PAPER

2

PERSPECTIVES ON CLIMATE CHANGE FROM THE CONVENTION ON BIOLOGICAL DIVERSITY

AHMED DJOGHLAF[1]

[1] Secretariat of the Convention on Biological Diversity

ABSTRACT: The Millennium Ecosystem Assessment as well as recent reports from the Intergovernmental Panel on Climate Change has made us all aware that climate change negatively impacts natural resources and that it is one of the main drivers of biodiversity loss. From the dramatic decline in amphibian populations in Central and South America, to the decreased fitness of polar bears in the Arctic, and the spread of the pine beetle in North America's forests, impacts have been felt across the Americas. It is important, as we work to achieve the 2010 Biodiversity Target to significantly reduce the rate of biodiversity loss, that we both consider the role of biodiversity in climate change mitigation and adaptation and enhance the ability of biodiversity to resist and respond to this rapidly emerging challenge. In order to accomplish this, the vital link between two of the most pressing environmental issues facing our planet - biodiversity loss and climate change - needs to be better understood. Some important emerging links between biodiversity and climate change can be found in ongoing discussions on avoided emissions from deforestation and forest degradation, adaptation and vulnerability, traditional and indigenous knowledge and the conservation and sustainable use of critical ecosystems such as wetlands, coastal zones, mountains, and dry and sub-humid lands. The role of protected areas and natural corridors in climate change mitigation and adaptation are also emerging issues for discussion. The Convention on Biological Diversity (CBD) set the international framework regarding biodiversity and very early on looked into the relationship between biodiversity and climate change. The CBD, through its cross-cutting issue on climate change, is enhancing the integration of climate change components within all of the programmes of work of the Convention. The Convention has also built synergies with the United Nations Framework Convention on Climate Change and convened an Ad Hoc Technical Expert Group on climate change and biodiversity to provide scientific and technical guidance on the issue. There remains, however, a number of challenges and opportunities for the further development of interlinkages between biodiversity and climate change, many of which will need to be addressed through national implementation. These include capacity buliding, mainstreaming,communication and awareness-raising and research and technology.

Keywords: biodiversity, climate change, Convention on Biological Diversity, adaptation, mitigation, conservation, sustainable use of biodiversity

Introduction

The fourth assessment report of the Intergovernmental Panel on Climate Change (IPCC, 2007) presents clear evidence that, since the mid-1800s, average annual global temperatures have increased by about 0.74°C. Climate change impacts include atmospheric and oceanic temperature increases, melting glaciers and sea-ice, changes in river flows, shifting patterns of precipitation, heightened storm surges, flooding, drought and rising sea levels. Between 1970 and 2004, global greenhouse gas emissions rose by 70% with carbon dioxide (CO_2)

emissions increasing at the fastest rate (IPCC, 2007). In fact, even if all greenhouse gas emissions were halted today, the impacts would continue to be felt for 50 years.

This global climate change also affects biodiversity. Recent changes in climate, especially warmer regional temperatures and shifting precipitation patterns, have already had significant impacts on biodiversity and ecosystems, through changes in species distribution, population sizes and timing of reproduction, migration events and increases in frequency of pest and disease outbreaks. These changes are projected to exacerbate the loss of biodiversity and increase the risk of extinction for many species. By the end of the century, climate change and its impacts may be the dominant direct driver of biodiversity loss and changes in ecosystem services globally (Millennium Ecosystem Assessment, 2005).

This paper presents the main impacts of climate change on biodiversity, as well as the role of biodiversity in climate change adaptation and mitigation. The paper also illustrates how the Convention on Biological Diversity addresses the issue of climate change, and the different challenges and opportunities that exist in this area.

Observed and Projected Climate Change Impacts on Biodiversity

The relationship between climate change and levels of biological diversity is of increasing concern due to anthropogenic increases in green house gas emissions. Studies of fossil records have shown that biodiversity richness was relatively low and extinction rates relatively high during warm phases, providing the evidence that the global climate impacts biodiversity at the global scale (Mayhew *et al.,* 2007). This pattern is, however, largely based on slowly emerging climatic changes or brief fluctuations during relatively stable cycles. According to the IPCC (2007), if temperature increases exceed 1.5 to 2°C, 20 to 30% of plant and animal species assessed will be at risk of extinction. Climate change is projected to exacerbate the loss of biodiversity and increase the risk of extinction for many species, especially those already at risk due to factors such as low population numbers, restricted patchy habitats, and limited climatic ranges (Millennium Ecosystem Assessment, 2005). Although estimates vary, as many as one million species may face increased threats of extinction as a result of climate change (Thomas *et al.*, 2004).

