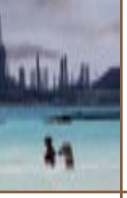
Gincana 3

Biological Diversity and Climate Change

Convention on Biological Diversity

Achieving the 2010 Biodiversity Target



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Ahmed Djoghlaf, *Executive Secretary, Convention on Biological Diversity (CBD)*

Climate Change is Real, The Time to Act is Now

The recently released report of the Intergovernmental Panel on Climate Change prepared by 2500 experts from 130 countries has made it clear that climate change is real. Indeed, the consequences of a warming planet are now visible. Bare green winter slopes in Alpine ski resorts and vast chunks of ice breaking off from land masses in the Arctic and Antarctic are stark reminders of the consequences of continuing to pour ever-greater quantities of greenhouse gases such as carbon dioxide into the atmosphere, and on the urgency of finding cleaner ways of providing energy, goods and services to a growing population.

What has been largely missing from this growing awareness of the threat of climate change has been the recognition that it is linked to another, equally-important human-caused change to the planet's loss of biological diversity. The Millennium Ecosystem Assessment prepared by 1395 experts from 95 countries have made it clear that climate change is the second root cause of the unfolding unprecedented loss of biodiversity on our planet

The link between biodiversity and climate change operates in two directions. Firstly, climate change is indeed an important driver of the loss of biological diversity, as species and ecosystems struggle to keep pace with rapid changes in temperature and rainfall. What is much less appreciated is the second aspect of the link: the ability of human societies to adapt to climate change will be compromised if we fail to reduce the other pressures on biodiversity—such as deforestation, pollution and unsustainable harvesting of fish stocks and other wildlife.

In recognition of this vital link, the Parties to the Convention on Biological Diversity (CBD) will celebrate this year's International Day for Biological Diversity under the theme biodiversity and climate change. This major event in the life of the Convention for life on Earth will also coincide with the celebration of the International Polar Year. We hope to highlight a positive opportunity: by tackling the two issues together, and with a sense of real urgency, it is still possible to prevent the livelihoods of people around the world from being jeopardized by the twin threats of climate change and the loss of biodiversity.

Already, scientific observations around the world have shown a range of responses in nature to changing weather patterns, from earlier bird-nesting seasons in Europe to the "bleaching" of tropical reefs as warmer sea temperatures upset the delicate symbiosis between coral organisms and algae.

Of course, plants and animals have often had to adapt to past changes in the climate—indeed, it has been an important factor in the evolutionary change that has produced the variety of species we see today.

It will be much more difficult, however, for ecosystems to adapt naturally to the present climatic trends brought about by human activity, for two main reasons. First, the rate of change projected over the coming century is much greater than anything experienced in recent geological time. Second, the options available for natural adaptation have been greatly reduced by the large-scale conversion of habitats: if a forest is surrounded by bare pasture or urban sprawl, for example, many animals and plants are unable to shift their range to more suitable locations should their current territories become unsuitable due to climate change.

Climate change therefore has the potential to accelerate the current rate of species extinctions, already higher than at any time since the disappearance of the dinosaurs 65 million years ago, and estimated to be already 100 to 1000 times the background rate.

As the Millennium Ecosystem Assessment has clearly demonstrated we need to protect biodiversity—even if only in terms of pure self-interest for our own species. The variety of plants, animals and micro-organisms—and this includes genetic diversity within species—underpins a range of services provided to us by healthy ecosystems, among them the provision of fresh water, food and fiber, the pollination of crops, opportunities for recreation, and even climate control itself through the absorption of carbon dioxide by vegetation.

A failure to address the causes of biodiversity loss therefore has huge implications for human development, especially as the rural poor are often those most directly dependent on these ecosystem services.

Slowing climate change through a reduction in emissions from the burning of fossil fuels is a vital long-term step in safeguarding the variety of life on Earth. Since forests, peatlands, and other ecosystems hold vast amounts of carbon, avoiding deforestation and the loss of peatlands and other ecosystems can contribute to these efforts.

However, even if all such emissions were stopped today, average temperatures could be expected to increase well into the future, because greenhouse gases linger in the atmosphere for many decades. Because of this inertia, an increasing focus is being placed on measures to help societies adapt to climate change, in parallel with efforts to minimize further warming. It is here that much greater priority must be placed on the role of biodiversity.

Despite its importance, climate change is only one of a number of human-induced pressures acting on ecosystems, often simultaneously. It is within our power to reduce each of these pressures. By using all the tools in our possession to maintain or increase the resilience of ecosystems, we can add to their ability to withstand the impact of a changing climate. In other words, protecting biodiversity should be seen as an essential component of adaptation to climate change.

Coral reefs provide a case in point. A wide range of different factors have led to the degradation of these "rainforests of the ocean", such as overfishing that depletes the reefs of

algae-grazing species and upsets the fragile balance of the ecosystem. Activities on land can also cause damage, including the poorly-managed use of fertilizers that run off farmland, adding excess nutrients such as nitrogen to coastal waters, and even deforestation hundreds of kilometers inland that causes soil erosion and swamps the coral reefs with sediment.

A recent report by the IUCN suggests that through better land management and the use of marine protected areas, it may be possible to prevent and even reverse the bleaching caused by rising sea temperatures. Such a strategy could significantly bolster the livelihoods of millions in areas such as the Caribbean Sea and the Pacific and Indian Oceans, who depend on the reefs for the tourism income they bring in, the seafood they provide and the physical protection they offer from storms and waves.

Other examples abound across the globe. Better protection of native vegetation in drylands such as the African Sahel and the semi-arid Caatinga of Brazil can check the advance of desertification and help farmers cope with the impacts of drought. Avoiding deforestation in Central America can reduce the likelihood of devastating landslides provoked by the more intense rainfall projected to be a consequence of climate change. Conserving wetland habitats, from the cypress marshes of the Mississippi Delta to the mangrove forests of Sri Lanka, can shield coastal communities from increasingly violent storms.

As governments around the world develop their climate adaptation strategies, failure to appreciate the importance of biodiversity can potentially lead to counterproductive measures. For example, large-scale engineering projects to move fresh water to drier areas might weaken the resilience of river ecosystems from which the water is abstracted, making communities more vulnerable to climate impacts. Introduction of drought-tolerant crops might inadvertently introduce invasive alien species to forests or savannas, jeopardizing the essential services provided by those ecosystems. Careful assessment of adaptation policies at the time of their design can help avoid such negative consequences.

The international community has committed itself to a target of slowing significantly the pace of biodiversity loss by 2010. *Global Biodiversity Outlook 2* cautioned last year that without urgent further measures, this target would be missed. The time has come to realize that investing in the resilience of ecosystems will ensure that future generations are not only bequeathed the dazzling variety of nature we take for granted, but are also much better able to cope with the less stable climate they will unfortunately inherit.

Ban Ki-moon, *The United Nations Secretary-General*

Message on the International Day For Biological Diversity

Biodiversity is the foundation of life on earth and one of the pillars of sustainable development. The richness and variety of life on earth makes possible the ecosystem services on which we depend: clean water, food, shelter, medicine and clothing. Environments rich in biodiversity are resilient when stricken by natural disaster. All of this is of particular importance for the poorest citizens of our world. Those who live on only a few dollars a day need biodiversity to meet their basic needs. Without the conservation and sustainable use of biodiversity, we will not achieve the Millennium Development Goals.

However, biodiversity is being lost at an unprecedented rate. This, in turn, is seriously eroding the capacity of our planet to sustain life of earth. It is for this reason that world leaders attending the World Summit on Sustainable Development in Johannesburg in 2002 agreed to achieve, by 2010, a significant reduction in the rate of loss of biodiversity. This commitment was reiterated at the 2005 World Summit. The 2010 Biodiversity Target is now fully integrated into the framework of the Millennium Development Goals and, as a sign of further support, the international community decided to declare 2010 the International Year for Biological Diversity.

As the world also focuses more attention on climate change, the links between climate change and biodiversity are also being articulated. The Millennium Ecosystem Assessment—a state-of-the-art appraisal of the world's ecosystems and the services they provide—has identified climate change as the one of the biggest causes of our planet's loss of biodiversity, along with changing land use. In addition, the recently released report of Intergovernmental Panel on Climate Change made it crystal clear that climate change is real and will continue to affect our lives and ecosystems for many years to come. Those impacts will include the extinction of ever increasing numbers of species, further weakening a number of already fragile ecosystems.

It is therefore timely that the theme of this year's observance of the International Day for Biological Diversity is "Biodiversity and Climate Change". Indeed, the conservation and sustainable use of biodiversity is an essential element of any strategy to adapt to climate change. Mangrove forests and other coastal wetlands represent a bulwark against extreme weather events and rising sea-levels. As agricultural landscapes become warmer and drier, the diversity of livestock and cereal crops can provide farmers with options to cope with new conditions. Forests, peatlands and other ecosystems contribute to sequestering carbon dioxide from the atmosphere, thereby helping to mitigate increases in greenhouse gas emissions.

Through the Convention on Biological Diversity and the United Nations Framework Convention on Climate Change, the international community is committed to conserving biodiversity and combating climate change. The global response to these challenges needs to move much more rapidly, and with more determination at all levels—global, national and local.

For the sake of current and future generations, we must achieve the goals of these landmark instruments.

Achim Steiner, *UN Under-Secretary General and Executive Director of the United Nations Environment Programme (UNEP)*

Curbing Climate Change:
Risks and Opportunities for World's Wildlife

"Rapid environmental change is all around us. The most obvious example is climate change, which will be one of my top priorities as Secretary-General. But that is not the only threat. Many other clouds are on the horizon, including water shortages, degraded land and the loss of biodiversity.

This assault on the global environment risks undermining the many advances human society has made in recent decades. It is undercutting our fight against poverty. It could even come to jeopardize international peace and security."

Along the world's mountain ranges the mighty glaciers are melting at an accelerating rate as climate change raises the temperature across the roof of the world.

Scientists at the World Glacier Monitoring Service in Zurich, Switzerland, say the rate of loss of glaciers is now three times faster than it was in the 1980s.

Eventually this is going to spell misery for millions if not billions of people who rely on these water towers for drinking water, agriculture and industry if dramatic reductions in greenhouse gases are not achieved.

Ecosystems, from wetland and river systems to forests and meadows, will also suffer imperiling biodiversity both high and humble.

