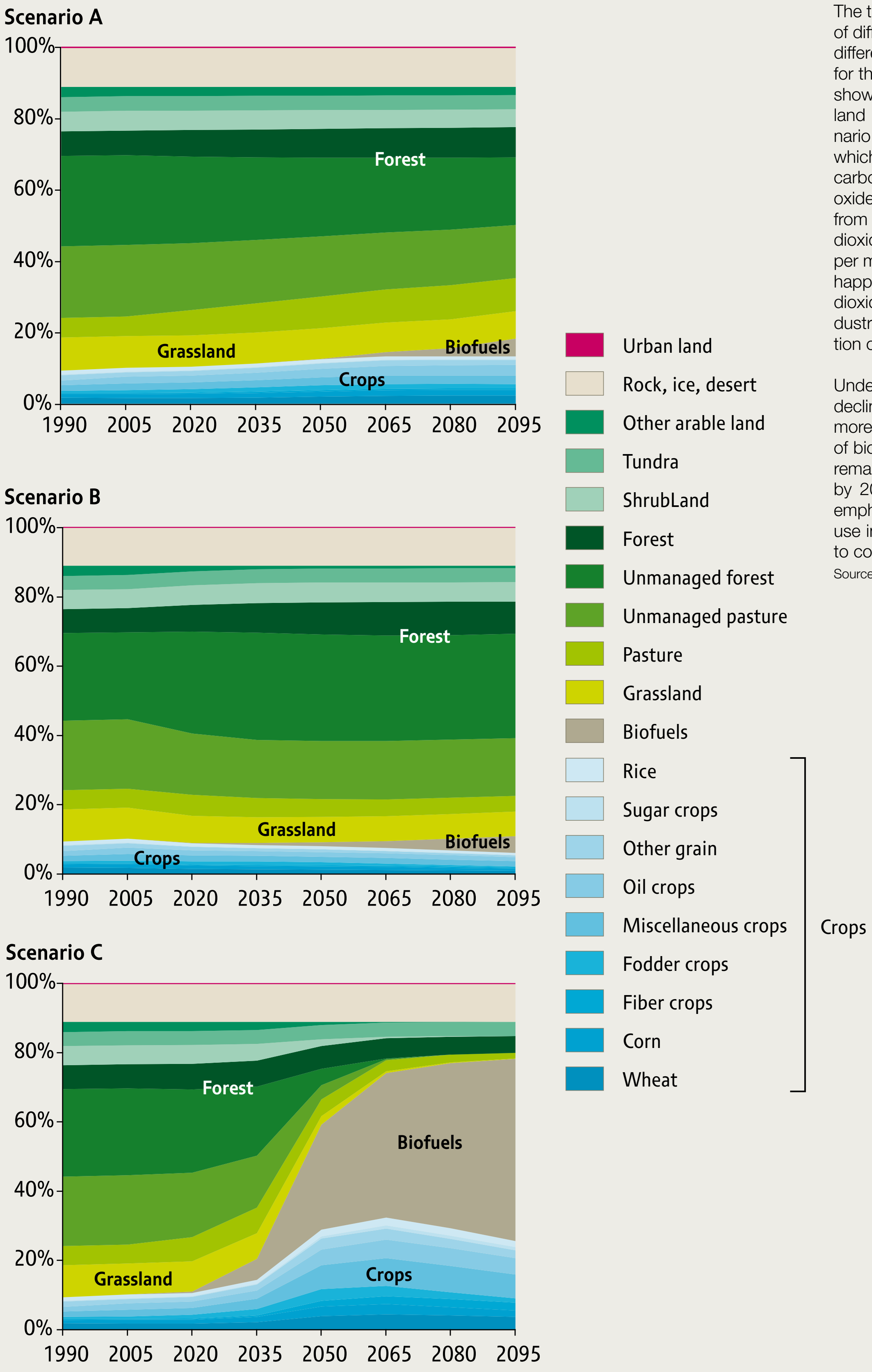
**FIGURE 19** Projected forest loss until 2050 under different scenarios




The graph shows projections of global forest cover to 2050, according to various scenarios from four assessments which assume different approaches to environmental concerns, regional co-operation, economic growth and other factors. These include three earlier assessments (Millennium Ecosystem Assessment, Global Biodiversity Outlook 2 and Global Environmental Outlook 4) and one model (MiniCam, developed for the fifth assessment report of the Intergovernmental Panel on Climate Change). When the different scenarios are considered together, the gap between better and worse outcomes for biodiversity is wider than has been suggested in any one of the earlier assessments. In addition, the MiniCam scenarios shows a greater range still. They mainly represent the contrasting outcomes for forests depending on whether or not carbon emissions from land use change are taken into account in climate change mitigation strategies.

Source: Leadley and Pereira et al (2010)

**FIGURE 20** Land use change under different scenarios




The three images represent a comparison of different global land use patterns under different scenarios from 1990 until 2095 for the same MiniCam scenarios as those shown in figure 19. Scenario A represents land use under a business as usual scenario. Scenario B illustrates a scenario in which incentives, equivalent to a global carbon tax, are applied to all carbon dioxide emissions, including those resulting from land use change, to keep carbon dioxide concentrations below 450 parts per million. Scenario C illustrates what will happen if the incentives apply to carbon dioxide emissions from fossil fuels and industrial emissions only, with no consideration of emissions from land use change.

Under scenario C, there is a dramatic decline in both forests and pasture as more land is devoted to the production of biofuels. The dramatic difference in the remaining extent of forests and pasture by 2095 under the respective scenarios emphasizes the importance of taking land use into account when designing policies to combat climate change.

Source: Wise et al. (2009). Science

# Inland water ecosystems to 2100

## Current path:

Inland water ecosystems continue to be subjected to massive changes as a result of multiple pressures, and biodiversity to be lost more rapidly than in other types of ecosystem. Challenges related to water availability and quality multiply globally, with increasing water demands exacerbated by a combination of climate change, the introduction of alien species, pollution and dam construction, putting further pressure on freshwater biodiversity and the services it provides. Dams, weirs, reservoirs for water supply and diversion for irrigation and industrial purposes increasingly create physical barriers blocking fish movements and migrations, endangering or extinguishing many freshwater species. Fish species unique to a single basin become especially vulnerable to climate change. One projection suggests fewer fish species in around 15% of rivers by 2100, from climate change and increased water withdrawals alone. River basins in developing countries face the introduction of a growing number of non-native organisms as a direct result of economic activity, increasing the risk of biodiversity loss from invasive species.

## Impacts for people:

The overall projected degradation of inland waters and the services they provide casts uncertainty over the prospects for food production from freshwater ecosystems. This is important, because approximately 10% of wild harvested fish are caught from inland waters, and frequently make up large fractions of dietary protein for riverside or lake communities.