Climate change has already begun to affect the functioning, appearance, composition and structure of ecosystems. Recently observed changes in the

climate, especially warmer regional temperatures and shifting precipitation patterns, have already had significant impacts on biodiversity and ecosystems, including changes in species distribution and population sizes, timing of reproduction or migration events, and increase in frequency of pest and disease outbreaks.

Between 1980 and 2005, summer minimum Arctic ice cover has generally decreased by 7.4% per decade (Lemke *et al.*, 2007). Even though sea ice extent varies with years and seasons, global projected trends for the future show a distinct downward trend. Indeed, simulations based on IPCC emission scenarios suggest a mean reduction of 22 to 33% in annually averaged sea ice area in the Arctic by 2080-2100 (Zhang and Walsh 2006). The marked reduction of the Arctic ice canopy is forcing polar bears to fast for increasingly longer periods of time and has increased the areas of open water across which polar bears must swim. In the course of the last 25 years, the average weight of female bears has dropped in some areas by 20%, thereby endangering their reproductive capacity (NASA 2006).

Climate change also greatly affects tropical areas. The golden toad of Costa Rica, for instance, has not been seen since 1989 (Pounds *et al.*, 1999). It is labelled as one of the first victims of climate change. Other impacts of climate change on ecosystem functions include the widespread bleaching of corals; instances of wetland salinization and salt water intrusion; the expansion of arid and semi-arid lands at the expense of grasslands and acacia; poleward and upward shifts in habitats; replacement of tropical forests with savanna in the Amazon Basin and Mexico; and shifting desert dunes. In fact, climate change impacts every ecosystem and these impacts can also reflect on the health of the biodiversity in surrounding ecosystems.

Even if greenhouse gas emissions were to decrease significantly tomorrow, climate change would continue to affect ecosystems for hundred of years due to global climate feedbacks mechanisms. For example, models suggest that by 2050, the Great Barrier Reef may have lost 95% of its living coral (WWF, 2004). As snow cover decreases and mountain ecosystems change, species living at or above the snowline, such as the mountain pygmy possum, are likely to go extinct (Pickering *et al.*, 2004). In sub-Saharan Africa, between 25 and 40% of mammals in national parks will become endangered while as many as 2% of the species currently classified as critically endangered will become extinct (Boko *et al.*, 2007). In the Succulent Karoo and Fynbos ecosystems in Southern Africa more than 50% of habitat is expected to be lost by 2050 (Boko *et al.*, 2007). By the end

of the century, 43% of 69 tree plant species studied could become extinct in Amazonia (Miles *et al.*, 2004).

Certain regions are particularly vulnerable to climate change. In Asia, up to 50% of biodiversity is at risk due to climate change while as many as 88% of reefs may be lost over the next 30 years (Cruz *et al.*, 2007). Furthermore, as many as 1522 plant species in China and 2835 plants in Indo-Burma could become extinct (Malcolm *et al.*, 2006). If projected rises in sea level occur, American Samoa could lose 50% of their mangroves and 15 other Pacific islands could face a 12% reduction in mangrove cover (Mimura *et al.*, 2007). Furthermore, a projected 0.5 meter sea-level rise in the Caribbean could cause a 35% decrease in turtle nesting habitat (Fish *et al.*, 2005).

Increasing threats to ecosystem services as a result of climate change have negative consequences for biodiversity-based livelihoods particularly among the poor. While subsistence and biodiversity-based livelihoods, such as subsistence agriculture, artisinal fisheries and handicraft industries, are among the least contributors to climate change, they are expected to be among the most vulnerable to the negative impacts.

Likewise, indigenous and local communities are particularly vulnerable to the negative impacts of climate change. They tend to be among the first to face the adverse consequences of climate change as a result of their dependence on, and close relationship with, the environment. Indigenous and local communities in Small Island Developing States, the Arctic, dry and sub-humid lands and high altitude areas have been identified as being particularly vulnerable.

Impacts of climate change on indigenous and traditional livelihoods include changes in prey availability in the Arctic, increased weed infestations in grazing lands throughout the world and increased exposure of livestock to disease especially in Africa. Loss of livelihoods and traditional practices of populations living in particular ecosystems are already significant. For instance, in communities living in mangroves the harvesting of dyes to treat textiles, nets and fish traps and the gathering of raw materials for handicrafts such as pupu shells in the Cook Islands are threatened.