Climate change threatens habitats and species in other ways which scientists are just beginning to understand. Take Africa for example. A new report, commissioned by the United Nations Framework Convention on Climate Change (UNFCCC) and released just prior to their last meeting in Nairobi, Kenya, estimates that between 25 per cent and over 40 per cent of species' habitats in Africa could be lost by 2085.

Habitats and ecosystems in Africa are currently under threat from a variety of impacts and climate change is likely to be an additional stress.

One study, examining over 5,000 plant species in Africa, has concluded that around 80 to well over 90 per cent of species' suitable habitats will decrease in size or shift due to climate change.

Shifts in rainfall patterns could affect the fynbos and karoo in southern Africa by altering the fire regime critical for their regeneration.

Wetland ecosystems such as the Okavanga Delta and the Sudd area could be impacted by decreased run off. There will also be impacts on coastal zones with reduced fish productivity, coral bleaching, salt water intrusion and loss of beach facilities.

For a country like Kenya, where UNEP is headquartered, this could prove economically disastrous. The country earns some $700 million a year in foreign exchange from tourism based largely on its ecosystems, wildlife and landscapes both terrestrial and marine.

And it is not just Africa. Another report, this time commissioned by the Convention on Migratory Species, pin-points individual species at risk in other parts of the world and some whose habits, habitats and health are already being affected.

Green turtles for example are suffering higher levels of tumours with the rise linked to warmer waters that may be favouring infections.

Others, like the North Atlantic Right Whale, may be impacted by a decline in their main food source plankton as a result of shifts in big ocean currents, says the study launched at the climate convention talks in Nairobi.

The report, compiled with support from the UK Department of Environment, Food and Rural Affairs, cites lower water tables and more frequent droughts that will reduce habitat for the Baikal Teal and foraging grounds for species like the Aquatic Warbler.

Exotic southern fish species like the Red Mullet, Anchovy, Sardine and Poor Cod are now being found in the North Sea.

Meanwhile, changing wind patterns are making it more difficult for passerine birds to

make their migration in the Caribbean where spring storms are becoming more numerous and of greater intensity.

Climate change may also favour the spread of alien invasive species. The Pacific Oyster (*Crassostrea gigas*) brought to Europe for commercial reasons was not able to survive outside artificial pens, says the CMS report. As the North Sea has grown warmer, the Pacific Oyster has been able to breed in the wild and is now displacing native oysters in the Wadden Sea.

As migratory species are affected by climate change, then so are their prey species. For example, reproductive success of the non-migratory Great Tit (*Parus major*) and migratory Pied Flycatcher (*Ficedula hypoleuca*) is being affected by the changing availability of caterpillar food supplies.

It is doubtful whether polar bears (*Ursus maritimus*) will be able to adapt fast enough to changing ice conditions affecting the habitat of their seal prey species, and the disappearance of the ice threatens the bears' survival.

These are just some of the facts and some of the concerns linking climate change and the Convention on Biological Diversity (CBD), connecting the build up of greenhouse gases and their impact on the 2010 target and beyond.

But what of the solutions and challenges facing the CBD and the wider world?

Firstly, it is clear that the best form of adaptation is mitigation—in other words cutting the gases triggering climate change.

There is, for the first time in several years, some genuine cause for optimism. The latest report by the Intergovernmental Panel on Climate Change has put a full stop behind the scientific debate by finding 'unequivocally' that humans are altering the climate.

In Europe, the Commission has proposed a 20 per cent cut in greenhouse gas emissions after the Kyoto Protocol expires in 2012 and even a 30 per cent cut if others join in.

The Federal Government in the United States remains unconvinced that legally binding emission reductions are the best way forward. However President Bush in his last State of the Union address conceeded that climate change is a serious challenge.

In addition, a significant number of individual states and over 300 metropolitan areas have or are considering emissions caps and or reductions in the sprit of Kyoto.

Important business and industrial sectors are also embracing emission reductions and energy efficiency. These include retailers like Wal-Mart who plan to sell each customer one compact fluorescent light bulb which would take the emissions equivalent of 1.3 million cars off the road.

Wal-Mart is also considering fitting solar power to many of its vast network of stores on a scale that would make it among the biggest generators of solar energy in America.

Meanwhile, the Clean Development Mechanism (CDM) of the Kyoto Protocol is set to generate $100 billion worth of funds flowing from the North to the South for cleaner and greener energy schemes.

The benefits for biodiversity from better access to the CDM are several including the installation of energy services in rural and urban areas of developing countries that may reduce pressure on forests for charcoal and wood for cooking.

The CDM also includes provisions for tree planting—an issue also at the heart of UNEP's new Billion Tree Planting Campaign. As I write the campaign is over a quarter of the way to its own voluntary target as a result of pledges from governments, business and civil society.

One flaw in the CDM currently is the uneven distribution of projects, with the lion's share going to rapidly developing countries like China and smaller economies missing out.

In order to overcome some of the economic and structural barriers, UNEP and the UN Development Programme recently launched a new initiative with support from Spain and Sweden. Other countries are set to come on board.

The initiative also includes a provision for adaptation and climate-proofing of infrastructure to fisheries, agriculture and health care services—even if the world can manage to turn of the carbon tap, there will be some measure of climate change as a result off carbon gases already in the atmospheric system.

There are various ways in which biodiversity could be potentially and directly assisted to adapt. These include the development of wildlife corridors, re-mapping protected areas to reflect the new reality of climate change and extending protected areas both on land and at sea.

In the marine environment this could especially benefit vulnerable and temperature sensitive ecosystems like coral reefs--reefs are doubly vulnerable to climate change if located in contaminated waters, new research shows.

In a sense these, are not just defensive actions but also conservation opportunities driven by new thinking, new science and new sources of funding in the face of the over arching impact of climate change.

For example an alliance of tropically-forested countries, led by nations like Papua New Guinea and Costa Rica, are pressing to have standing forests included in the Kyoto provisions.

Currently there are few incentives to conserve such forests and their extraordinary array of wildlife alongside their important role as suppliers of food, medicines and materials for local communities during good and hard times.

At the moment tropical forests are outside the CDM despite the fact that they may sequester as much as $100 billion worth of carbon annually.

Like so many areas of biodiversity and climate change, we have a chicken and egg situation here. If standing forests are to be counted, the emission reductions post 2012 need to be significant and sizeable.

So in the end it turns on politics and will of nations to match the science with real action. This is no longer only the responsibility of environment ministers but also of ministers of economic cooperation, finance, health, transport, planning, security and defense

Indeed, given the size of the threat and the impact across all sectors of economies, surely it is a responsibility at the very top of the political tree, namely heads of state.

Over recent months the idea of a Heads of State summit on climate change—somewhere between the G8 Summit and the next climate change conference in Indonesia, in December—has been gaining ground.

It is a proposal that may generate even faster momentum when the IPCC Working Group II report is launched in April. Here the impacts on people and on biodiversity will come to the fore.

I mentioned the world's glaciers at the outset and, along with the polar regions their highly visible vulnerability to climate change. In doing so I must mention World Environment Day (WED) 2007 which is to be hosted this year by Norway with the central events focused on the Arctic gateway of Tromsø.

This year's theme is *Melting Ice—A Hot Topic?* The logo underlines the global theme by asking a polar bear, an African farmer, a Pacific islander, an insurer and businessman, two indigenous children and ultimately 'Yourself' the rhetorical question of whether indeed this is the topic of our time.

As I note in my final paragraph: "Perhaps we should have added a further person—namely a politician: Just how much hotter does this topic need to become before governments across the globe finally act?"

It is a point I will raise in all my meetings throughout this year up to the Climate Convention conference in Bali, 3-14 December 2007.

It is the theme that all of the multilateral environmental agreements including the CBD, I believe should echo and amplify in their daily dealings in this most crucial of years for climate change and thus for biodiversity too.

Gérald Tremblay, *Mayor of Montréal*

Cities Must be Part of the Solution

The Ville de Montréal is proud to welcome the Convention on Biological Diversity (CBD) to our city. In December 2005, Montreal had the honour of hosting the Conference of the Parties to the UN Framework Convention on Climate Change (UNFCCC). This memorable event gathered the global community around issues related to the consequences of climate change.

I had the opportunity to preside over the opening meeting of the World Mayors Council on Climate Change, held as part of the Fourth Municipal Leaders Summit on Climate Change. This event ran parallel to the UNFCCC meeting.

As a result of these circumstances, we have developed a particular interest in climate change and biodiversity—which, as we now know, are closely inter-related. Both of these issues must be addressed at all levels.

Some of my colleagues—the mayors of towns located in northern Quebec—are already facing a number of problems related to climate change. These include the melting of sea ice and permafrost, and they have significant effects on both infrastructure and residents.

Recently, unusually warm temperatures have given us a taste of what a changing climate could mean for southern Quebec. The spread of diseases such as that linked to the West Nile virus, the arrival of exotic invasive species—one of the key causes of biodiversity loss—and the lengthening of the allergy season: these are some of the repercussions we may have to face.

As I said at the first meeting of the World Mayors Council on Climate Change, "Cities must be part of the solution." This is why the Montreal region has adopted a sustainable development plan, which places a priority on the reduction of greenhouse gas (GHG) emissions. Following an 80% reduction in corporate GHG emissions between 1990 and 2002. Montreal has now undertaken to reduce its GHG emissions by an additional 20% between 2002 and 2012. And we have developed an action plan to get us there.

In addition, the Ville de Montréal—through its nature museums—is equally pleased to offer support to a network of prestigious scientific partners, in order to ensure that we meet the 2010 Biodiversity Target set in the Convention of Biological Diversity. To get there, we will have to face the major challenge that climate change represents. Cities have a role to play in finding solutions to the problems of both biodiversity and climate change.

Yvo de Boer, *Executive Secretary, United Nations Framework Convention on Climate Change (UNFCCC)*

Climate Change and Biodiversity: Efforts That Become Mutually Supportive

Scientific research has shown how emissions of greenhouse gases in the atmosphere are leading to substantial changes in the Earth's climate. Effects such as increasing temperatures, sea-level rise, drought and changes in rainfall patterns and in the frequency and intensity of extreme climatic events pose additional pressure to the world's ecosystems and challenge social development. Climate change is quoted by the Millennium Ecosystem Assessment as one of the main drivers of ecosystem change. The United Nations Framework Convention on Climate Change (UNFCCC) acknowledges this situation by stating in its objective that stabilizing greenhouse gases in the atmosphere to prevent dangerous interference with the climate system should be achieved in a timeframe that, among others, allows ecosystems to adapt naturally to a changing climate.