***In addition, there is a high risk of dramatic loss of biodiversity and degradation of services from freshwater ecosystems if certain thresholds are crossed. Plausible scenarios include:***

- **Freshwater eutrophication** caused by the build-up of phosphates and nitrates from agricultural fertilizers, sewage effluent and urban stormwater runoff shifts freshwater bodies, especially lakes, into an algae-dominated (eutrophic) state. As the algae decay, oxygen levels in the water are depleted, and there is widespread die-off of other aquatic life including fish. A recycling mechanism is activated which can keep the system eutrophic even after nutrient levels are substantially reduced. The eutrophication of freshwater systems, exacerbated in some regions by decreasing precipitation and increasing water stress, can lead to declining fish availability with implications for nutrition in many developing countries. There will also be loss of recreation opportunities and tourism income, and in some cases health risks for people and livestock from toxic algal blooms.

- **Changing patterns of melting of snow and glaciers** in mountain regions, due to climate change, cause irreversible changes to some freshwater ecosystems. Warmer water, greater run-off during a shortened melt-season and longer periods with low flows disrupt the natural functioning of rivers, and ecological processes which are influenced by the timing, duration and volume of flows. Impacts will include, among many others, loss of habitat, changes to the timing of seasonal responses (phenology), and changes to water chemistry.

BEFORE

## *Alternative paths:*

*There is large potential to minimize impacts on water quality and reducing the risk of eutrophication, through investment in sewage treatment, wetland protection and restoration, and control of agricultural run-off, particularly in the developing world.*

*There are also widespread opportunities to improve the efficiency of water use, especially in agriculture and industry. This will help to minimize the tradeoffs between increasing demand for fresh water and protection of the many services provided by healthy freshwater ecosystems.*

*More integrated management of freshwater ecosystems will help reduce negative impacts from competing pressures. Restoration of disrupted processes such as reconnecting floodplains, managing dams to mimic natural flows and re-opening access to fish habitats blocked by dams, can help to reverse degradation. Payments for ecosystem services, such as the protection of upstream watersheds through conservation of riparian forests, can reward communities that ensure continued provision of those services to users of inland water resources in different parts of a basin.*

*Spatial planning and protected area networks can be adapted more specifically to the needs of freshwater systems, by safeguarding the essential processes in rivers and wetlands, and their interactions with terrestrial and marine ecosystems. Protection of rivers that are still unfragmented can be seen as a priority in the conservation of inland water biodiversity. Maintaining connectivity within river basins will be increasingly important, so that species are better able to migrate in response to climate change.*

*Even with the most aggressive measures to mitigate climate change, significant changes to snow and glacier melt regimes are inevitable, and are already being observed. However, the impacts on biodiversity can be reduced by minimizing other stresses such as pollution, habitat loss and water abstraction, as this will increase the capacity of aquatic species and ecosystems to adapt to changes in snow and glacier melting.*

AFTER

Snow and glaciers

BEFORE AFTER

Freshwater eutrophication

# Marine and coastal ecosystems to 2100

## Current path:

Demand for seafood continues to grow as population increases and more people have sufficient income to include it in their diet. Wild fish stocks continue to come under pressure, and aquaculture expands. Progressively fishing down the marine food web comes at the expense of marine biodiversity (continuing decline in marine trophic index in many marine areas). Climate change causes fish populations to redistribute towards the poles, and tropical oceans become comparatively less diverse. Sea level rise threatens many coastal ecosystems. Ocean acidification weakens the ability of shellfish, corals and marine phytoplankton to form their skeletons, threatening to undermine marine food webs as well as reef structure. Increasing nutrient loads and pollution increase the incidence of coastal dead zones, and increased globalization creates more damage from alien invasive species transported in ship ballast water.

## Impacts for people:

The decline of fish stocks and their redistribution towards the poles has major implications for food security and nutrition in poor tropical regions, as communities often rely on fish protein to supplement their diet. The impact of sea level rise, by reducing the area of coastal ecosystems, will increase hazards to human settlements, and the degradation of coastal ecosystems and coral reefs will have very negative impacts on the tourism industry.

***In addition, there is a high risk of dramatic loss of biodiversity and degradation of services from marine and coastal ecosystems if certain thresholds are crossed. Plausible scenarios include:***

- **The combined impacts of ocean acidification and warmer sea temperatures make tropical coral reef systems vulnerable to collapse**. More acidic water (brought about by higher carbon dioxide concentrations in the atmosphere) decreases the availability of the carbonate ions required to build coral skeletons. At atmospheric carbon dioxide concentrations of 450 parts per million (ppm), the growth of calcifying organisms is inhibited in nearly all tropical and sub-tropical coral reefs. At 550 ppm, coral reefs are dissolving. Together with the bleaching impact of warmer water, and a range of other human-induced stresses, reefs increasingly become algae-dominated with catastrophic loss of biodiversity.

- **Coastal wetland systems** become reduced to narrow fringes or are lost entirely, in what may be described as a "coastal squeeze". This is due to sea level rise, exacerbated by coastal developments such as aquaculture ponds. The process is further reinforced by greater coastal erosion created by the weakened protection provided by tidal wetlands. Further deterioration of coastal ecosystems, including coral reefs, will also have wide-ranging consequences for millions of people whose livelihoods depend on the resources they provide. The physical degradation of coastal ecosystems such as salt marshes and mangroves will also make coastal communities more vulnerable to onshore storms and tidal surges.

- **The collapse of large predator species in the oceans**, triggered by overexploitation, leads to an ecosystem shift towards the dominance of less desirable, more resilient species such as jellyfish. Marine ecosystems under such a shift become much less able to provide the quantity and quality of food needed by people. Such changes could prove to be long-lasting and difficult to reverse even with significant reduction in fishing pressure, as suggested by the lack of recovery of cod stocks off Newfoundland since the collapse of the early 1990s.The collapse of regional fisheries could also have wide-ranging social and economic consequences, including unemployment and economic losses.

BEFORE

## *Alternative paths:*

*More rational management of ocean fisheries can take a range of pathways, including stricter enforcement of existing rules to prevent illegal, unreported and unregulated fishing. Scenarios suggest that the decline of marine biodiversity could be stopped if fisheries management focuses on rebuilding ecosystems rather than maximizing catch in the short-run. Fishery models suggest that modest catch reductions could yield substantial improvements in ecosystem condition while also improving the profitability and sustainability of fisheries. The development of low-impact aquaculture, dealing with the sustainability issues that have troubled some parts of the industry, would also help to meet the rising demand for fish without adding pressure on wild stocks.*

*The reduction of other forms of stress on coral systems may make them less vulnerable to the impacts of acidification and warmer waters. For example, reducing coastal pollution will remove an added stimulus to the growth of algae, and reducing overexploitation of herbivorous fish will keep the coral/algae symbiosis in balance, increasing the resilience of the system.*

*Planning policies that allow marshes, mangroves and other coastal ecosystems to migrate inland will make them more resilient to the impact of sea level rise, and thus help to protect the vital services they provide. Protection of inland processes including the transport of sediments to estuaries would also prevent sea level rise from being compounded by sinking deltas or estuaries.*