The negative impacts of climate change on key ecosystem goods and services can affect millions of people at once. For example, the coasts of Africa support vibrant fisheries which provide up to 50% of protein requirements to some coastal communities and support a quarter of Africa's population. In the

Caribbean and Pacific, more than half of the population lives within 1.5 kilometers of the coast and have their livelihoods threatened by increased coastal erosion, damages from storm surges and coral die-offs. In fact, within the next 30 to 50 years coral bleaching could become an annual event in Small Island Developing States, putting at risk local economies and income derived from tourism.

Likewise, while a warming of up to 2 °C may have positive effects on pasture production and livestock in humid temperate regions, the same increase is expected to negatively impact production in arid, semi-arid and tropical regions (Easterling *et al.*, 2007). In Egypt, for example, climate change could, by 2050, decrease the national production of rice by 11% and of soybeans by 28% compared to their production under current climate conditions (Boko *et al.*, 2007). Due to a lack of information, it is unclear what impact should be expected in tropical grasslands and rangelands. However, warming greater than 3 °C is projected to have negative impacts on agricultural production in all regions (Easterling *et al.*, 2007).

Role of Biodiversity in Climate Change Adaptation and Mitigation

Biodiversity contributes to many ecosystem services including the provision of food and fodder, nutrient cycling and the maintenance of hydrological flows. As such, maintaining biodiversity and associated ecosystem functions is an important component of climate change adaptation. Likewise, biodiversity resources such as land races of common crops (including wheat, rice and maize which together account for 50% of the world's dietary requirements), mangroves and other wetlands and vegetative cover can form an integral part of adaptation plans.

As one example, coastal wetlands can provide protection against storm surges and wave action and are an important habitat for fish and birds. In fact, in Malaysia, the value of mangroves for coastal protection is estimated at USD300,000 per kilometer of coast (Gilman *et al.*, 2006). Furthermore, adaptation linked to agricultural biodiversity, such as changing varieties in cereal cropping systems, is expected to avoid 10 to 15% of the projected reductions in yield under changing climatic conditions (IPCC, 2007).

The conservation and sustainable use of biodiversity as a tool to maintain and enhance the resilience of ecosystems are therefore crucial to climate change adaptation and land-use and forest based mitigation. The resilience of

ecosystems can be enhanced through the creation of ecological corridors, networks of protected areas, refuges and buffer zones; restoration of native ecosystems; protection and enhancement of ecosystem services; and reduction of other existing threats to biodiversity such as habitat fragmentation, overharvesting, pollution and land use change.

In integrating biodiversity into adaptation and mitigation, it is also important to consider the observed and predicted responses of species and ecosystems to climate change. In particular, climate change will force some species to shift habitat and will favor survival of species that are better able to adapt to changing climatic conditions. In coral reefs, for example, some species of coral have a high degree of natural adaptive capacity. Since such corals will play an important role in maintaining the structure of coral reefs as other corals die off, the identification and protection of these highly adaptive species is critical. Likewise, in the face of sea-level rise, mangroves can move inland while maintaining a functioning coastal ecosystem as long as the inland route is not blocked by development.

To adapt to climate change, adjustments in the way we use and manage biodiversity will be necessary. For instance, drought tolerant crops can be planted and improved water harvesting and storage should be promoted in regions where temperature increases are forecasted. The use of pest-resistant varieties, efficient management of rainwater, and change in timing of planting, irrigation and fertilizer use are other examples of activities that may help reduce the impacts of climate change.

Biodiversity also contributes to climate change mitigation. Forests account for as much as 80% of the total above-ground terrestrial carbon while peatlands, which only cover 3% of the world's terrestrial surface, store 30% of all global soil carbon or the equivalent of 75% of all atmospheric carbon (Parish *et al.*, 2007). As such, healthy forests and wetland systems have the potential to capture a significant portion of projected emissions.

However, each year about 13 million hectares of the world's forests are lost due to deforestation. This deforestation is currently estimated to be responsible for 20% of the annual human induced CO_2 emissions.

On the other hand, sustainable land management in agricultural areas can increase carbon sequestration in the soil through techniques such as integrated pest management, conservation tillage, intercropping, and the planting of cover crops. In fact, when cover crops are used in combination with conservation tillage, soil carbon content can increase annually for a period of up to 50 years.

The sustainable management of grazing land can provide similar co-benefits since such lands contain between 10 and 30% of the world's soil carbon stocks.