The understanding of the relationship between actions to address climate change and biodiversity loss has increased as the UNFCCC and the Convention on Biological Diversity (CBD) have advanced work to meet their respective objectives. At the outset, the Earth's ecosystems play a major role in the global carbon budget and, hence, the way they are managed influences the concentration of greenhouse gases in the atmosphere. While Parties to the UNFCCC have committed themselves to protect reservoirs and enhance carbon sinks as a means to mitigate climate change, they have also taken into account biodiversity concerns: for example, forestry-related activities under the Kyoto Protocol must contribute to the conservation of biodiversity. Furthermore, regulation for afforestation and reforestation under the Clean Development Mechanism (CDM) requires that any potential negative impacts on biodiversity and natural ecosystems be taken into account during the project-design phase. In practice, the CDM has provided incentives to recover degraded lands.

Activities to cope with the impacts of climate change have also revealed opportunities for synergy. The capacity of society to adapt to a changing climate is strongly determined by the state and health of its natural base, particularly in the case of those communities whose livelihoods depend on ecosystem goods and services. Science has also shown that diverse and healthy ecosystems are more likely to adapt to a changing climate. Hence,

protecting and restoring key ecosystems could contribute to adaptation strategies and help society cope with drought and floods, the risk of foregone goods and services and other climate-related impacts. In this context, work under the National Adaptation Programmes of Action (NAPAs) in the UNFCCC context has assisted least developed countries to identify how ecosystem resilience and biological diversity contribute to enhancing their adaptive capacity. The Nairobi work programme on impacts, vulnerability and adaptation to climate change, recently adopted under the UNFCCC, is likely to further identify issues of common concern.

Finally, reducing emissions from deforestation in developing countries is an emerging topic under the UNFCCC which can potentially provide opportunities for strengthening action to address climate change and contribute to biodiversity conservation. Not only is the loss of forests one of the main causes of biodiversity loss, it also contributes to approximately one fifth of global greenhouse gas emissions. For this reason, protecting and managing the world's forests in a sustainable way can contribute to stabilizing greenhouse gas concentrations in the atmosphere, help communities to adapt to climate change and, at the same time, reduce biodiversity loss. Parties to the UNFCCC are currently working toward establishing a framework for such a purpose.

Actions to address climate change and biodiversity can be mutually reinforcing at the level of national and local implementation. For example, policies on integrated land management can reduce greenhouse gas emissions (through forest conservation), provide options for adaptation (for example, protection of watersheds and soil) and contribute to biodiversity conservation (by protecting the habitat of several species). The potential for synergy is illustrated by the following concrete activities[1]:

- Several governments are currently exploring how soil, rangeland and forest management can enhance the resilience of ecosystems and help local populations adapt to climate change;
- Reforestation and restoration of mangrove forests is currently being used as an adaptation strategy against storms and coastal erosion while, at the same time, sequestering carbon and contributing to safeguarding the habitat of marine and coastal species;
- Management and conservation of bamboo forests, although of lower potential to stabilising greenhouse gas concentrations in the atmosphere, provides an alternative for adaptation and biodiversity conservation;
- Agroforestry projects also provide options for adaptation while lessening the pressure on the agricultural frontier, thus helping protect important habitats and reservoirs of carbon.

The above highlights some developments from the first ten years of the UNFCCC. The negotiation process is looking forward to defining and setting an arrangement for long-term cooperative action to address climate change. The post 2012 era will see a mature process strengthened by lessons from the past and where linkages to issues outside the Convention are likely to be further explored and strengthened. Biodiversity will be, with no doubt, one of them.

1. These examples have been extracted from the UNFCCC website, in particular, registered CDM methodologies and the local coping strategy database.

Dr. R. K. Pachauri, *Director-General, The Energy Resources Institute (TERI), Chairman, Intergovernmental Panel on Climate Change (IPCC)*

Climate Change and Impacts on Biodiversity

"On account of the inertia in the system oceans will continue to warm over a much longer period than land areas even with stabilization of the concentration of greenhouse gases, which indicates that sea level rise would likely continue for centuries beyond the stage when stabilization of concentration of these gases may be achieved."

The first part of the Fourth Assessment Report of the IPCC dealing with the physical science basis of climate change was released in early February 2007. It is important to understand the major findings of this report in assessing the likely impacts on biodiversity, which would be dealt with in detail as part of the report of Working Group II of the IPCC, to be released in early April 2007. The subject of changes in the world's climate and their implications for biodiversity have been dealt with in previous reports of the IPCC, including a technical paper on "Climate Change and Biodiversity" published in April 2002. However, not only has our understanding of the nature and extent of climate change advanced significantly since the beginning of this decade, but there is also stronger evidence available on acceleration in some of the impacts. In other words, ecosystems and natural resources in several parts of the world are now much more vulnerable to the impacts of climate change than was estimated earlier. This is partly articulated in the statement "The understanding of anthropogenic warming and cooling influences on climate has improved since the Third Assessment Report (TAR), leading to very high confidence that the globally averaged net effect of human activities since 1750 has been one of warming, with a radiative forcing of +1.6 [+0.6 to +2.4] W m^{-2}".

It would also be useful to understand that the Arctic region is warming at twice the rate of the global average. Based on observations that apply to the past 100 years, it was also concluded that Arctic temperatures have high decadal variability, and a warm period was also observed from 1925 to 1945. These changes have important implications for all forms of life in that part of the globe.

It would also be important to assess the impacts of biodiversity on the basis not only of the magnitude of changes that have taken place, but also the rate at which these have occurred within a historical context. The increase in concentration of greenhouse gases in the atmosphere, which is the main driver of anthropogenic climate change, therefore, has to be seen within a framework of long-term historical changes as well. For instance, the atmospheric concentration of methane in 2005 exceeds by far the natural range of the last 650,000 years as determined from ice cores. With the coming into existence of the Montreal Protocol and other measures undertaken, growth rates have declined since the early 1990s, but concentration levels still remain very high as compared to the long-term trend estimated for the past. In the case of carbon dioxide also, the observed value of 379 ppm in 2005 exceeds by far the natural range over the past 650,000 years, which has led to a warming of average global surface temperature of 7.4°C between 1906 and 2005.

Biodiversity would also be affected by extreme aspects of climate change, including heavy precipitation events as well as intensity and frequency increases observed with droughts as well as floods in different parts of the world. At the same time, observed evidence indicates that there has been increased precipitation in eastern parts of North and South America, northern Europe and northern and central Asia, while drying has been observed in the Sahel, the Mediterranean, southern Africa and parts of southern Asia. All of this has important implications for biodiversity in the areas affected. While important findings have been drawn from an analysis of observed effects in the past, it is also necessary to look at future projections that would help in our understanding of the threat to biodiversity in the future. Firstly, for the next two decades a warming of about 0.2°C per decade is projected for a range of SRES emission scenarios (the standard set of scenarios used by the IPCC for its previous and current assessments). On the basis of projections arrived at in the Fourth Assessment Report it can be stated that the best estimate for the low scenario is 1.8°C (from a likely range of 1.1°C to 2.9°C), and the best estimate for the high scenario is 4°C (from a likely range of 2.4°C to 6.4°C). This range is broadly consistent with the span of projected changes estimated in the TAR. Of course, the changes projected as average values do not translate into uniform changes across the globe not only across land areas but also between land surfaces and oceans. On account of the inertia in the system oceans will continue to warm over a much longer period than land areas even with stabilization of the concentration of greenhouse gases, which indicates that sea level rise would likely continue for centuries beyond the stage when stabilization of concentration of these gases may be achieved. Sea level rise and warming of the oceans have important implications for biodiversity as well as ecosystems existing in coastal areas and islands. The mangroves growing in several coastal and island locations for instance would be seriously affected as a result of sea level rise.

All in all, observations from the past as well as projections from the future indicate that given the seriousness of the subject, it is particularly important for those dealing with the physical aspects of climate change to work closely with those research communities that are concerned with the preservation of species and the existence of biodiversity on Earth. Even more important would be the involvement of social scientists in such collaborative efforts, so that human society can come to grips with not only mitigation measures that would require significant changes in those activities which result in emissions of greenhouse gases, but also arrive at means by which the world can adapt to climate change which would be inevitable even if we were to bring about major and rapid cuts in emissions in the immediate future. Human society cannot neglect the effects of climate change on all living species, because quite apart from maintaining the delicate balance of nature that the existence of different species are an important and vital constituent of, the history of human progress in fields as diverse as agriculture and medicine has been determined largely by the wealth of biodiversity which human society has benefited from. This wealth cannot be destroyed or depleted if we are to act in the interests of both the current as well as future generations.

Monique Barbut, *Chair and CEO, Global Environment Facility (GEF)*

Building a Global Constituency for the Environment

The polar bear, lumbering through forbidding Arctic seasons, is the embodiment of strength, power and survival. So, recent painful images of depleted and struggling polar bears are wrenching calls to action—both to balance climate change trends and to protect the survival of living species. The polar bear's plight, sadly, helps bring home the urgent need for integrated thinking and action at the convergence of climate change and biodiversity conservation.

By the middle of this century we are no longer likely to have year-round Arctic sea ice and the polar bear may disappear from the wild. Many scientists believe that the rapid rate of climate change in the Arctic could ultimately produce changes in ocean and atmospheric circulation patterns. The impact on the polar bear, however, is more immediate—already, there is a perceptible thinning of the weight of polar bears and in the birth and survival of cubs.

This powerful species' endangerment is just one of many predicted and observed impacts of climate change on biodiversity. The Millennium Ecosystem Assessment noted that by the end of the 21st century, climate change and its impacts may be the most dominant driver of biodiversity loss and changes in ecosystem goods and services that biodiversity provides to society.

From a biodiversity management perspective, we must ensure that protected areas adapt to climate change through proper design of protected area systems. According to a CBD study, in the Arctic the most effective adaptation strategies available are monitoring and predicting future conditions, using traditional knowledge to formulate hypotheses, and identifying knowledge gaps. Conversely, from the climate change perspective, conservation and maintenance of ecosystem structures serve as important climate change strategies, since species-rich ecosystems have a greater potential to adapt to climate change. In the Arctic, it is not just polar bears affected by the changing climate; the Innuits and other indigenous human communities who live in and depend on the Arctic ecosystems will be affected and will need to develop the capacity to adapt.

