BIODIVERSITY AND CLIMATE CHANGE

ISSUE PAPER No. 1

BIODIVERSITY AND ECOSYSTEMS: SYNERGIES FOR MITIGATING AND ADAPTING TO CLIMATE CHANGE

It is now widely recognized that climate change and biodiversity are interconnected, not only through the effects of climate change on biodiversity, but also through changes in biodiversity and ecosystem functioning that affect climate change. The carbon cycle and the water cycle, arguably the two most important large-scale processes for life on Earth, both depend on biodiversity—at genetic, species and ecosystem levels—and can produce feedbacks that enhance climate change mitigation and adaptation. Healthy ecosystems can buffer the impacts of climate change, especially extreme weather events. Improving the health of ecosystems is one way of adapting to and mitigating climate change and yields multiple environmental, economic and social benefits.

The current picture and future trends

There is growing scientific consensus that exceeding 2°C of average global warming above the pre-industrial average temperature (which would require limiting atmospheric carbon dioxide equivalent to around 450 parts per million) would have serious implications for the achievement of the Millennium Development Goals and the objectives of the Convention on Biological Diversity and other Rio Conventions.

The third edition of the *Global Biodiversity Outlook* presents several messages, both positive and negative, regarding climate change. On the one hand, climate change is already affecting biodiversity, and its effects are expected to grow in the coming decades. Although some species are able to adapt naturally, it is expected that many will be unable to keep up. Furthermore, the natural adaptive capacity of many species will be hampered by other threats, such as overuse, habitat change and pollution. As a result, there will be an increased risk of extinction proportionate to the extent of change as the resilience of ecosystems is stressed broadly (see boxes 1 and 2).

On the other hand, while climate change can affect biodiversity negatively, determined and appropriate action to protect biodiversity can help to slow or mitigate climate change by enabling ecosystems to store and absorb more carbon (see box 2) and can help people adapt to climate change by making ecosystems more resilient and less vulnerable (see Issue Paper No. 4). The protection and restoration of resilient ecosystems are among the most cost-effective means of limiting both the scale and negative consequences of climate change. From the information available, it is clear that addressing the multiple drivers of biodiversity loss is a vital form of climate change mitigation and adaptation.

Ecosystem-based approaches to climate change adaptation and mitigation: two sides of the same coin

Ecosystem-based approaches that integrate biodiversity conservation and sustainable use and the provision of ecosystem services into overall climate change adaptation and mitigation strategies can be cost-effective, can generate social, economic and cultural co-benefits and can help to maintain resilient ecosystems (SCBD 2009; see Issue Paper No. 2). Such approaches include, but are not limited to, the protection of natural forest and peatland carbon stocks (see box 3), the sustainable management of forests, the use of native assemblages of forest species in reforestation activities, sustainable wetland management, restoration of degraded wetlands and sustainable agricultural practices. Ecosystem-based approaches to adaptation and mitigation have potential benefits for indigenous peoples and local communities.

Many ecosystem-based approaches to mitigation and adaptation can be designed and implemented to enhance the conservation and management of biodiversity and the relatively long-term provision of key ecosystem services. For example, with regard to the carbon storage service of ecosystems, ecosystem-based

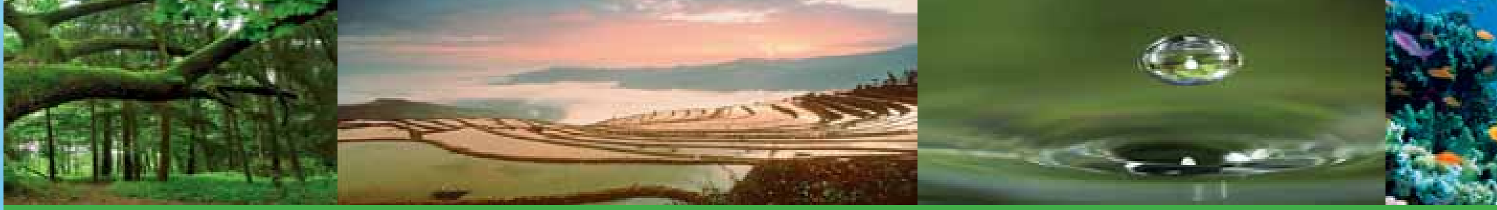
Author: Anne-Marie Wilson, Secretariat of the Convention on Biological Diversity (SCBD)
Series Editors: Tim Christophersen, Jacqueline Grekin (SCBD) and
Balakrishna Pisupati, (United Nations Environment Programme-Division of Environmental Law and Conventions)