Another emerging role of biodiversity in greenhouse gas mitigation is the use of bioenergy, which derived from renewable sources, are considered to be carbon-neutral, since in theory the carbon released during the combustion can be taken up by growing plants. However, the greenhouse gas reduction potential ultimately depends on the type of biomass used and the associated production practices including the extent and type of land conversion for biomass production. If produced in a sustainable way, the use of biomass to produce bioenergy can efficiently mitigate climate change impacts while enhancing biodiversity, especially on degraded lands.

Climate Change and the Convention on Biological Diversity

The Convention on Biological Diversity (CBD) is the international framework for the conservation and sustainable use of biodiversity and the equitable sharing of its benefits. With 191 Parties, the CBD has near-universal participation among countries that have committed to preserving life on Earth. The CBD seeks to address all threats to biodiversity and ecosystem services, including threats from climate change, through scientific assessments, the development of tools, incentives and processes, the transfer of technologies and good practices and the full and active involvement of relevant stakeholders including indigenous and local communities, youth, non-governmental organizations (NGOs) and women.

The Convention's cross-cutting issues on biodversity and climate change and the ecosystem approach allow for the comprehensive consideration of biodiversity-climate change links and response solutions. Both cross-cutting issues take into account the local, national and international levels, as well as the traditional knowledge and the local and indigenous communities.

The CBD is also mainstreaming climate change components within all of the programmes of work of the Convention. This began with a commitment to adaptation activities during the fifth meeting of the Conference of the Parties (COP) in May 2000 which addressed adaptation regarding coral bleaching. Adaptation is also mentioned specifically in the programmes of work on mountains, forests, inland waters, island biodiversity, and protected areas while the programme of work on the biodiversity of dry and sub-humid lands refers specifically to vulnerability to climate change.

In order to support the mainstreaming of climate change, the Subsidiary Body on Scientific, Technical and Technological Advices (SBSTTA) of the Convention established in 2001 an ad hoc technical expert group to carry out an assessment of the interlinkages between biodiversity and climate change, and produced two technical reports (SCBD 2003; SCBD 2006a) based on the best available scientific knowledge.

Based on scientific information and observed changes, Parties to the CBD have acknowledged both the need to facilitate the adaptation of biodiversity to the impacts of climate change, such as in the case of mountain biodiversity, and the contribution of biodiversity to broader adaptation activities, such as peatlands within the inland waters biodiversity programme.

At its ninth meeting in 2008, the COP adopted a comprehensive decision on biodiversity and climate change which called for enhanced synergies between biodiversity, climate change and land degradation, especially at the national level.

Particularly relevant to the climate change issue, COP 8 and COP 9 adopted decisions focusing on the links between the CBD and Nairobi work programme on impacts, vulnerability and adaptation to climate change and the reducing emissions from deforestation mechanism under the United Nations Framework Convention on Climate Change (UNFCCC) was adopted. Since then, the UNFCCC has acknowledged that reducing emissions from deforestation in developing countries can contribute to the achievement of other international conventions. The same decision under the UNFCCC calls on Parties to note the relevant provisions under the CBD when implementing demonstration activities to reduce emissions from deforestation and forest degradation.

Finally, at COP 9, Parties convened a new series of Ad Hoc Technical Expert Group Meetings to provide biodiversity-relevant information to the UNFCCC process. The first meeting of the group will focus on impacts and vulnerability and the links between biodiversity and climate change mitigation. The second meeting will generate scientific and technical advice on the links between biodiversity and climate change adaptation.

The three Rio Conventions—on Biodiversity, Climate Change and Desertification—derive directly from the 1992 Earth Summit. Each instrument represents a way to contribute to the sustainable development goals of Agenda 21 and, as such, the three conventions are intrinsically linked, operating in the same ecosystems and

addressing interdependent issues. In 2001, the Rio Conventions established a Joint Liaison Group (JLG) to enhance the exchange of information and explore opportunities for synergistic activities.

Activities for enhanced synergies on adaptation, as identified by the JLG, include providing focal points of all Conventions with up-to-date information on relevant assessments, research programmes and monitoring tools; collaborating on the development of common messages on the linkages among climate change, biodiversity and desertification; developing educational materials; and establishing joint web-based communication tools.

As an initial contribution, the CBD Secretariat, with the support of the Government of Canada, developed a web-based guidance on the integration of biodiversity considerations within climate change adaptation planning (**http://adaptation.cbd.int/**). This web-based communication tool makes relevant materials available to Parties including: a map displaying vulnerable regions, sub-regions, ecosystem types and natural World Heritage Sites; tables outlining the threats to biodiversity from climate change and the impacts of adaptation options on biodiversity; searchable databases of relevant documents and websites; and an interactive map of case studies on biodiversity in adaptation planning.