It is becoming starkly clear that the increasing convergence of global environmental problems can only be solved with an intelligently integrated set of solutions. Furthermore, as we honor the 2007 International Day for Biological Diversity—and International Polar Year and World Environment Day on climate change—we can build on the growing public awakening about the interlinked nature of these alarmingly imminent problems. We are in a unique position to help create a global constituency for integrated solutions.

I would like to challenge environmentalists, business leaders, and governments to develop a campaign to build this global constituency, employing proven marketing practices and low-cost social change strategies, and sending compelling, targeted messages across the planet. It would result in a groundswell of awareness, a commitment to change, and a practical, personal response that would influence communities, societies, and nations. A global constituency for the environment entails each of us. I invite you to join with us in this effort.

Jens Stoltenberg, *Prime Minister of Norway*

Finding Solutions to Environmental Challenges: A Responsibility for All

The further north you go, the more extreme the consequences of climate change become. Today, Norway experiences mayflowers in December and green Christmases, and its bears no longer follow normal hibernation patterns—events unthinkable just a few years ago. Climate change is starting to affect the way we live.

There is a further major environmental concern for humankind today. Loss of biodiversity, along with climate change, undermines sustainable development and poverty alleviation efforts. Moreover, degradation and loss of biodiversity have been identified as barriers to achieving the UN Millennium Development Goals.

Climate change and biodiversity are strongly interlinked. Climate change affects biodiversity and biodiversity can affect the world's climate, most importantly when forests are lost. Active management and preservation measures aimed at protecting biodiversity cover a wide range of measures which also have the effect of mitigating climate change. I therefore welcome the selection of "biodiversity and climate change" as the theme for the International Day for Biological Diversity this year.

If we are to succeed in fighting global warming, we do indeed need to understand the links between biodiversity and climate change. The Millennium Ecosystem Assessment has provided valuable insights in our dependence of ecosystems. Biodiversity is a safety net for humankind.

Biodiversity is vital, as we need to be able to replace threatened plants or crops and develop stronger crop strains. Genetic diversity is an insurance policy against the effects of climate change, destructive plant diseases, and pests.

Biodiversity can also be an important means of preventing famine. The breeding of better food crops depends on the availability of genetic material, and a global back-up system to protect against irreversible loss of biological diversity is therefore vital. Many existing seed banks are vulnerable to natural disasters, the effects of war and shut-downs.

As a response to this need the Norwegian Government is building a global seed vault on Svalbard. Due to be opened in 2008, this depository will house up to three million seed types, and will provide an additional safety net for the world's food supply. It will offer all countries a place to store further samples of seeds that are already stored in seed banks elsewhere in the world. The designers are taking advantage of Svalbard's permafrost by building the seed vault into the side of a mountain, thereby ensuring that the seeds will retain their ability to germinate for a very long time, even if the cooling system should fail.

The world's poorest countries contribute less to global warming than rich countries. Yet they are the most vulnerable and the ones that have to bear the most serious consequences of climate change. In the Rio convention all states agreed that countries have a common but differentiated responsibility for reducing emissions of greenhouse gases. Still, seventy per cent of the world's emissions are not regulated by

the Kyoto protocol. This calls for a new Kyoto protocol, one which is much more comprehensive and more efficient. It will be necessary to address the global ceilings of emissions, where reductions should take place and how the financial responsibility should be shouldered. Rich countries must take on a much greater share of the costs of reductions.

I had the pleasure of serving as one of the co-chairs of the UN High-level Panel on System-wide Coherence, which submitted its report, Delivering as One, last year. A key message from the report was that greater coherence and coordination are needed. The same applies to environmental organisations, and instruments such as the three Rio Conventions. All three of them address the need for sustainable development, and we have to make sure that they are applied in a coordinated way. We must ensure that climate and biodiversity goals are fully integrated into policies in all sectors, at both national and international level.

The signs of climate change in the Arctic are alarming, and Norway has a front row seat. Temperatures are rising, and polar ice and glaciers are melting. We have to make use of all appropriate means in combating these developments, and all sectors of society have to become involved if we are to succeed. My Government is preparing national action plans on emissions targets for all sectors of society that emit greenhouse gases, in the hope that this will lead to a substantial reduction in Norway's emissions.

New technology is not the answer to all challenges in the field of climate change and biodiversity. But I believe technology change and innovation will be an extremely important contribution to emission reductions on a global scale. As a petroleum producing nation, Norway has decided to be a leading developer of technology to clean, capture and store CO_2 from petroleum production and power plants. We have established a close cooperation between government and industry. Together with the Norwegian oil and gas company "Statoil" we have agreed to establish the world's first and largest full-scale CO_2 capture and storage project at the Mongstad combined heat and power plant in Western Norway. This project will hopefully contribute to reduce the cost of CO_2-reduction technology and thus make it attractive for other countries.

In June this year, Norway will host the international World Environment Day celebrations, under the Melting Ice—a Hot Topic? slogan. As 2007 is the International Polar Year, events will focus on the effects of climate change on polar ecosystems and communities, and the knock-on effects for the rest of the world.

The impacts of melting polar ice will have consequences far beyond the Arctic. Its effects may include altered ocean currents, rises in sea levels and a reduction in biodiversity. These in turn will affect many aspects of the world's social and economic systems, as shown in the recent Stern Report and the report of the Intergovernmental Panel on Climate Change (IPCC) have highlighted the costs of inaction on climate change. Climate change and biodiversity thus demand the urgent attention of—and action by—decision-makers and the public worldwide.

Rt. Hon. Sir Anerood Jugnauth G.C.S.K., *K.C.M.G., Q.C., President of the Republic of Mauritius*

Achieving Sustainable Development is a Common Challenge

Over the last decades, Mauritius has developed rapidly on all fronts. The growth from a low income to a middle income country has been sustained by the four main economic pillars, namely agriculture, manufacturing, tourism, and financial services. Other emerging sectors are the Information and Communication Technology (ICT), the seafood hub, the knowledge hub and the medical hub. These achievements have no doubt created a lot of pressure on the country's resources.

Today Mauritius, like other Small Island Developing States (SIDS), is confronted with a number of internal and external challenges coupled with inherent vulnerabilities. Major changes in global markets for sugar, textiles and the projected impacts of climate change, particularly on coastal and marine resources present major risks to the continued prosperity of other economic sectors. Today, the economic scene is very difficult especially with globalization, the dismantling of protective barriers for our sugar and textile exports, and the energy crisis.

In light of this changing economic context, which is affecting adversely global trade and the Mauritian economy, my Government, has devised a number of important measures to adjust to the external economic and environmental shocks. Policies targeted to reforms in a number of critical sectors such as education, skills development, agriculture, tourism and public sector management are being implemented. These will ensure that economic decisions are taken in accordance with sustainable development principles and established environmental objectives.

Mauritius is fully aware that economic, social and environmental sustainability are the three crucial components for sustainable development and human welfare. In the lost decade, we have brought a number of important changes in the legislative, regulatory and institutional frameworks with particular focus on environmental protection and management. Continuous improvements have been made to ensure sound environmental governance.

Conscious of the numerous challenges, Mauritius is among the first countries to have ratified the United Nations Convention on Biological Diversity in 1992. Mauritius has also signed and ratified a number of other multilateral environmental agreements. It is still contributing in generating and sustaining sites of global interest and of environmental benefits through a number of measures implemented and financed by the Government.

It is interesting to note that the biodiversity in Mauritius has developed a high degree of endemism due to its age and isolation. The high level of endemism and species diversity per unit area has resulted in the Mascarenes being identified as a Centre of Plant Diversity by the IUCN (World Conservation Union). However, this unique biodiversity has been under stress and suffered devastation by human activities and invasive alien plant species introduced since the first settlement, about 400 years ago.

Substantial progress has been made in terms of conservation and management of genetic resources, in particular, the rescuing of a number of endemic birds from the brink of extinction. Other successfully implemented projects comprise the establishment of terrestrial and islets national parks (13,926.0 ha), 11 Conservation Management Areas (45 ha), and marine protected areas (7,216.0 ha), These projects are partnerships and Joint initiatives by key actors in certain sub sectors, Mauritius, being endowed with a wide biodiversity heritage has still a long way to go towards achieving a proper understanding and appreciation of environmental benefits as they relate to conservation, protection and management of biodiversity resources.

We would all acknowledge that achieving sustainable development is a common challenge. The Mauritian journey started even before the 1992's UN Conference on Environment and Development (UNCED) and continued through the International Meeting on SIDS held in Mauritius in January 2005. It proves that achieving sustainable development is not an individual concern but requires the intricate support and participation of one and all. In 2005, the Mauritian declaration reaffirmed the continued validity of the Barbados Programme of Action for the Sustainable Development of Small Island Developing States, as the blueprint providing the fundamental framework for the sustainable development of Small Islands Developing States also taking into account new emerging issues. Mauritius is really privileged to have hosted that important conference and I wish to place on record my deepest thanks to all those who have directly and indirectly contributed towards the success of that international meeting I would add that last, but not the least, global warming has become an international issue. Climate change is the talk of the town and its cause most likely man-made Therefore as Heads of State and Government, today we all have a duty to take this phenomenon seriously as it is a bleak observation of what is happening now and even more of a prediction for the future.

World leaders need to take this message right. I wish that this makes the difference and creates awareness among policy makers, to pay more attention to the warnings of climate change.

A. Raja, *Minister for Environment & Forests, India*

Climate Change: The Unseen Threat to Biodiversity

"The UN Framework Convention on Climate Change and the Convention on Biological Diversity are the major international agreements to tackle two of the most important global environmental concerns of our time and if I may say so perhaps, of all time."

Evidence that climate change is for real and is affecting life on Earth, including biodiversity, continues to mount. Biodiversity of any region is determined by a number of factors including biotic interactions; and the intensity and kind of reproduction and genetic recombination mechanisms. It is also a known fact that each species can survive only under a particular set of climatic conditions. This 'climate envelope', dependent on the current geographical distribution and with finite resilience in relation to climatic gradients, serves to predict future distribution. Biological diversity at all levels, as the dynamics of natural evolutionary and ecological processes, induces a natural background rate of change. However, current rates and magnitude of species extinction, related to habitat fragmentation, reduction and degradation, far exceed normal background rates. Human activities result in loss of biodiversity depending on the intensity of both direct and indirect drivers. The rate and magnitude of climate change induced by increased greenhouse gas emissions has and will continue to affect biodiversity, either directly or in combination with other drivers, and might outweigh them in the future.