This series provides a synopsis of issues relevant to the Rio Conventions.
It is part of ongoing collaboration between the United Nations Environment Programme and the Secretariat of the Convention on Biological Diversity

Life in harmony, into the future — COP10 AICHI-NAGOYA, JAPAN 2010

2010 International Year of Biodiversity

www.unep.org/delc/IssuePapers



Box 1: Main findings on biodiversity and climate change

- Impacts of climate change on biodiversity have already been observed and an increasing number of ecosystems, including areas of high biodiversity, are likely to be further disrupted by a temperature rise of 2°C or more above pre-industrial levels.
- Ten per cent of species assessed so far will face an increasingly high risk of extinction for every 1°C rise in global mean surface temperature (up to an increase of about 5°C).
- Wetlands, mangroves, coral reefs, Arctic ecosystems and cloud forests are considered to be particularly vulnerable to climate change. In the absence of strong mitigation action, it is possible that some cloud forests and coral reefs will cease to function in current forms within a few decades.
- Climate change will have predominantly adverse impacts on many ecosystems and their services, many of which are essential for human well-being. Climate change will exacerbate other pressures acting on natural systems, including land use change, invasive alien species and disturbance by fire.
- Societies need to be aware of the adverse impacts of climate change response measures on biodiversity and the provision of key ecosystem services (see Issue Paper No. 7). For example, some of the geo-engineering options currently being discussed by the scientific community, such as ocean fertilization, may have significant negative impacts on biodiversity. The Conference of the Parties to the Convention on Biological Diversity at its ninth meeting called for the precautionary approach to be applied to ocean fertilization activities, given uncertainty over its impacts on marine biodiversity and associated ecosystem services (see Issue Paper No. 8).

Sources: SCBD 2009; IPCC 2007a.

Box 2: Climate change and the Great Barrier Reef

Coastal and near-shore ecosystems are already under multiple stresses, which will be exacerbated by climate change and ocean acidification. The predicted consequences of ocean acidification for marine plants and animals, food security and human health are profound, including disruption to fundamental biogeochemical processes, regulatory ocean cycles, marine food chains and production and ecosystem structure and function.