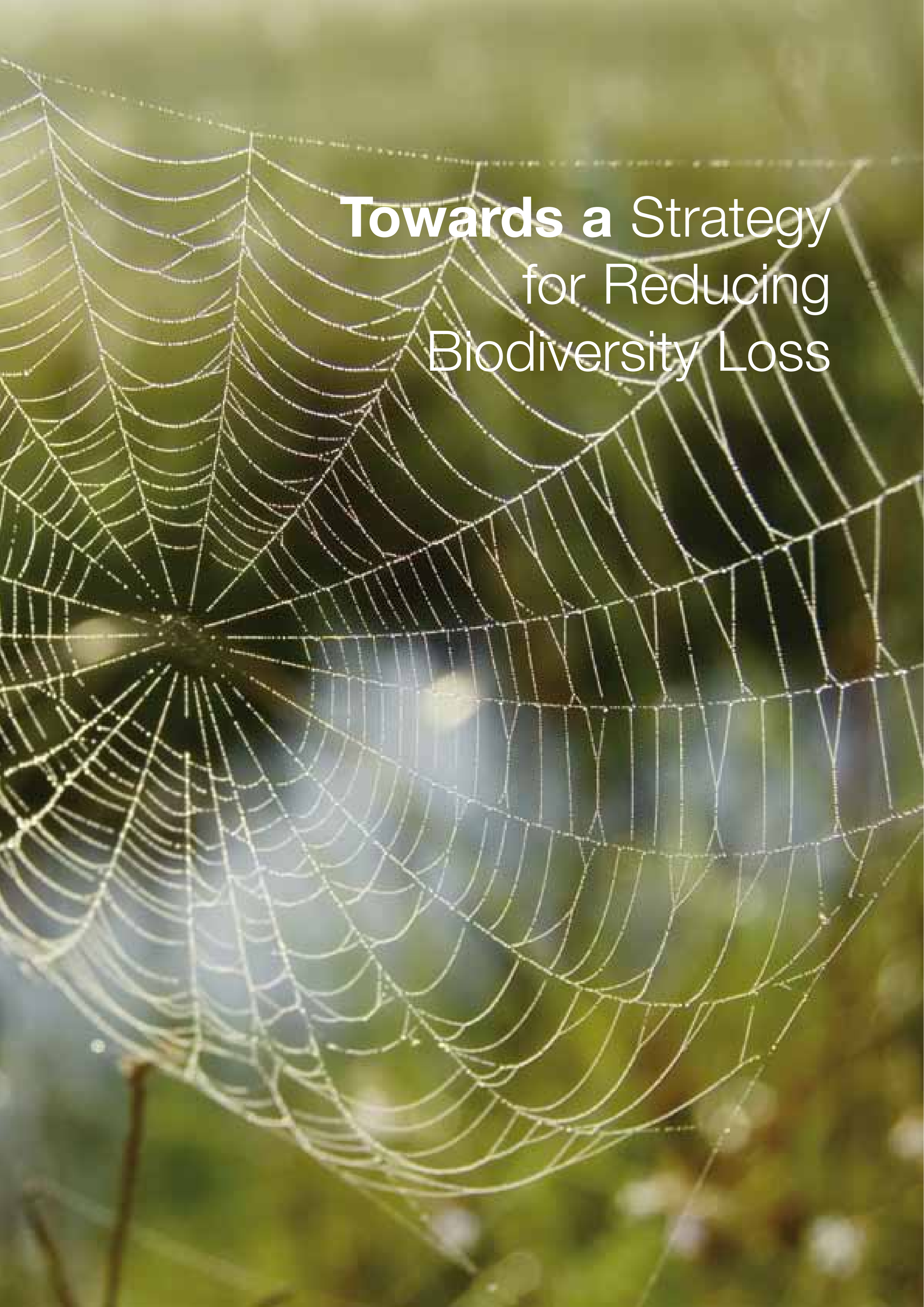
AFTER

Tropical coral reefs

BEFORE

AFTER

Coastal wetlands



# **Towards a** Strategy for Reducing Biodiversity Loss

*Well-targeted policies focusing on critical areas, species and ecosystem services can help to avoid the most dangerous impacts on people and societies from biodiversity loss in the near-term future, which it will be extremely challenging to avoid. In the longer term, biodiversity loss may be halted and then reversed, if urgent, concerted and effective action is applied in support of an agreed long-term vision. The 2010 review of the strategic plan for the Convention on Biological Diversity provides an opportunity to define such a vision and set time-bound targets to stimulate the action required to achieve it.*

***A key lesson from the failure to meet the 2010 biodiversity target is that the urgency of a change of direction must be conveyed to decision-makers beyond the constituency so far involved in the biodiversity convention.*** The CBD has very nearly universal participation from the world's governments, yet those involved in its implementation rarely have the influence to promote action at the level required to effect real change.

Thus, while the activities of environmental departments and agencies in tackling specific threats to species, and expanding protected areas, has been and continues to be extremely important, they are easily undermined by decisions from other ministries that fail to apply strategic thinking on policies and actions that impact on ecosystems and other components of biodiversity.

Mainstreaming therefore needs to be seen as the genuine understanding by government machinery as a whole that the future well-being of society depends on defending the natural infrastructure on which we all depend. To some extent, this approach is already working its way through some government systems on the question of climate change, with "climate-proofing" of policies becoming a more common practice. Some trade-offs between conservation and development are inevitable, and it is important that decisions are informed by the best available information and that the tradeoffs are clearly recognized up-front.

***Systematic proofing of policies for their impact on biodiversity and ecosystem services would ensure not only that biodiversity was better protected, but that climate change itself was more effectively addressed. Conservation of biodiversity, and, where necessary restoration of ecosystems, can be cost-effective interventions for both mitigation of and adaptation to climate change, often with substantial co-benefits.***

It is clear from the scenarios outlined above that addressing the multiple drivers of biodiversity loss is a vital form of climate change adaptation. Looked at in a positive way, this understanding gives us more options. We do not need to resign ourselves to the fact that due to the time lags built into climate change, we are powerless to protect coastal communities against sea level rise, dry regions against fire and drought, or river-valley dwellers against floods and landslides.

Although it will not address all climate impacts, targeting ecosystem pressures over which we have more immediate control will help to ensure that ecosystems continue to be resilient and to prevent some dangerous tipping points from being reached.

If accompanied by determined action to reduce emissions – with the conservation of forests and other carbon-storing ecosystems given due priority in mitigation strategies – then biodiversity protection can help buy time, while the climate system responds to a stabilizing of greenhouse gas concentrations.

***Important incentives for the conservation of biodiversity can emerge from systems that ensure fair and equitable sharing of the benefits arising out of the use of genetic resources,*** the third objective of the Convention on Biological Diversity. In practice, this means drawing up rules and agreements that strike a fair balance between facilitating access to companies or researchers seeking to use genetic material, and ensuring that the entitlements of governments and local communities are respected, including the granting of informed consent prior to access taking place, and the fair and equitable sharing of benefits arising from the use of genetic resources and associated traditional knowledge.