The present global biota was affected by fluctuating Pleistocene concentrations of atmospheric carbon dioxide, temperature, and precipitation, and coped through evolutionary changes, species plasticity, range movements, and/or the ability to survive in small patches of favorable habitat. These changes, which resulted in major shifts in species' ranges and marked reorganization of biological communities, landscapes, and biomes, occurred in a landscape that was not as fragmented as today, and with little or no pressures from human activities. Anthropogenic habitat fragmentation has now confined many species to relatively small areas within their previous ranges, with reduced genetic variability. Warming beyond the ceiling of temperatures reached during the Pleistocene will stress ecosystems and their biodiversity far beyond the levels imposed by the global climatic change that occurred in the recent evolutionary past. Both the issues related to conservation of biological diversity and addressing climate change concerns are intricately linked with each other and have grave ramifications on human welfare and overall development. The UN Framework Convention on Climate Change (UNFCCC)

and the Convention on Biological Diversity (CBD) are the major international agreements to tackle two of the most important global environmental concerns of our time, and if I may say so perhaps of all time. The international response in addressing these concerns has been in the form of widely acclaimed and agreed Conventions, associated Protocols and other initiatives.

The CBD has three major objectives namely 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. Climate change is a major cause of biodiversity loss and one of the obligations under the CBD is to identify and address such threats. At the same time, the ultimate objective of the UNFCCC is to achieve stabilization of greenhouse concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate. The Climate Change Convention further contemplates that such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner. There seems be a great deal of complementarities between these two Conventions. On the one hand biodiversity management can contribute to climate change mitigation and adaptation and to combating desertification, while on the other hand, appropriate climate change mitigation and adaptation interventions may have positive bearings on global biological resources. The negotiators of these Conventions were aware of the synergies between the two issues as the UNFCCC also calls for the conservation and enhancement of terrestrial, coastal and marine ecosystems as sinks for greenhouse gases.

There has been considerable progress in the implementation of both these Conventions since 1992. However, in my view, much more needs to be done. During the World Summit on Sustainable Development (WSSD) held in 2002, the assembled Heads of States Governments 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." Change in the Earth's climate and its adverse effects were another area of deep concern and the WSSD reiterated that all countries face increased risks of negative impacts of climate change and recognized that the problems of poverty, land degradation, access to water and food and human health remain at the centre of global attention. The WSSD further recognized that the UNFCCC is the key instrument for addressing climate change, and they reaffirmed their commitment to achieving its ultimate objective. The 2010 Biodiversity Target, as agreed by the WSSD, was further reconfirmed at the World Summit Review 2005 by stating that the Millennium Development Goals and the fight against poverty and hunger will not be achieved without winning the baffle against environmental degradation and depletion of the biological diversity capital of our planet.

According to the Millennium Ecosystem Assessment, as far as conservation of bio-

logical diversity is concerned over the last 100 years, human induced species extinction has multiplied as much as 1000 times. Some 23 percent of mammals, 25 percent of conifers and 32 percent of amphibians are threatened with extinction. 100 to 300 species may be becoming extinct every year. At least one out of every eight plant species worldwide is threatened with extinction. In addition, 80 percent of the world's forest cover has disappeared and 13.7 million hectares of forest are destroyed every year. During the last 50 years, about two third of global agricultural land has been degraded and many countries face serious desertification problems. Apart from genetic, species and ecosystem loss of diversity, traditional knowledge of people using biological resources is also threatened. These consequences on the global biological diversity resources due to various anthropogenic pressures are visible.

Let us now explore the likely impact of the invisible hand of climate change on biological diversity including overall productivity of resources, areas of prevalence and succession. Changes in climate over the last few decades of the 20th century have already affected biodiversity. The observed changes in the climate system, particularly the warmer regional temperatures, have affected the timing of reproduction of animals and plants and/or migration of animals, the length of the growing season, species distribution and population sizes, and the frequency of pest and disease outbreaks. By currently available assessments, projected changes in climate during the 21st century will occur faster than in at least the past 10,000 years, and combined with land use change and exotic/alien species spread, are likely to limit both the capability of species to migrate and the ability of species to persist in fragmented habitats. However, the effects of climate change would vary from species to species. Similarly different species may face varying degrees of climate change effects. For a given ecosystem, functionally diverse communities are more likely to adapt to climate change and climate variability than impoverished ones. In addition, high genetic diversity within species appears to increase their long–term persistence. It must be stressed, however, that the effect of nature and magnitude of genetic and species diversity on certain ecosystem processes is still poorly known. The ability of ecosystems to either resist or return to their former state following disturbance may also depend on given levels of functional diversity. This can have important implications for populations, which are typically the most vulnerable.

The projected impacts due to changes in mean climate, extreme climatic events and climate variability include: movement of the climatic range of many species towards pole ward or upward in elevation from their current locations, extinction of many vulnerable species and ecosystems, replacement of existing ecosystems by new plant and animal assemblages depending on changes in the frequency, intensity, extent, and locations of climatically and non climatically induced disturbances, changes in net primary productivity of many species (including crop species), and adverse effect on the livelihood of many indigenous and local communities.

It would be pertinent to mention that reduction of other pressures on biodiversity arising from habitat conversion, over harvesting, pollution, and alien species invasions, constitutes important climate change adaptation measures. In my experience, planning, implementation, monitoring and evaluation interventions that involve the communities and institutions most affected by climate change mitigation and adaptation activities, and recognize that different spatial and temporal scales will be required to assess the implications of biological diversity conservation activities, are likely to be the most successful. There are significant opportunities for mitigating climate change, and for adapting to climate change, while enhancing the conservation of biodiversity at the ecosystem and landscape scale. The ecosystem approach of the CBD provides a good basis to guide the formulation of climate change mitigation policies/projects and conservation of biodiversity. This holistic framework considers multiple temporal and spatial scales and can help to balance ecological, economic, and social considerations in projects, programmes, and policies related to climate change mitigation and adaptation.

Land–use, land–use change and forestry (LULUCF) activities are known to play an important role in reducing net greenhouse gas emissions to the atmosphere by : (a) conservation of existing carbon pools, i.e., avoiding deforestation; (b) sequestration by increasing the size of carbon pools, e.g., through afforestation and reforestation; and (c) substitution of fossil fuel energy by use of modern biomass. The estimated upper limit of the global potential of biological mitigation options (a and b) through afforestation, reforestation, avoided deforestation, and agriculture, grazing land, and forest management is on the order of 100 Gt C (cumulative) by the year 2050, equivalent to about 10–20% of projected fossil–fuel emissions during that period, although there are substantial uncertainties associated with this estimate. The largest biological potential is projected to be in subtropical and tropical regions.

In my view, the current pace of biological mitigation options is inadequate and needs to be pursued vigorously. Similarly, climate change mitigation and adaptation options pertaining to biological diversity of terrestrial and oceanic ecosystems could play a significant role in the global carbon cycle and their proper management; and can make a significant contribution in reducing the build–up of greenhouse gases in the atmosphere. It is, therefore, amply evident that there are significant opportunities for mitigating climate change, and for adapting to climate change, while enhancing the conservation of biodiversity. Within the context of the Kyoto Protocol, all the three flexible mechanisms need to further explore win–win opportunities for mitigation of GHGs through various biological processes such as afforestation, reforestation and improved management of forests and farm lands. However, one has to be careful as afforestation and reforestation can have positive, neutral, or negative impacts on biodiversity depending on the ecosystem being replaced, management options applied, and the spatial and temporal scales. Similarly short rotation plantations are not expected to sequester and maintain carbon as much as long rotation plantations in which vegetation and soil carbon are allowed to accumulate. Improved forest management can also enhance carbon uptake or minimize carbon losses and conserve biodiversity. Revegetation activities that increase plant cover on eroded or severely degraded lands have a high potential to increase carbon sequestration and enhance biodiversity.

We in India are implementing a massive programme for rehabilitation of wastelands and management of watersheds in the country now for many years. In my opinion, plantations of native tree species will support more biodiversity than exotic species. Similarly, plantations of mixed tree species will usually support more biodiversity than monocultures. Once again, I reiterate that involvement of local communities in the design and implementation of such interventions may contribute to enhance local support. Slowing or reversing deforestation and forest degradation, as we have achieved in India, can also provide substantial biodiversity benefits in addition to mitigating greenhouse gas emissions and preserving ecological services.

Marine ecosystems may offer mitigation opportunities, but the potential implications for ecosystem function and biodiversity are still not well understood. Oceans are substantial reservoirs of carbon with approximately 50 times more carbon than is present in the atmosphere. There have been suggestions to fertilize the ocean by spraying iron dust and other means to promote greater biomass production and thereby sequester carbon and to mechanically store carbon deep in the ocean. However, the potential for either of these approaches to be effec-

tive for carbon storage and their impacts on ocean and marine ecosystems and their associated biodiversity need to be further explored. Bio–energy plantations provide the potential to substitute fossil fuel energy with biomass fuels but may have adverse impacts on biodiversity if they replace ecosystems with higher biodiversity. However, bio–energy plantations on degraded lands or abandoned agricultural sites could benefit biodiversity. Similarly, renewable energy sources (crop waste, solar– and wind–power) may have positive or negative effects on biodiversity depending upon site selection and management practices. Replacement of fuel wood by crop waste, the use of more efficient wood stoves and solar energy and improved techniques to produce charcoal can also reduce the pressure on forests and woodlots. In India we have launched massive programme for promoting improved cooking stoves through public private partnerships. Hydropower has significant potential to mitigate climate change by reducing the greenhouse gas intensity of energy production but can also have potential adverse effects on biodiversity. In a few cases, emissions of carbon dioxide and methane caused by dams and reservoirs may be a limiting factor on the use of hydropower to mitigate climate change. Large–scale hydropower development can also have other high environmental and social costs such as loss of biodiversity and land, disruption of migratory pathways and displacement of local communities. On the other hand, run of the river hydropower and, small–dams have generally less impact on biodiversity than large dams, but the cumulative effects of many small units should be taken into account.

As my concluding remarks, I would suggest that the interactions between the CBD and the UNFCCC should not be confined to participating in each others Conferences of the Parties and need to be strengthened many fold. It would also be worthwhile to explore the possibility of a comprehensive ecosystem based action plan by both the CBD and UNFCCC duly supported by other international developmental and financial institutions for conservation of biological diversity as well as addressing climate change concerns.

Stefan Wallin, *Minister, Ministry of the Environment, Finland*

Biodiversity and Climate Change

"Climate change is having profound and long-term impacts on human welfare and adds yet even more pressure on terrestrial and marine ecosystems that are already under threat from land-use change, pollution, over-harvesting, and the introduction of alien species."