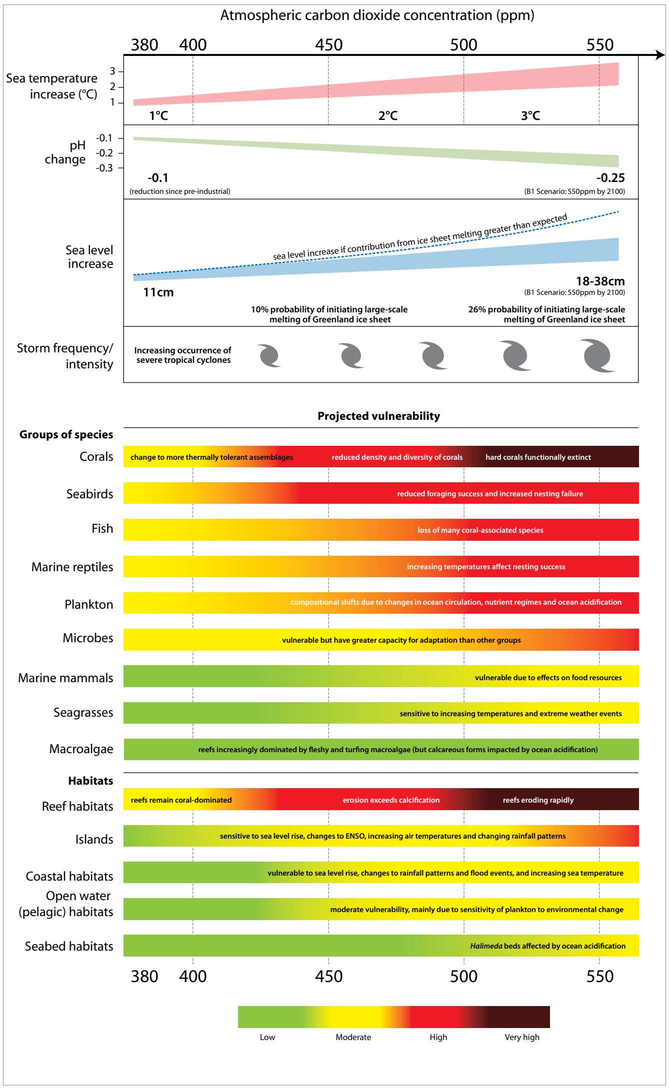


Figure 1: Projected vulnerability of components of the Great Barrier Reef ecosystem to climate change across a range of CO_2 concentrations (fig. 5.7 in GBRMPA, 2009)

mitigation can integrate carbon and biodiversity conservation and management activities to enhance the resilience of terrestrial and coastal and marine ecosystems (UNEP 2009).

Reducing emissions from deforestation and forest degradation in developing countries (REDD) and biodiversity

It is recognized that carbon emissions can be reduced by preventing deforestation and forest degradation. In the context of the United Nations Framework Convention on Climate Change this is discussed under the acronym REDD, which stands for "reducing emissions from deforestation and forest degradation in developing countries". It is also recognized that in addition to reducing carbon emissions efforts to curb deforestation can contribute significantly to the conservation and sustainable use of biodiversity, in particular through the conservation of primary forests (See Issue Paper No. 5). This synergy, which is discussed under the rubric of "REDD-plus", could also provide livelihood and other benefits to indigenous and local communities and help societies adapt to climate change.

Given the possibility of both positive and negative impacts on biodiversity from emerging REDD efforts, it is crucial that biodiversity be appropriately considered. The potential of REDD to address the biodiversity crisis and climate change simultaneously is unprecedented, while poorly designed REDD

Box 3: Peatlands: carbon storehouses

Peatlands, which are wetland ecosystems, store about twice the carbon of the entire Earth's forest systems. They have high biodiversity values, particularly in tropical areas, and play significant roles in sustaining ecosystem services, including water cycling, protection against flooding and the provision of food, fodder and basic materials supporting livelihoods. Peatland degradation is a major source of greenhouse gas emissions worldwide and a major source of biodiversity loss and poverty in tropical regions (Parish et al. 2008). Some estimates suggest that investments in measures to avoid peatland degradation or restore degraded peatlands can be up to 100 times more cost effective than other mitigation measures. Because peat is stored below ground there have been some difficulties in undertaking appropriate carbon accounting in relation to the Kyoto Protocol. Many tropical peatlands are forested, and therefore offer significant opportunities to achieve benefits through activities aimed at reducing emissions from deforestation and forest degradation.

efforts could damage forest biodiversity and in the process threaten the continued provision of ecosystem services for human well-being. The Convention on Biological Diversity has an important role to play in supporting the Framework Convention on Climate Change and other stakeholders in ensuring that the many aspects of biodiversity are at the forefront of the discussions on the development and implementation of REDD efforts.

Wetlands, freshwater resources and climate change

Many of the major impacts of climate change on ecosystems and people are occurring through changes in the water cycle (See Issue Paper No. 3). An Intergovernmental Panel on Climate Change technical paper on climate change and water (Bates et al. 2008) concludes that the relationship between climate change and freshwater resources is of primary concern; that water resource issues have not been adequately addressed in climate change analyses and climate policy formulations; and that, according to many experts, water availability and quality will be among the main issues resulting from climate change.