**The real benefits of biodiversity, and the costs of its loss, need to be reflected within economic systems and markets**

**Better decisions for biodiversity must be made at all levels and in all sectors**

Development of systems for access and benefit-sharing (ABS) has been slow, and negotiations on an international regime to regulate such agreements have been long and protracted. However, individual examples have shown the way that communities, companies and biodiversity can each benefit from ABS agreements. [**See Box 22**]. With the deadline for the 2010 target now here, the global community must consider what long-term vision it is seeking, and the type of medium-term targets that might set us on the road towards achieving it. These targets must also be translated into action at the national level though national biodiversity strategies and action plans, and treated as a mainstream issue across government.

From analysis of the failure so far to slow biodiversity loss, the following elements might be considered for a future strategy **[See Figure 21]**:

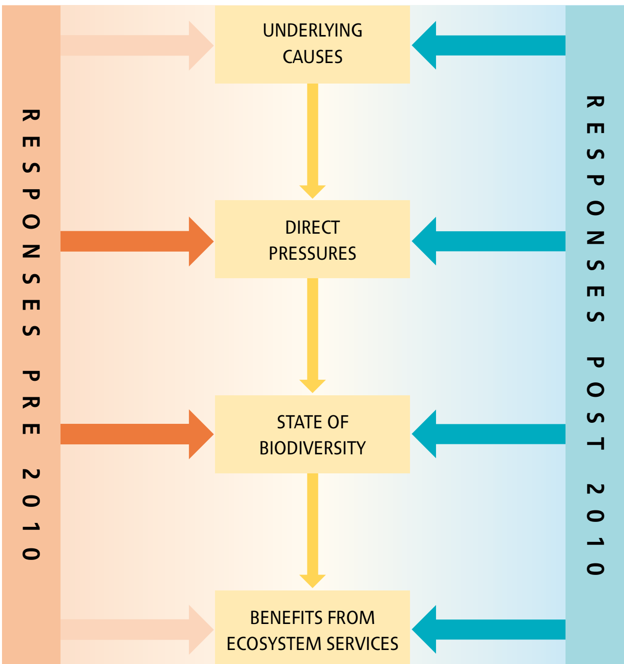
- Where possible, tackle the indirect drivers of biodiversity loss. This is hard, because it involves issues such as consumption and lifestyle choices, and long-term trends like population increase. However, as the analysis conducted as part of The Economics of Ecosystems and Biodiversity (TEEB) illustrates, public engagement with the issues combined

**BOX 22 Sharing the benefits of biodiversity access – examples from Africa**

- Vernonia (*Vernonia galamensis*), a tall weed endemic to Ethiopia, has shiny black seeds rich in oil. The oil is being investigated for its possible use as a "green chemical" in the production of plastic compounds that are currently only made from petrochemicals. In 2006, a British company, Vernique Biotech, signed a 10 year agreement with the Ethiopian Government to have access to Vernonia and to commercialize its oil. As part of the deal, Vernique Biotech will pay a combination of licence fees, royalties and a share of its profits to the Ethiopian Government. In addition, local farmers will be paid to grow Vernonia on land which is otherwise unsuitable to grow food.

- Uganda is one of the few African countries that has developed specific regulations on access to genetic resources and benefit-sharing. Introduced in 2005 as part of the National Environment Act, the regulations set out procedures for access to genetic resources, provide for the sharing of benefits derived from genetic resources; and promote the sustainable management and utilization of genetic resources, thereby contributing to conservation of biological resources in Uganda.

**FIGURE 21** Why the 2010 Biodiversity Target was not met, and what we need to do in the future




One of the main reasons for the failure to meet the 2010 Biodiversity Target at the global level is that actions tended to focus on measures that mainly responded to changes in the state of biodiversity, such as protected areas and programmes targeted at particular species, or which focused on the direct pressures of biodiversity loss, such as pollution control measures.

For the most part, the underlying causes of biodiversity have not been addressed in a meaningful manner; nor have actions been directed ensuring we continue to receive the benefits from ecosystem services over the long term. Moreover, actions have rarely matched the scale or the magnitude of the challenges they were attempting to address. In the future, in order to ensure that biodiversity is effectively conserved, restored and wisely used, and that it continues to deliver the benefits essential for all people, action must be expanded to additional levels and scales. Direct pressures on biodiversity must continue to be addressed, and actions to improve the state of biodiversity maintained, although on a much larger scale. In addition, actions must be developed to address the underlying causes of biodiversity loss, and to ensure that biodiversity continues to provide the ecosystem services essential to human wellbeing.

Source: Secretariat of the Convention on Biological Diversity

with appropriate pricing and incentives (including the removal of perverse subsidies) could reduce some of these drivers, for example by encouraging more moderate, less wasteful – and more healthy – levels of meat consumption. Awareness of the impact of excessive use of water, energy and materials can help to limit rising demand for resources from growing and more prosperous populations.

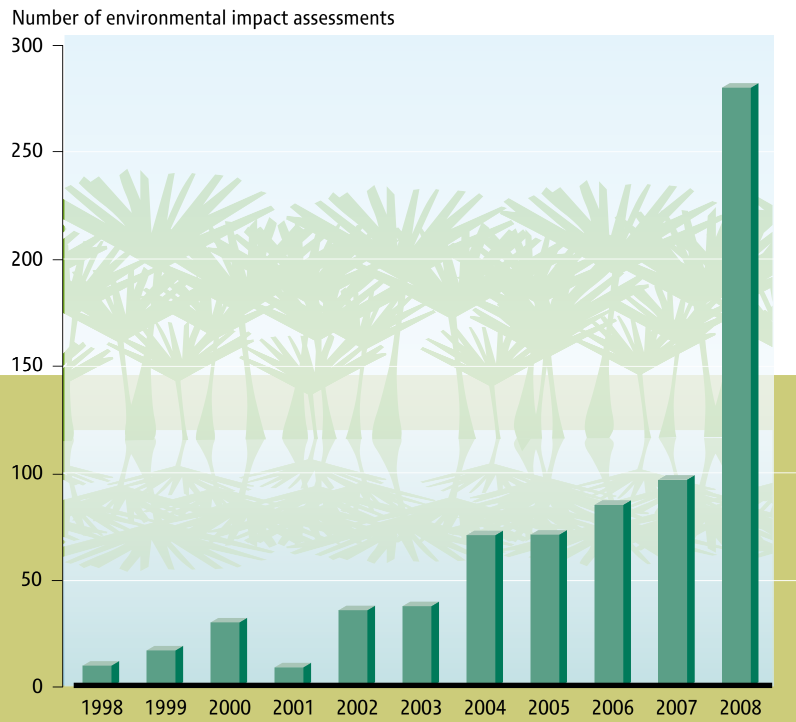
- International and national rules and frameworks for markets and economic activities can and must be adjusted and developed in such a way that they contribute to safeguarding and sustainably using biodiversity, instead of threatening it as they have often done in the past. Using pricing, fiscal policies and other mechanisms to reflect the real value of ecosystems, powerful incentives can be created to reverse patterns of destruction that result from the under-valuation of biodiversity. An important step will be for governments to expand their economic objectives beyond what is measured by GDP alone, recognizing other measures of wealth and well-being that take natural capital and other concepts into account.