The three Secretariats also recently launched joint publications on forests, biodiversity, land degradation and climate change and on adaptation, biodiversity and land degradation. These publications raise awareness of the relevant provisions under each convention including emerging issues and opportunities to enhance synergies.

The CBD and the United Nations Convention to Combat Desertification are also joining forces with regards to the biodiversity of dry and sub-humid lands. These ecosystems are vulnerable to the combined effects of biodiversity loss, desertification and climate change. Since these areas are usually dominated by agricultural activities there are also significant linkages to the CBD programme of work on agro-biodiversity.

Climate change, as one of the main drivers of change for biodiversity, is also reflected in the 2010 biodiversity target to significantly reduce the rate of biodiversity loss. Target 7 to maintain and enhance resilience of the components of biodiversity to adapt to climate change is crucial in the battle against biodiversity loss. The Global Biodiversity Outlook 2 (SCBD 2006b), which looks at the prospects for achieving the 2010 biodiversity targets, concluded that

progress related to target 7 is challenging and depends on protecting the critical habitats, populations of species and genetic diversity that contribute to resilience and/or facilitate adaptation in the face of climate change.

The CBD also has a role to play in raising awareness. People have the power to trigger massive changes. Climate change already benefits from wide media coverage, which increases public knowledge and leads to changes in daily habits or political choices. The level of awareness of the importance of biodiversity and its interlinkages with climate change needs to be raised. To this end, the theme for the 2007 International Day for Biological Diversity, which was celebrated by more than 60 countries and 14 partner organizations, was biodiversity and climate change.

Challenges and Opportunities for the Future

Although much progress on biodiversity conservation and sustainable use and addressing climate change has been made in the international framework, there remains a number of challenges and opportunities for further consideration. Opportunities for collaboration and related emerging issues on the links between the conservation and sustainable use of forest biodiversity and climate change (including within the framework of reducing emissions from deforestation) include monitoring and reporting which are crucial to the implementation of mitigation strategies.

Engagement by the private sector constitutes an important step in the fight against climate change. Already, pioneering initiatives with a business dimension have been established, including the Potsdam Initiative – Biological Diversity 2010, agreed by the G8 + 5 countries (Brazil, China, India, Mexico and South Africa) in March 2007, and the consideration of ecosystem services as one of the four focus areas of the World Business Council for Sustainable Development.

Although climate change activities have not yet been integrated within the programme of work on Technology Transfer, the CBD and the UNFCCC have long been working collaboratively on technology transfer through the exchange of information and efforts to harmonize relevant databases. In addition, Parties and other Governments have committed to exploring possible ways and means by which incentive measures promoted through the Kyoto Protocol can support the objectives of the CBD.

Enhancing the integration of climate change impact and response activities within the programmes of work of the CBD remains of great importance to

strengthen collaboration. Accordingly, the links between biodiversity and the programmes of work will be evaluated during all in-depth reviews of implementation and proposals on ways to improve the links will be considered.

The JLG identified a number of opportunities for collaboration on cross-cutting activities including capacity building, technology transfer, research and monitoring, information and outreach, reporting, and financial resources. Promoting synergies at the national level is also crucial and usually represents a challenge. National level cooperation will often allow for the most efficient and effective coordination on the implementation of commitments under each convention.

Conclusion

There is now clear evidence that climate change is already affecting humans and ecosystems, and will continue to do so. Many different assessments now highlight the interlinkages that exist between biodiversity and climate change: biodiversity is threatened by climate change, but the conservation of biodiversity can also promote the adaptation to and mitigation of climate change impacts.

Early on, the Convention on Biological Diversity examined the issue of climate change, taking decisions acknowledging its impact on biodiversity, and its role in adaptation and mitigation. A number of opportunities exist for collaboration on this topic between other Rio conventions, and action is moving towards incorporating climate change and biodiversity considerations into areas such as capacity building, education and awareness raising, technology transfer, and research. There is evidence that the links between the two issues are being recognized at the national level, as many countries are now providing examples of good practice and are showcasing the value of maintaining rich and diverse ecosystems in the face of climate change.

Finally, the consideration of climate change in biodiversity conservation strategies and the integration of biodiversity into climate change adaptation and mitigation plans are crucial. Overall, increased synergies and collaboration at all levels and an enhanced implementation of the Convention are vital in the battle against climate change.

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