Climate change is one of the most pressing issues that the world faces today. The current unprecedented rate at which we are losing biodiversity is a huge threat to the ecosystem services on which we all depend, as has been well documented in the Millennium Ecosystem Assessment (MA). The recent IPCC report states that the rate at which the climate is changing may be even markedly greater than estimated earlier. This not only underlines the need to continue our work to mitigate emissions, but also that we need to work for enhancing the adaptation of ecosystems and various sectors of society in order to cope with the harmful effects that climate change has on life on Earth.

As noted in the Millennium Ecosystem Assessment, climate change is one of the most important drivers of biodiversity loss. The impacts of climate change on biodiversity have been of major concern to the parties to the Convention on Biological Diversity since 2002 when, following a request from the COP and the SBSTTA, an Ad Hoc Technical Expert Group (AHTEG) on Biological Diversity and Climate Change was established to carry out an assessment of the interlinkages between biological diversity and climate change.

Climate change is having profound and long-term impacts on human welfare and adds yet even more pressure on terrestrial and marine ecosystems that are already under threat from land-use change, pollution, over-harvesting, and the introduction of alien species. The Convention on Biological Diversity has highlighted the risks, in particular, to coral reefs and forest ecosystems, and has helped to draw attention to the serious impacts of the loss of biodiversity of these systems on people's livelihoods.

At the 2002 World Summit on Sustainable Development (WSSD), the world's political leaders committed themselves to a significant reduction in the rate of biodiversity loss by 2010. The World Summit also reaffirmed the central importance of the Convention on Biological Diversity and the United Nations Framework Convention on Climate Change and encouraged the parties to these conventions, along with the parties to the Convention to Combat Desertification, to work together effectively. Climate change poses an immediate challenge to the achievement of the 2010 biodiversity target. There is increasingly firm evidence of biological responses to climate change, such as changes in flowering times and migratory patterns, changes in the distribution patterns of species, and changes in the composition, structure and productivity of ecosystems and habitats.

Biodiversity and climate are intimately linked. Climate change has an impact on biodiversity, and changes in biological systems affect the climate. On the global scale, some 20 per cent, or even more in some years, of anthropogenic carbon dioxide emissions, are the result of deforestation or human-induced forest fires. Additionally, there are strong links on local and regional scales between forest ecosystems and precipitation. There are also significant inter-linkages between climate, forests and marine biodiversity.

We need to ensure that mitigation and adaptation activities take account of biodiversity, and we need to consider the opportunities for climate change mitigation and adaptation that exist through the conservation and sustainable use of biodiversity. In particular, it is necessary to raise more awareness of the relationships between climate change and biodiversity.

The AHTEG's report on interlinkages between biological diversity and climate change highlighted these issues from both the biodiversity and climate change point of view in an integrative way.[1] The report concludes that there are significant opportunities for mitigating climate change, and for adapting to climate change while enhancing the conservation of biodiversity. However, these synergies will not happen without conscious attention to biodiversity concerns. Additionally, the report identifies a wide range of tools that can help decision-makers assess the likely impacts and make informed choices. The report is a tangible product of cooperation between the parties to the three Rio Conventions.

Sigmar Gabriel, *Federal Minister for the Environment, Nature Conservation and Nuclear Safety, Germany*

Nature Conservation is Climate Protection

The theme for the 2007 International Day for Biological Diversity is Biodiversity and Climate Change. Like the designation of 2007 to 2008 as "International Polar Year", and the focus of UNEP's World Environment Day on climate change, this decision reflects the major importance of this topic and the issues connected with it. I too feel that there is no global development of greater cause for concern, no issue on which international action is more urgently required than climate change, which impacts in particular on biological diversity.

The public has long been aware of the impacts of climate change on mankind—for example through loss of harvests or devastating floods—and now the media is also reporting more frequently on the impacts of climate change on biological diversity. Rightly so, for these impacts are serious and indirectly also have a major effect on mankind. The vegetation belts will shift northwards or to higher lying regions. Habitats are changing due to the loss of glaciers and the rise in sea level. The ability of species to adapt to these changes is limited. Climate change threatens biological diversity to a catastrophic degree.

I do not intend to simply paint a black and white picture, but with regard to climate change the facts are clear and the evidence is indisputable. Climate change already has a dramatic effect on biodiversity, as is shown in a number of recent studies. The IPCC predicts that a third of all species living today will be lost by the end of this century. Mountain regions, coral reefs and wetlands are threatened with a devastating extinction of species. Loss of species is as irrevocable as melted glaciers, the drastic weakening or even collapse of the Gulf Stream or an end to the effects of the Amazon forests on the global ecology. For this reason we must preserve the genetic diversity and habitat diversity of all species, even if their respective functions in the ecosystem and their benefit for humans are not yet fully understood. To achieve this we must not only increase our own efforts considerably, we must also conduct a great deal of public relations and information work in order to convince people of the essential role of biodiversity.

To this end, in addition to highlighting the ecological aspects, it will be useful to lay greater emphasis on the economic benefit of preserving biodiversity in the public debate. The destruction of biological diversity has major economic impacts, for we rely on nature for services which would otherwise not be technically possible, or only with great effort and excessive cost. The more intact the self-cleaning powers of water bodies, the simpler and more cost-effective it is to extract drinking water. The greater the natural soil fertility, the less fertilizer must be spread.

On 30 October 2006 the report of the former chief economist of the World Bank Nicholas Stern was published, studying the economic consequences of global warming. If we accept the hypothesis that the benefits of all the world's ecosystems amount to between 16 and 64 trillion dollars per year, the statements in the Stern Report are particularly striking: the global economy is threatened with costs of nearly seven trillion dollars if we do not come to grips with the impacts of climate change and their devastating consequences for nature. To put it plainly: inaction would cause damage comparable to the global economic crises of the last century; economic common sense requires us to take action!

This can be seen especially in the way natural ecosystems can act as sinks for greenhouse gas emissions: their destruction plays a significant role in the exacerbation of climate change. The devastation of natural ecosystems, particularly through forest clearance or their conversion to intensively used woods and plantations, through the drainage of marshland and through development of natural grasslands for agricultural use, has caused around one quarter of CO_2 emissions over the past decades. Here is a fundamental starting point for climate policy!

The comments made so far can be neatly summarised: nature conservation is climate protection and climate protection is nature conservation. This may be a banal statement but its consequences are complex. It actually means that we must harness the instru-

At its meeting in Helsinki in September 2005, the AHTEG prepared a follow-up report to its previous one from 2003.[2] The report includes advice and guidance on how to integrate biodiversity considerations into adaptation activities. These activities fall mainly into two categories: biodiversity-specific adaptation activities that primarily aim to minimize the loss of biodiversity, and ecosystem-specific and sectoral adaptation activities that primarily seek to reduce the negative impacts on the relevant sector.

As summarised in the report on key issues for advice and guidance, maintaining biodiversity should be a part of all national policies, programmes and plans for adaptation to climate change. This is important for the proper functioning of ecosystems so that ecosystems can continue to provide goods and services, which is essential if the UNFCCC objective and Millennium Development Goals for poverty alleviation, food production and sustainable development are to be met. Effective collaboration and networking between biodiversity and climate change communities at all levels is necessary for the successful implementation of adaptation activities for biodiversity and the integration of biodiversity concerns into climate change adaptation activities and other sectors. In particular, programmes and plans for adaptation to climate change should, according to the summary, take into account the maintenance and restoration of resilience, which is an essential element to sustain the delivery of ecosystem goods and services.

It is clear that integrating biodiversity considerations into adaptation activities is a rapidly developing area with many new national adaptation plans in preparation, including the need to extract lessons learned. Many opportunities to further develop synergies between conventions or the sharing of best practice from ongoing work warrant further work and consideration by national governments, the UNFCCC, the UNCCD and the CBD. I trust that it will prove to be a useful step in promoting implementation of the three Rio Conventions in a mutually supportive manner.

Additionally, we need to continue to work together at the national and international level and we should commit ourselves to working more closely together in the future, at national, regional and international levels, particularly in the area of scientific exchange on biodiversity and climate change.

1. Interlinkages between biological diversity and climate change. Advice on the integration of biodiversity considerations into the implementation of the United Nations Framework Convention on Climate Change and its Kyoto Protocol. CBD Technical Series No. 10, SCBD 2003.

2. Guidance for promoting synergy among activities addressing biodiversity, desertification, land degradation and climate change, CBD Technical Series No. 25, SCBD 2006.

"We know that nature and its diversity and functions is the basis for all human life…We need to prove that protecting global biodiversity is financially feasible and promotes rather than hinders growth and development."

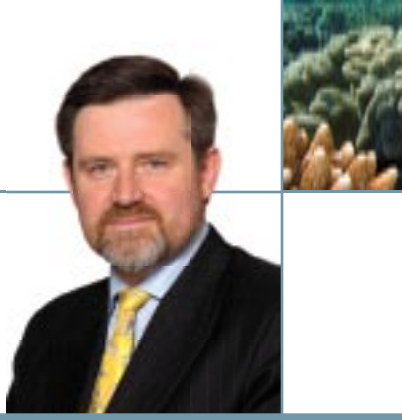
ments of climate protection for nature conservation and vice versa. In the development of the Kyoto Protocol post-2012, the topics of sinks and non-destruction of ecosystems as CO_2 sources will also play a role. Incorporating emissions caused by deforestation in developing countries into the international climate protection regime presents a special opportunity to achieve nature conservation and climate protection in the international emissions trading scheme with one and the same instrument. In the framework of the CBD the necessary biodiversity standards must be agreed on, for example in the implementation of the Framework Convention on Climate Change and the Kyoto Protocol, especially concerning sinks, deforestation and biomass.

Thus there are already instruments which serve nature conservation and climate protection equally. However, cooperation between the two conventions must be improved in order to make better use of the synergy effects between climate protection and nature conservation instruments. The 9th Conference of the Parties to the CBD, which will take place in 2008 in Bonn, the home of the UN Climate Change Secretariat, is a good opportunity for this. As the host to global nature conservation, we are particularly committed to protecting life and ensuring a sustainable management of biological diversity. We want to implement effective measures in order to halt the loss of biodiversity. To this end, we are aiming to improve coordination and cooperation not only between the CBD and the UN Climate Change Secretariat, but also between the CBD and the UN Forum on Forests, trade and industry and other relevant players.