- Use every opportunity to break the link between the indirect and direct drivers of biodiversity loss – in other words, prevent underlying pressures such as population increase and increased consumption from inevitably leading to pressures such as loss of habitat, pollution or over-exploitation. This involves much more efficient use of land, water, sea and other resources to meet existing and future demand **[See figure 22]**. Better spatial planning to safeguard areas important for biodiversity and ecosystem services is essential. Specific measures such as addressing the pathways of invasive species transfers can prevent increased trade from acting as a driver of ecosystem damage.

- Efficiency in the use of a natural resource must be balanced with the need to maintain ecosystem functions and resilience. This involves finding an appropriate level of intensity in the use of resources, for example increasing productivity of agricultural land while maintaining a diverse landscape, and reducing fishing intensity below the so-called maximum sustainable yield. An ecosystem-level approach will be required to establish this balance.

- Where multiple drivers are combining to weaken ecosystems, aggressive action to reduce those more amenable to rapid intervention can be prioritized, while longer-term efforts continue to moderate more intractable drivers, such as climate change and ocean acidification. The many human pressures on coral reefs, mentioned above, provide an example of where this strategy can be applied.

**FIGURE 22** Environmental impact assessment in Egypt




Since 1998, the number of environmental impact assessments conducted in Egypt has been steadily increasing, with a marked increase in 2008. Environmental impact assessments have been undertaken to review enforcement of environmental laws and to monitor Egypt's adherence to international conventions, amongst other things. The increased use of environmental impact assessment in Egypt mirrors a similar global trend. The use of strategic environmental impact assessment is also increasing globally, though its use still remains very low.

Source: Egyptian Environmental Affairs Agency

With adequate resources and political will, the tools exist for loss of biodiversity to be reduced at wider scales

- Avoid unnecessarily tradeoffs resulting from maximizing one ecosystem service at the expense of another. Substantial benefits for biodiversity can often arise from only slight limits on the exploitation of other benefits – such as agricultural production. An example is that funds to reward protection of forest carbon stocks could dramatically improve species conservation, if targeted towards areas of high biodiversity value, with a tiny marginal increase in cost.

- Continue direct action to conserve biodiversity, targeting vulnerable and culturally-valued species and habitats, and critical sites for biodiversity, combined with priority actions to safeguard key ecosystem services, particularly those of importance to the poor such as the provision of food and medicines. This should include the protection of functional ecological groups – that is, those species collectively responsible for the provision of ecosystem services such as pollination, maintenance of healthy predator- prey relationships, cycling of nutrients and soil formation.

- Take full advantage of opportunities to contribute to climate change mitigation through conservation and restoration of forests, peatlands, wetlands and other ecosystems that capture and store large amounts of carbon; and climate change adaptation through investing in "natural infrastructure", and planning for geographical shifts in species and communities by maintaining and enhancing ecological connectivity across landscapes and inland water ecosystems.

- Use national programmes or legislation to create a favourable environment to support effective "bottom-up" initiatives led by communities, local authorities, or businesses. This also includes empowering indigenous peoples and local communities to take responsibility for biodiversity management and decision-making; and developing systems to ensure that the benefits arising from access to genetic resources are equitably shared [**See Box 23**].

- Strengthen efforts to communicate better the links between biodiversity, ecosystem services, poverty alleviation and climate change adaptation and mitigation. Through education and more effective dissemination of scientific knowledge, a much wider section of the public and decision-makers could be made aware of the role and value of biodiversity and the steps needed to conserve it.

- Increasingly, restoration of terrestrial, inland water and marine ecosystems will be needed to re-establish ecosystem functioning and the provision of valuable ecosystem services. A recent analysis of schemes to restore degraded ecosystems showed that, overall,

**BOX 23** Local action for biodiversity

Actions by local communities to conserve biodiversity occur worldwide and most countries indicate that they have mechanisms in place for co-management and or community management of biological resources. Though these actions occur on relatively small scales, and can often go unrecognized, they can none the less have significant positive impacts on local biodiversity conditions and human wellbeing. For example:

- The Nguna-Pele Marine Protected Area Network in Vanuatu , which is composed of 16 village collaborations across two islands, works to strengthen traditional governance strucutures while enabling more effective natural resource management. Since the initiative began in 2002 there have been significant increases in fish biomass, marine invertebrate abundance and live coral cover within community reserves as well as an increase in villagers average income, largely as a result of ecotourism. The Network has also encouraged a resurgence in local cultural and lingusitics traditions as well as the increased invovlement of women and children in governce and decision making processes.

- The Tmatboey village borders the Kulen Promtep Wildlife Sanctuary in northern Cambodia, an area known for its endangered bird populations such as the white-shouldered ibis (Pseudibis davisoni). Given its proximity to the wildlife sanctuary ecotourism is particularly important to the village. To promote sustainable use of the sanctuary the Tmatboey Community Protected Area Committee has, amongst other things, established a comprehensive land use plan for the village and implemented a hunting ban. As a result of the Committees actions the declines of some critically endangered endemic wildlife species has stopped and has even been reversed while deforestation and encroachment into key wildlife areas has declined. As revenues from ecotourism are reinvested into local infrastructure the actions of the committee have also helped to promote sustainable development in the village.

such schemes are successful in improving the status of biodiversity. Moreover, economic analysis conducted by the Economics of Ecosystems and Biodiversity (TEEB), shows that ecosystem restoration may give good economic rates of return when considering the long-term provision of ecosystem services. However the levels of biodiversity and ecosystem services remained below the levels of the pristine ecosystems, reinforcing the argument that, where possible, avoiding degradation through conservation is preferable (and even more cost-effective) than restoration after the event. Restoration can take decades to have a significant impact, and will be more effective for some ecosystems than for others. In some cases, restoration of ecosystems will not be possible as the impacts of degradation are irreversible.

Addressing biodiversity loss at each of these levels will involve a major shift in perception and priorities on the part of decision-makers, and the engagement of all sections of society, including the private sector. For the most part, we know what needs to be done, but political will, perseverance and courage will be required to carry out these actions at the necessary scale and address the underlying causes of biodiversity loss.

Continued failure to slow current trends has potential consequences even more serious than previously anticipated, and future generations may pay dearly in the form of ecosystems incapable of meeting the basic needs of humanity. The rewards for coherent action, on the other hand, are great. Not only will the stunning variety of life on Earth be much more effectively protected, but human societies will be much better equipped to provide healthy, secure and prosperous livelihoods in the challenging decades ahead.