As the availability of water resources for ecosystems and people changes in both overall quantity and timing of flows (e.g., increasing droughts and floods), one key adaptation response is to sustain or restore the water-related services that both aquatic (wetland) and terrestrial ecosystems provide. The desire to protect water-related services provided by ecosystems is a major driver of the establishment and management of protected areas worldwide, including in forests (Blumenfield et al. 2010). Linkages between biodiversity, water and climate change present some of the best examples of means by which nature can help us cope with climate change (SCBD 2009).

Protected areas, ecosystem resilience and climate change

Given the important role of protected areas in conserving biodiversity and thereby increasing ecosystem resilience, protected areas should constitute an explicitly recognized component of an ecosystem-based adaptation strategy (see Issue Paper No. 6).

Protected areas can serve as important elements of climate change adaptation in several ways: first, by providing unbroken blocks of intact habitat; second, by providing places to which species and ecosystems can shift their ranges; third, by increasing ecosystem resilience and recovery by providing intact structures and natural processes; fourth, by providing protection against the physical impacts of climate change such as rising sea levels, rising temperatures and extreme weather events (Mulongoy and Gidda 2008); and, fifth, by sustaining water supplies and increasing water security under changing hydrological conditions. In addition, corridors between protected areas will become increasingly important to dealing with climate change as they will allow species to migrate along temperature or precipitation gradients in response to changing conditions. Protected areas are also subject to the impacts of climate change, and the risks posed by that fact need to be better understood and anticipated.

Marine biodiversity, ecosystem services and climate change

Ocean acidification has been identified as a potentially serious threat to cold-water corals and other marine organisms that rely on calcium carbonate in seawater for skeleton and shell production (see Issue Paper No. 7). In the absence of strong mitigation action, the risk to marine ecosystem resilience is high. Key adaptation options to enhance the resilience of marine and coastal biodiversity include:

- Further development of integrated approaches to coastal and marine zone management in a manner that respects both societal interests and the integrity of ecosystems;
- Identification of vulnerable species and ecosystems and the alleviation of other threats to such biodiversity;
- Enhancing efforts to expand networks of marine protected areas to conserve biological diversity and associated ecosystems through, for example, protecting critical spawning and nursery habitats to help them recover from stresses and provide spillover benefits for adjacent areas (for example, by supporting fish stocks in areas beyond marine protected area boundaries);
- Reducing the spread of invasive alien species.

Climate-resilient ecosystems, climate-resilient communities

It is increasingly clear that climate change, pollution, fragmentation and loss of habitat, invasive alien species infestation and over-use of natural resources, individually or combined, are having severe effects on the world's ecosystems and the services that they provide. The combined effects of these phenomena may steadily, and in some cases abruptly, increase the vulnerability of these systems and services, with important ecological, economic and social implications. The importance of climate-resilient ecosystems as a foundation for climate-resilient communities should not be underestimated; there are strong links between climate change impacts, ecosystem degradation and increased risk of climate-related disasters (UNEP 2009; see Issue Paper No. 2).

The report for national and international policymakers published under the auspices of the Economics of Ecosystems and Biodiversity (TEEB) initiative discusses the links between poverty and the loss of ecosystems and biodiversity and the risks that they pose to the achievement of several Millennium Development Goals (TEEB 2009). The prospect of irreversible climate change adds to the urgency of achieving the objectives of the Rio conventions.

Maintaining and restoring biodiversity in ecosystems promotes their resilience to human-induced pressures and therefore acts as an essential insurance policy to safeguard against climate-change impacts. Acting now to identify priorities for ecosystem-based approaches to adaptation and mitigation can help to reduce the risk of species extinctions and limit damage to the resilience of ecosystems. It can also help to reduce risks to the provision of ecosystems services and the communities dependent on them. We can preserve intact habitats, especially those sensitive to climate change, improve our understanding of the relationship between climate change and biodiversity and think of biodiversity as part of the solution to climate change.