A report modelled on the Stern Report, studying the economic costs of neglected protection measures and the global loss of biodiversity and the positive functions of its ecosystems, would be conceivable for me as an important step in the preparations of the Conference. We know that nature and its diversity and functions is the basis for all human life: nature ensures oxygen formation and soil fertility, provides drinking water, raw materials and medicines. However, we do not have enough solid evidence or concrete figures to prove that the continuous loss of biodiversity is a serious global threat to mankind which demands a collective response. We need to prove that protecting global biodiversity is financially feasible and promotes rather than hinders growth and development.

Much is said about the protection of natural resources and sustainable development—especially on the occasion of the annual International Day for Biological Diversity. However, to people in many countries the topic often seems distant and abstract, even though there are natural riches right on their doorstep. This year, the important topic of biodiversity is linked to the far more familiar issue of climate change. For me, this is a signal and an opportunity to use synergies to bring awareness and acceptance of the need to protect biodiversity to the fore. It is our duty to protect biodiversity, our responsibility towards future generations. Let us focus our activities. Let us be ambitious! Let us be united for a living world!

Barry Gardiner, *Minister for Biodiversity, Landscape and Rural Affairs, United Kingdom*



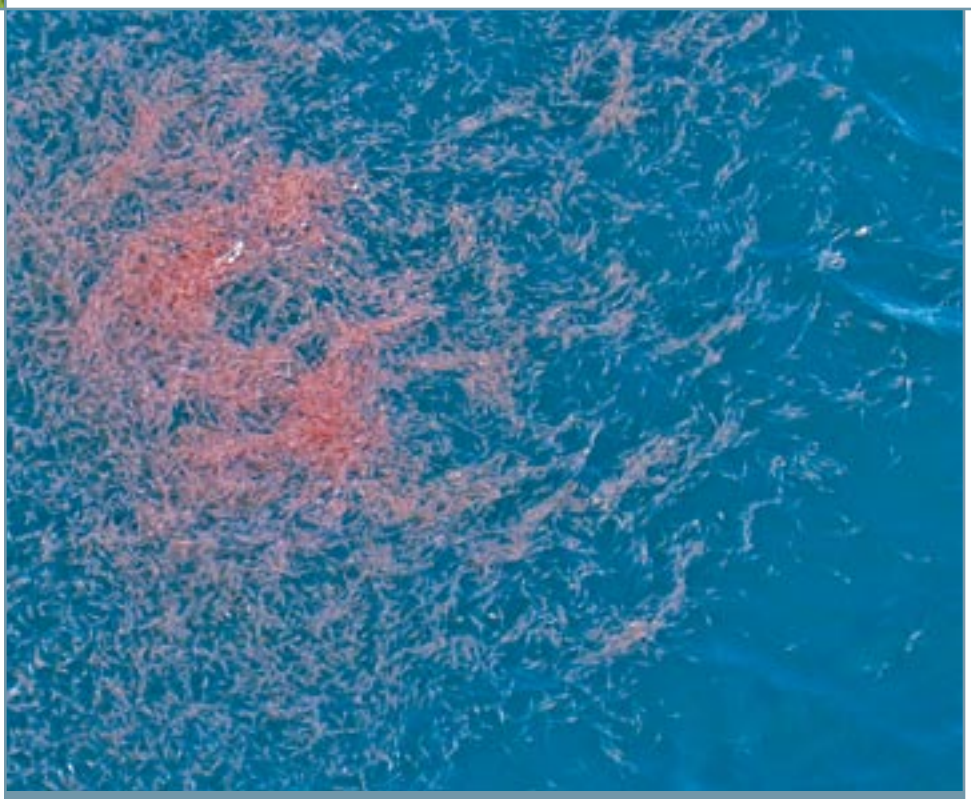
Climate Change and Biodiversity

There is no doubt that climate change is the greatest environmental challenge facing the world today. It is no longer just a future threat—it is a reality. It's widely recognised that the impacts of global warming reach far and wide; already climate change is casting a perilous spectre over the complex and delicate structure of biodiversity worldwide. What isn't so widely recognised is the huge role biodiversity has to play in combating the negative impacts of climate change—in fact, it is one of our greatest weapons.

Globally, the ten warmest years since records began in 1850, have occurred in the last twelve years. The recent Intergovernmental Panel on Climate Change report concluded that an average global temperature rise of between 1.1 and 6.4°C can be expected by the end of this century. This projected range is dependant on future emissions and remaining scientific uncertainty, however, temperature increases towards the higher end of this range would be unprecedented in the last 10,000 years.

According to the Millennium Ecosystem Assessment, by the end of the century, climate change and its impacts may be the dominant direct drivers of both biodiversity loss and the change in ecosystem services globally. Key findings summarised in the recent Stern Review Report show that an increase of just 1°C would lead to at least 10% of land species facing extinction and with 80% bleaching of coral reefs (including the Great Barrier Reef). This figure rises dramatically to 15-40% of species facing extinction with an increase of 2°C in the global temperature.

Climate change will affect us all—flooding, droughts, food shortages and the spread of disease have all been predicted. The social, environmental and economic costs of climate change could be massive, and catastrophic, if urgent action is not now taken to tackle this global problem. Governments have a huge role to play in leading the way in taking action. As such, we must strive to raise awareness globally about the links between climate change and biodiversity.



"Modelling of future changes in 'climate space' shows that some species will retain or gain space by expansion towards the poles, while others lose space by contracting polewards. Such models show that few species will be unaffected by such changes."

Climate change affects biodiversity and changes in biodiversity can also affect climate. Biodiversity plays a crucial role in mitigating climate change, for example oceans, peatlands and forests act as massive carbon sinks, absorbing and storing carbon from the atmosphere. Biodiversity and ecosystems can also play a significant role in supporting adaptation to climate change, for example coastal marshes, mangroves and coral reefs can provide protection against an increase in the frequency and intensity of storms.

It is clear that any action to address climate change needs to focus on both mitigation and adaptation. The Intergovernmental Panel on Climate Change recently highlighted that the planet will undergo unavoidable climatic changes over coming decades due to past global greenhouse gas emissions and the lag time in the climatic system. Therefore, we need global action not only to mitigate greenhouse gas emissions and avoid future dangerous climate change, but also to ensure that adaptation policies are in place that will enable us, and the biological diversity of the planet, to cope with the unavoidable consequences of past emissions.

Impacts of climate change on biodiversity

Climate change is already affecting biodiversity and will increasingly become the dominant factor leading to biodiversity loss. Rising levels of carbon dioxide have had, and will continue to have, complex impacts on different elements of biodiversity and ecosystem functions. But the knock-on effects that rises in greenhouse gases will have in terms of increases in temperature and changes in rainfall, will have far wider and more damaging effects. For many species, climate change presents a greater threat to survival than simply changes in their natural habitats. Existing pressures from habitat destruction and unsustainable use may be further exacerbated by the impact of measures to adapt to climate change.

As a direct result of increasing atmospheric levels of carbon dioxide, more carbon dioxide is being dissolved in the world's oceans. This has already reduced ocean pH and is projected to continue. Altered oceanic chemistry will have major effects on marine ecosystems and calcification rates of coral, phytoplankton and other species. Coupled with other drivers of biodiversity loss, such as overfishing, adverse consequences on fish stocks are likely.

Climate change will affect ecosystem boundaries. Flooding, sea level rise and temperature changes will see some ecosystems and species expanding into new areas, and others retreating. The impacts will vary between regions, although scientific models have shown that the most serious impacts will occur where there are no alternative areas for species dispersal—in polar and mountainous regions, islands and peninsulas, lakes and isolated seas.

Modelling of future changes in 'climate space' shows that some species will retain or gain space by expansion towards the poles, while others lose space by contracting polewards. Such models show that few species will be unaffected by such changes. However, even where there is potential 'climate space', many species will face barriers to dispersal and colonization, and as the ability of species to exploit new space will differ, existing interdependencies between species and community structures are likely to be disrupted. Habitat fragmentation and the isolation of protected areas places a constraint on the ability of species to disperse, and the capacity of ecosystems to alter their species composition. The rate and nature of recent environmental changes is often too fast for ecosystems, and their component species, to properly adapt. This is particularly the case for those species and ecosystems with narrowly defined environmental tolerances, such as coral reefs.

Many species and habitats are already showing changes in distribution. In particular, many birds, butterflies, dragonflies and spiders in the northern hemisphere are showing a considerable expansion in their northward range. Of 368 species with distribution limits in the UK, 297 (81%) have shown a northwards shift and 30 limits have moved by over 150km in 25 years. Some migratory species are also showing changes to their overwintering sites, often by altering their migration distances.

Evidence has also shown changes in population sizes and relative abundance, advances in the timing of reproduction or migration, increases in the length of growing seasons in many regions and an increase in the frequency of pest and disease outbreaks.

Role of biodiversity in mitigating climate change

Biodiversity plays a crucial role in the provision of ecosystem services. One of these key services is climate regulation and storage of

"There is much that we can now do to give a better future for biodiversity, and it is in our interest to do so, governments simply cannot use scientific uncertainty as an excuse to do nothing. The Conference of the Parties to the Convention on Biological Diversity have encouraged all Parties to integrate biodiversity considerations into all their relevant national policies, programmes and plans in response to climate change and we are working to fulfill this."

greenhouse gases (GHG's). Forests and other plant life are especially important for regulating the climate. Trees are often described as carbon 'sinks' due to their ability to absorb and store CO_2. It is estimated that the world's forests store 283 gigatonnes (Gt) of carbon in their biomass alone, and 638 Gt of carbon in the ecosystem as a whole (to a soil depth of 30 cm). Thus forests contain more carbon than the entire atmosphere. Roughly half of total carbon is found in forest biomass and dead wood combined, and half in soils and litter combined.

Cutting down and burning large sections of forest releases the stored CO_2, leading to an increase in the levels of CO_2 in the atmosphere and contributing to global warming. Therefore, reducing deforestation can contribute to climate change mitigation via sink protection and enhancement, emission reduction, and supply of renewable biofuels. The Stern Review highlighted that over 18% of global GHG emissions—more than from all global transport—arise from changes in land use, primarily deforestation. Forests also play a key role in regulating temperature and moisture in the atmosphere. Hence, measures to reduce deforestation will have a range of benefits. It is therefore critical that any action plan to mitigate climate change includes the effective management of these ecosystems.