***The overall message of this Outlook is clear. We can no longer see the continued loss of biodiversity as an issue separate from the core concerns of society: to tackle poverty, to improve the health, prosperity and security of present and future generations, and to deal with climate change. Each of those objectives is undermined by current trends in the state of our ecosystems, and each will be greatly strengthened if we finally give biodiversity the priority it deserves.***

***In 2008-9, the world's governments rapidly mobilized hundreds of billions of dollars to prevent collapse of a financial system whose flimsy foundations took the markets by surprise. Now we have clear warnings of the potential breaking points towards which we are pushing the ecosystems that have shaped our civilizations. For a fraction of the money summoned up instantly to avoid economic meltdown, we can avoid a much more serious and fundamental breakdown in the Earth's life support systems.***

**There are greater opportunities than previously recognized to address the biodiversity crisis while contributing to other social objectives**

# Acknowledgements

The preparation of the third edition of *Global Biodiversity Outlook* (GBO-3) began in 2006 following the eighth meeting of the Conference of the Parties to the Convention on Biological Diversity. GBO-3, like its previous two editions, is an output of the processes under the Convention. Parties to the Convention, other Governments, and observer organizations have helped to shape the Outlook through their contributions during various meetings as well as through their comments and inputs to earlier drafts of GBO-3.

GBO-3 has been prepared by the Secretariat of the Convention on Biological Diversity, in close collaboration with the World Conservation Monitoring Centre of the United Nations Environment Programme (UNEP-WCMC). Numerous partner organizations and individuals from Governments, non-governmental organizations and scientific networks have generously contributed their time, energy and expertise to the preparation of GBO-3, which really is a product of the collective efforts of this community. The sheer number of organizations and people involved in GBO-3 makes it difficult to thank all contributors by name and doing so runs the risk that some may be overlooked. We sincerely apologize to anyone who may have been unintentionally omitted.

The third and fourth national reports submitted by the Parties to the Convention have been key sources of information in the preparation of GBO-3. These reports, which detail the status and trends of biodiversity at the national level as well the successes and challenges in implementing the Convention, have influenced the entire report and have in particular guided the preparation of the chapter on future strategic actions, alongside the process to update the Convention's Strategic Plan beyond 2010. The Secretariat would like to thank the more than 110 Parties who had submitted their fourth national reports by the time GBO-3 was finalized.

One of the main purposes of GBO-3 is to report on the progress which has been made by the world community towards the 2010 Biodiversity Target. This assessment, presented in the first section of the report, is based on data and analyses provided by the 2010 Biodiversity Indicators Partnership, a network of organizations which have come together to provide the most up-to-date biodiversity information possible in order to judge progress towards the target. The Partnership is coordinated by UNEP-WCMC, with the Secretariat supported by Anna Chenery, Philip Bubb, Damon Stanwell-Smith and Tristan Tyrrell. Indicator partners include BirdLife International, the Convention on International Trade in Endangered Species, the Food and Agriculture Organization of the United Nations, the Global Footprint Network, the Global Invasive Species Programme, the International Nitrogen Initiative, IUCN, the Organisation for Economic Co-operation and Development, the Royal Society for the Protection of Birds, The Nature Conservancy, the University of Queensland, TRAFFIC International, the United Nations Educational, Scientific and Cultural Organization, the United Nations Environment Programme GEMS/Water Programme, the UNEP-WCMC, the University of British Columbia Fisheries Centre, WWF, and the Zoological Society of London as well as a number of Associate Indicator Partners. Global Environment Facility full-sized project funding provided substantial financial support for the activities of the Partnership, including development of many of the global indicators used in monitoring progress towards the 2010 target. Financial support was also provided by the European Commission.

In preparing GBO-3 some 500 scholarly articles were examined and multiple assessments from international organizations were drawn upon. This collection of scientific information, experiences and perspectives was fundamental to the conclusions presented in GBO-3, and essential in reinforcing the information contained in the fourth national reports and that provided by the 2010 Biodiversity Indicators Partnership. In addition, case study material was provided by a large number of partners amongst which the Equator Initiative, the Small Grants Program of the Global Environment Facility and the Forest Peoples Programme have been particularly active.

The section of GBO-3 on biodiversity scenarios and tipping points is based on a larger study prepared by DIVERSITAS and UNEP-WCMC. The Secretariat would like to thank the lead authors of this report Paul Leadley, Henrique Miguel Pereira, Rob Alkemade, Vânia Proença, Jörn P.W. Scharlemann, and Matt Walpole, as well as the contributing authors John Agard, Miguel Araújo, Andrew Balmford, Patricia Balvanera, Oonsie Biggs, Laurent Bopp, William Cheung, Philippe Ciais, David Cooper, Joanna C. Ellison, Juan Fernandez-Manjarrés, Joana Figueiredo, Eric Gilman, Sylvie Guenette, Bernard Hugueny, George Hurtt, Henry P. Huntington, Michael Jennings, Fabien Leprieur, Corinne Le Quéré, Georgina Mace, Cheikh Mbow, Kieran Mooney, Aude Neuville, Carlos Nobres, Thierry Oberdorf, Carmen Revenga, James C. Robertson, Patricia Rodrigues, Juan Carlos Rocha Gordo, Hisashi Sato, Bob Scholes, Mark Stafford-Smith, Ussif Rashid Sumaila, and Pablo A. Tedescco.

In order to ensure that the findings of GBO-3 were of the highest possible quality, two drafts were made available for peer review between August and December 2009. During this time responses were received from almost 90 reviewers who provided more than 1,500 individual comments. The Outlook was greatly enhanced by these comments. The preparation of GBO-3 has been overseen by an Advisory Group and a Scientific Advisory Panel. The Secretariat is grateful for the guidance and support provided by the members: Thomas M. Brooks, Stuart Butchart, Joji Carino, Nick Davidson, Braulio Dias, Asghar Fazel, Tony Gross, Peter Herkenrath, Kazuaki Hoshino, John Hough, Jon Hutton, Tom Lovejoy, Kathy MacKinnon, Tohru Nakashizuka, Carsten Neßhöver, Alfred Oteng-Yeboah, Axel Paulsch, Balakrishna Pisupati, Jan Plesnik, Christian Prip, Peter Schei, James Seyani, Jane Smart, Oudara Souvannavong, Spencer Thomas, Matt Walpole, Dayuan Xue, and Abdul Hamid Zakri.

GBO-3 consists of a range of products. This main report was prepared to provide a short and concise overview of current and projected biodiversity trends, and policy options to address biodiversity loss and negative impacts for human well-being. Comments and additional information received through the peer review process as well as case study examples that could not be incorporated in the main report have mostly been included in an extended technical document and will be made available online through the GBO-3 web portal accessible from www.cbd.int/gbo3. For reasons of readability, this version of the report does not include scientific references. However, these can be consulted in an annotated version also available on the GBO-3 web portal.