Looking ahead: enhancing synergies

The implementation of ecosystem-based approaches for adaptation and mitigation and the integration of biodiversity considerations into relevant climate change adaptation and mitigation plans and strategies will require enhanced cooperation and synergies between the different biodiversity and climate change actors, especially the three Rio Conventions, while taking into account their different mandates and Parties.

Many best practice examples of mechanisms to promote synergies at the national and local level are available, including the establishment of national committees consisting of focal points to the three Rio Conventions, the development of common pools of experts, the integrated management of funding to address biodiversity and climate change, and the integration of climate change and biodiversity elements within national biodiversity strategy and action plans and national adaptation plans and programmes.

References

Bates, B.C., et al. (eds.) (2008). Climate Change and Water. Intergovernmental Panel on Climate Change Technical Paper No. VI. Geneva: Secretariat of the Intergovernmental Panel on Climate Change.

Blumenfeld, S., et al. (2009). Water, Wetlands and Forests. A Review of Ecological, Economic and Policy Linkages. Convention on Biological Diversity Technical Series No. 47. Gland, Switzerland, and Montreal, Canada: Secretariat of the Convention on Biological Diversity and Secretariat of the Ramsar Convention on Wetlands of International Importance, Particularly as Waterfowl Habitat.

Great Barrier Reef Marine Park Authority (2009). *Great Barrier Reef Outlook Report 2009*. Townsville, Australia.

IPCC (2007a). Intergovernmental Panel on Climate Change (2007). *Climate Change 2007: Synthesis Report: Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, United Kingdom: Cambridge University Press.

IPCC (2007b). Intergovernmental Panel on Climate Change (2007). *Climate Change 2007: The Physical Science Basis: Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, United Kingdom: Cambridge University Press.

Mulongoy, K.J. and S.B. Gidda (2008). *The Value of Nature: Ecological, Economic, Cultural and Social Benefits of Protected Areas*. Montreal: Secretariat of the Convention on Biological Diversity.

Thompson, I., et al. (2009). Forest resilience, biodiversity, and climate change: a synthesis of the biodiversity/resilience/stability relationship in forest ecosystems. Convention on Biological Diversity Technical Series No. 43. Montreal: Secretariat of the Convention on Biological Diversity.

SCBD (2009). Secretariat of the Convention on Biological Diversity (2009). *Connecting Biodiversity and Climate Change Mitigation and Adaptation: Report of the Second Ad Hoc Technical Expert Group on Biodiversity and Climate Change*. Technical Series No. 41. Montreal: Secretariat of the Convention on Biological Diversity.

SCBD (2010). Secretariat of the Convention on Biological Diversity (2010). *Global Biodiversity Outlook 3*. Montreal: Secretariat of the Convention on Biological Diversity.

TEEB 2009: The Economics of Ecosystems and Biodiversity 2009. The Economics of Ecosystems and Biodiversity for National and International Policy Makers – Summary: Responding to the Value of Nature. TEEB Report

UNEP (2009). United Nations Environment Programme (2009). The Role of Ecosystem Management in Climate Change Adaptation and Disaster Risk Reduction. UNEP Copenhagen Discussion Series.

---

[1] Resilience is the capacity of an ecosystem to return to its pre-condition state, including its essential characteristics, taxonomic composition, structures, ecosystem functions and process rates, following a perturbation (Thompson and others 2009, p. 5).

[2] In line with decision 5/CP.15 of the UNFCCC, REDD-plus refers to reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries. The acronyms REDD and REDD-plus are used here for convenience only, without any intention to preempt current or future negotiations under the Framework Convention on Climate Change.

Photo credits: Eduardo Augusto Muylaert Antunes—UNEP/Still Pictures; Flickr.com, Martha de Jong-Lantink; Jason Hall-Spencer; iStockphoto; Dan Montagano; Stefano Padulosi;

Convention on Biological Diversity

UNEP