GBO-3 was written by Tim Hirsch with Kieran Mooney, Robert Höft and David Cooper. Ahmed Djoghlaf and Jo Kalemani Mulongoy provided guidance. Its production was managed by Robert Höft, Kieran Mooney and David Ainsworth. In addition many Secretariat colleagues provided input and feedback on GBO-3 including Ahmed Abdullah, Véronique Allain, Claire Baffert, Mateusz Banski, Caroline Belair, Lise Boutin, Lijie Cai, Monique Chiasson, Tim Christophersen, David Coates, Olivier de Munck, Charles Gbedemah, Linda Ghanimé, Christine Gibb, Sarat Babu Gidda, Susanne Heitmuller, Michael Hermann, Oliver Hillel, Christopher Hogan, Lisa Janishevski, Claudia Kis Madrid, Stefano La Tella, Jihyun Lee, Markus Lehmann, Sandra Meehan, Djessy Monnier, Noriko Moriwake, Valerie Normand, Neil Pratt, Nadine Saad, John Scott, Ravi Sharma, Junko Shimura, Stella Simiyu, Gweneth Thirlwell, Alberto Vega, Danush Viswanathan, Frédéric Vogel, Jaime Webb, Anne-Marie Wilson, Kati Wenzel, and Yibin Xiang.

Graphs were designed by In-folio. The layout was prepared by Phoenix Design Aid. Camellia Ibrahim assisted with photo selection.

Editing and proof-reading of the language versions was done by Abdelwahab Afefe, Anastasia Beliaeva, Lise Boutin, Lijie Cai, Clementina Equihua Zamora, Moustafa Fouda, Thérèse Karim, Diane Klaimi, Nadine Saad, Jérôme Spaggiari and Tatiana Zavarzina.

The production of GBO-3 was enabled by financial contributions from Canada, the European Union, Germany, Japan, Spain and the United Kingdom, as well as UNEP.

While the Secretariat has taken great care to ensure that all statements made in GBO-3 are backed up by credible scientific evidence, it assumes full responsibility for any errors or omission in this work.

# *Photo Credits*

**Cover:** (The Earth in a drop) = © Shevs | Dreamstime.com
(Coral reef) = © Carlcphoto | Dreamstime.com
(Cattle with people) = © Claude Hamel
(Mountain and eagle) = © Urosmm | Dreamstime.com

**Page 2:** © Kay Muldoon Ibrahim

**Page 4:** © I-rishka | Dreamstime.com

**Page 8:** © Jeffthemon... | Dreamstime.com

**Page 10:** © David Coates

**Page 12:** © Johnanders... | Dreamstime.com

**Page 14:** © Tfaust | Dreamstime.com

**Page 16:** © Christian Carroll | istockphoto.com

**Page 17:** © Parks Canada / Heiko Wittenborn

**Page 21:** © 0tvalo | Dreamstime.com

**Page 23:** © Dejan750 | Dreamstime.com
© Ryszard | Dreamstime.com
© Ferdericb | Dreamstime.com
© Chesterf | Dreamstime.com

**Page 25:** © Cathy Keifer | istockphoto.com

**Page 26:** © William Davies | istockphoto.com

**Page 28:** © Johnanders... | Dreamstime.com
© Deborahr | Dreamstime.com

**Page 29:** © Rudis | Dreamstime.com
© Weknow | Dreamstime.com

**Page 31:** © Ajay Rastogi
© Ajay Rastogi

**Page 32:** © Charles Besançon

**Page 33:** © luoman | istockphoto.com

**Page 34:** © Nmedia | Dreamstime.com
© Jan Rihak | istockphoto.com
© Hoshino Village, Fukuoka, Japan

**Page 37:** © Jmjm | Dreamstime.com

**Page 40:** © Robert Höft

**Page 41:** © Tupungato | Dreamstime.com

**Page 42:** © Ellah | Dreamstime.com

**Page 44:** © Jan Kofod Winther

**Page 45:** © Peter Malsbury | istockphoto.com

**Page 47:** © Pniesen | Dreamstime.com

**Page 49:** © Desislava Nikolova | istockphoto.com

**Page 50:** © Francisco Ramananjatovo
© Carl Chapman | istockphoto.com
© Jerl71 | Dreamstime.com
© Jerry Oldenettel | flickr.com

**Page 52:** © Royal Botanic Gardens, Kew
© Royal Botanic Gardens, Kew

**Page 53:** © Phillipmin... | Dreamstime.com

**Page 54:** © Oranhall | Dreamstime.com

**Page 56:** © Ricardo278 | Dreamstime.com

**Page 58:** © Gail A Johnson | istockphoto.com

**Page 60:** © Kodym | Dreamstime.com

**Page 62:** © Lightcatch... | Dreamstime.com

**Page 63:** © Simon Gurney | istockphoto.com
© Charles Taylor | Shutter Stock.com
© Joe McDaniel | istockphoto.com

**Page 64:** © Photawa | Dreamstime.com
© Davecurrey | Dreamstime.com
© Billwarcho... | Dreamstime.com

**Page 65:** © Lucaplacid... | Dreamstime.com

**Page 66:** © Slobo Mitic | istockphoto.com

**Page 70:** © Marjo Vierros

**Page 73:** © Claude Hamel

**Page 74-75:** © 3000ad | Dreamstime.com
© Tony1 | Dreamstime.com
© Kate Kiefer, Australian Antarctic Division
© Kate Kiefer, Australian Antarctic Division

**Page 78-79:** © Robert Höft
© Robert Höft
© Brighthori... | Dreamstime.com
© Barsik | Dreamstime.com

**Page 80-81:** © Ilanbt | Dreamstime.com
© Alexedmond... | Dreamstime.com
© Erikgauger | Dreamstime.com
© Spanishale... | Dreamstime.com

**Page 82:** © Leightonph... | Dreamstime.com

**Page 87:** © Invisiblev... | Dreamstime.com

**Page 88:** © Claude Hamel

**Back cover:** (Boat on a river) = © David Cooper
(Trees with person) = © Luis Alfonso Argüelles
(Woman with beans) = © Louise Sperling
(Shark) = © Lenta | Dreamstime.com
(Gorilla) = © Warwick Lister-Kaye | istockphoto.com
(Frog) = © Geckophoto | Dreamstime.com
(Field) = © Alexsol | Dreamstime.com
(Forest) = © Lagustin | Dreamstime.com
(Leaf background) = © Cobalt88 | Dreamstime.com

# List of Boxes, Tables and Figures

## Boxes



## Tables



## Figures

**Figure 8:** Extent of national designated protected areas
(Source - Adapted from UNEP World Conservation Monitoring Centre (2009) World Database on Protected Areas (WDPA))

**Figure 9:** Protection of critical biodiversity sites
(Source - Adapted from Stuart Butchart/Alliance for Zero Extinction)

**Figure 10:** Coverage of terrestrial protected areas by ecoregions
(Source – Bastian Bomhard, adapted from Coad, L., Burgess, et.al. (2009). The ecological representativeness of the global protected areas estate in 2009: progress towards the CBD 2010 target. UNEP-WCMC, WWF-US and the Environmental Change Institute at the University of Oxford.

**Figure 11:** Malaysia river basin quality
(Source - Adapted from Government of Malaysia - Ministry of Natural Resources and Environment (2009). Fourth National Report to the Convention on Biological Diversity and Malaysia Department of Environment (2009). Malaysia Environment Quality Report 2008. Department of Environment.

**Figure 12:** China's Marine Trophic Index
(Source - Adapted from Chinese Ministry of Environmental Protection (2008). China's Fourth National Report on Implementation of the Convention on Biological Diversity and Xu, H., Tang, X., Liu, J., Ding, H., Wu, J., Zhang, M., Yang, Q., et al. (2009). China's Progress toward the Significant Reduction of the Rate of Biodiversity Loss. BioScience, 59(10), 843-852)

**Figure 13:** Extinction risk of livestock breeds
(Source - Adapted from FAO. (2007). The State of the World's Animal Genetic Resources for Food and Agriculture, edited by Barbara Rischkowsky & Dafydd Pilling. Rome)

**Figure 14:** Arctic sea ice
(Source - Adapted from NSIDC (2009) Sea Ice Index. Boulder, Colorado USA: National Snow and Ice Data Center)

**Figure 15:** Marine "dead zones"
(Source - Updated and adapted from Diaz, R. J., & Rosenberg, R. (2008). Spreading Dead Zones and Consequences for Marine Ecosystems. Science, 321(5891)

**Figure 16:** Nitrogen balance in Europe
(Source - Adapted from OECD (2008) Environmental Performance of Agriculture in OECD countries)

**Figure 17:** Summary of biodiversity indicators
(Source - Adapted from Butchart, S. H. M., Walpole, M., et.al. (2010) Global biodiversity: indicators of recent declines. Science (in press)

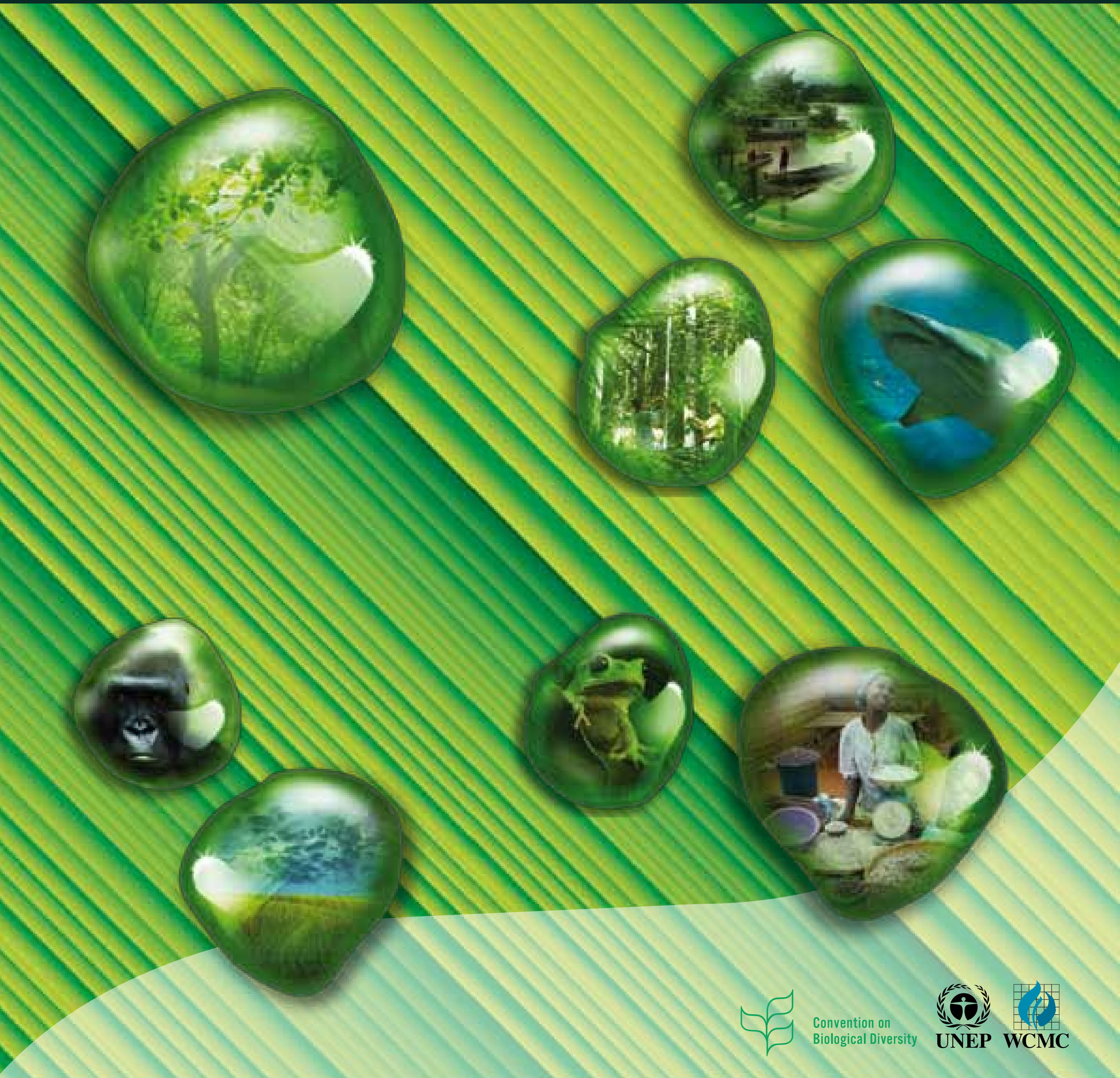
**Figure 18:** Tipping points – an illustration of the concept
(Source - Secretariat of the Convention on Biological Diversity)

**Figure 19:** Projected forest loss until 2050 under different scenarios
(Source - Adapted from Leadley, P., Pereira, H.M., et.al. (2010) Biodiversity Scenarios: Projections of 21st century change in biodiversity and associated ecosystem services. Secretariat of the Convention on Biological Diversity, Montreal. Technical Series no. 50)

**Figure 20:** Land use change under different scenarios
(Source -Adapted from Wise, M., Calvin, K., Thomson, A., Clarke, L., Bond-Lamberty, B., Sands, R., Smith, S. J., et al. (2009). Implications of Limiting CO2 Concentrations for Land Use and Energy. Science, 324(5931), 1183-1186)

**Figure 21:** Why the 2010 biodiversity target was not and we need to do in the future
(Source - Secretariat of the Convention on Biological Diversity)

**Figure 22:** Environmental impact assessment in Egypt
(Source - Adapted from Arab Republic of Egypt (2009). Egypt State of Environment Report 2008. Ministry of State for Environmental Affairs Egyptian Environmental Affairs Agency)




**Secretariat of the Convention on Biological Diversity**
World Trade Centre · 413 St. Jacques Street, Suite 800
Montreal, Quebec, Canada H2Y 1N9
Phone: 1(514) 288 2220 · Fax: 1 (514) 288 6588
E-mail: secretariat@cbd.int · Website: http://www.cbd.int