With careful attention to biodiversity considerations, afforestation and reforestation projects in appropriate areas can mitigate climate change and support human populations that depend on forest resources and the ecosystem services that forests provide, such as food, materials, medicines, soil and water resources.

Peatlands and oceans are also important carbon sinks. Peatlands store the equivalent of 75% of all atmospheric carbon. They also store large amounts of methane. The need to conserve these important ecosystems is clear from the estimation that the peat fires of 1997 in Indonesia, released over 40% of the global total GHG emissions for that year. For the last 200 years, oceans have absorbed over half the carbon dioxide produced by fossil fuel burning and cement production.

I welcome the discussions taking place under the UNFCCC to reduce emissions from deforestation in developing countries. These discussions also pose an important opportunity for other benefits to be considered aside from reduced GHG emissions. Such multiple benefits include biodiversity conservation, enhanced ecosystem services and livelihood opportunities for communities dependent on forests.

Biodiversity is important in increasing the resilience of the environment to the impacts of changing climatic conditions, because functionally diverse communities are less vulnerable and better equipped to adapt to a changing climate.

So what are we doing?

There is much that we can now do to give a better future for biodiversity, and it is in our interest to do so, governments simply cannot use scientific uncertainty as an excuse to do nothing. The Conference of the Parties to the Convention on Biological Diversity have encouraged all Parties to integrate biodiversity considerations into all their relevant national policies, programmes and plans in response to climate change and we are working to fulfill this.

In England, we have already started this process by establishing a Climate Change Adaptation work stream as part of the England Biodiversity Strategy—to provide better guidance on impacts of climate change, identify research needs and promote adaptation of policies and programmes in all relevant sectors—including agriculture, water management and land use planning. This will need to be a long term activity as we gain new knowledge and review our successes and failures as part of an ongoing process of adaptive management.

We have supported a considerable amount of research on the implications of climate change for biodiversity. For example, the MONARCH research programme (Modelling Natural Resource Responses to Climate Change), has developed models of how the suitable climate space for species might move under a changing climate, using a range of species from various habitats as examples. The results show that significant changes in climate space are projected for most species identified as priority species in the UK Biodiversity Action Plan. However, for some species at the northern edge of their range, warming could potentially allow them to expand whilst those already restricted to the north of the country may lose suitable climate space. The research has been used to inform the adaptation of nature conservation policy and management practice within the context of a changing climate.

We have also supported research at the international stage. A study into the strength of links between climate change and the abundance, distribution and behaviour of migratory species, found that birds like the Chiffchaff are now living in Britain all year round, instead of migrating south. Although the information available varied between species, it found that climate change is likely to lead to most species facing changes in food availability, as well as loss of breeding and wintering habitat.

Conclusion

It is clear that climate change poses an increasing challenge to meeting our international objectives and commitments to biodiversity. It is set to become the dominant cause of biodiversity loss in the present century.

Scientists, academics and policy makers; from both the climate change and biodiversity communities, need to join their expertise, in policy and research. I was pleased to see that last year there was a joint meeting of the UNFCCC and CBD Subsidiary Bodies on Scientific, Technical and Technological Advice. In the UK we are building on this: in June the Royal Society will host a workshop in London in collaboration with the UK Government entitled "Biodiversity—Climate Interactions: adaptation, mitigation and human livelihoods".

In the face of so much uncertainty one thing is clear: we need to work together on a global scale to combat the negative impacts of climate change. Part of this is recognising and understanding the vital tool that biodiversity is in helping us to redress the delicate balance of the natural world that a single species, human beings, has disturbed.

Nicolas Hulot, *Fondation Nicolas Hulot pour la Nature et l'Homme*

L'impératif écologique comme opportunité pour l'humanité

C'est une évidence : la Terre a atteint un seuil de vulnérabilité sans précédent.

J'ai tellement fait le tour de notre planète que je ressens charnellement la fragilité des écosystèmes et l'imbrication de la communauté de destin entre les êtres humains de quelque origine qu'ils soient. Chaque fois que la beauté naturelle est menacée de destruction, c'est pour moi le sort de l'Homme et sa dignité qui sont en jeu.

Aujourd'hui chacun peut percevoir combien notre Terre est traumatisée.

Cela fait trente ans environ que la crise écologique est apparue au grand jour. Pourtant il y a déjà eu dans l'histoire de la planète des cycles climatiques et des extinctions d'espèces, mais jamais ils ne furent d'une telle rapidité. La catastrophe qui se profile est bien plus terrible qu'une sixième extinction. Les extinctions précédentes se sont faites sur des échelles de temps permettant au vivant de s'adapter, celle-ci prend de vitesse la vie et sa capacité d'évolution.

Chaque disparition d'espèce constitue un préjudice inestimable pour l'humanité. Ainsi, le Millennium Ecosystem Assessment élaboré par les Nations unies établit que 60 % des services vitaux que les écosystèmes fournissent à l'humanité sont dégradés ou exploités de manière non rationnelle. C'est également une catastrophe qui nous concerne d'un double point de vue : nous en serons la cause et en subirons les conséquences. Car l'effondrement des équilibres du vivant menace la survie de l'espèce humaine, puisque la santé et les activités de celle-ci dépendent du bon fonctionnement des écosystèmes. Que ce soit par ses activités ou par le changement climatique provoqué, l'Homme détruit sans mesure le vivant qui partage et fait vivre sa planète. Nous l'oublions souvent, surtout dans nos sociétés « riches » mais nous ne sommes pas dissociés de la nature qui nous entoure, nous en sommes partie prenante et dépendents.

Or, nous nous mentons à nous-même. Collectivement et individuellement. Dans le regard que nous portons sur les êtres et les choses, dans notre refus de faire allégeance à la nature, dans notre obstination à croire que les problèmes s'arrangeront tout seuls. Et notre solitude est à l'image de notre aveuglement.

« Nous devons apprendre à retrouver notre place au cœur de la nature. Nous avons trop longtemps cru en occuper le centre. »

Pour la première fois dans l'histoire, les ennemis les plus redoutables que nous avons à affronter ne sont pas les autres mais nous-mêmes. L'Homme d'aujourd'hui endosse un double rôle, celui de responsable et de victime et comme le disait Victor Hugo, « à force de vouloir posséder, nous sommes nous-même possédés »

C'est en effet une évidence : nous sommes à la croisée des chemins, l'ère de l'abondance est terminée et celle de la rareté des ressources naturelles s'annonce. Le choc nous est promis à un moment où l'incertitude, les déséquilibres, les inégalités s'aggravent sur la planète. De multiples défis dont le changement climatique et la crise de la biodiversité et leurs conséquences pour nos sociétés humaines sont à relever.

Le système du progrès est grippé. En portant atteinte aux équilibres du vivant, l'excès de nos productions, l'outrance de nos consommations, la dérive de nos comportements ont engendré quelque chose qui nous dépasse et qui s'est retourné en risque majeur. L'impératif écologique sonne le glas des deux grands systèmes économico-politiques qui se sont partagés le monde, le système capitaliste et le système collectiviste. C'est, au vrai sens du terme, une question d'intérêt général. Et quel intérêt, puisque la vie de chacun est en jeu !

Un autre système doit donc émerger autour du concept de développement durable afin de conjuguer les impératifs d'aujourd'hui avec les nécessités de demain, et la solidarité envers les générations d'aujourd'hui avec la solidarité envers les générations futures. C'est avant tout un *devoir* de pays riche !

Aujourd'hui, il n'y a pas d'autre alternative que de construire cette troisième société. Nous avons besoin du jaillissement de la créativité et de l'inventivité humaine pour aider l'humanité à conjuguer ses impératifs écologiques et sociaux mais, simultanément, c'est à la révision comportementale et sociétale de nos civilisations qu'il faut s'attacher.

L'impératif écologique offre cette opportunité providentielle à l'humanité de se ressaisir. Si nous savons le maîtriser, l'impératif écologique permettra d'approfondir et de renforcer la civilisation humaine, de raisonner et d'agir à des échelles plus longues. C'est une chance unique de faire cause commune, de tirer le meilleur de nos systèmes de pensée tout en abandonnant les excès et rigidités qui nous ont conduits dans des impasses.

En ce printemps 2007, alors que les français vont avoir à choisir leurs dirigeants, je propose que cette vaste mutation économique, sociale et culturelle, à engager, s'organise autour d'un « pacte écologique ».

L'idée du pacte consiste à dire que l'enjeu écologique du temps présent, parce qu'il est plus que tout autre d'essence collective, parce qu'il détermine l'avenir de tous et celui des générations futures, parce que c'est en quelque sorte la vie qu'il retient en otage, doit conduire à dépasser les différences politiques traditionnelles. M'adressant au futur chef d'état

de mon pays, j'affirme que l'impératif écologique n'est pas une priorité, c'est *la* priorité ! J'en appelle aux hommes et femmes politiques pour qu'ils fassent preuve de lucidité et de courage, d'une nouvelle attitude politique, concentrée sur l'essentiel de l'enjeu, fédératrice des énergies, des esprits, des forces vives, de la créativité, capable d'insuffler un élan populaire.

À ce jour, la plupart des candidats à l'élection française ont signé ce pacte, près d'un million de français également et ce n'est qu'un début. Je voudrais rêver d'une contagion de ce pacte à l'Europe et pourquoi pas au reste du monde.

L'impératif écologique nous offre la chance de mutualiser au niveau mondial les ressources, les moyens et les cultures.

Nous devons apprendre à retrouver notre place au cœur de la nature. Nous avons trop longtemps cru en occuper le centre.

Et si nous voulons continuer à revendiquer une souveraineté quelconque sur cette Terre, que ce soit en ne limitant pas nos efforts à la seule protection de la vie humaine mais en l'étendant à l'ensemble du vivant, tous ensemble exerçons enfin sur cette terre, non pas une domination aveugle, mais une vigilance globale. Que nos enfants ne puissent se dire plus tard : « les salauds,ils savaient »

Julia Marton-Lefèvre, *Director General, The World Conservation Union (IUCN)*

Climate Change and Biodiversity: Two Conventions, One Goal

As we celebrate the International Day for Biological Diversity, which this year focuses on Climate Change and Biodiversity, it is important to understand where we are and what actions we must take to tackle the daunting challenge that climate change poses.

I think it is fair to say that remarkable progress has been made on these topics separately. The Convention on Biological Diversity (CBD) inspires and guides international and national efforts to reduce the rate of biodiversity loss—making an important contribution to poverty reduction and the wellbeing of societies around the world. After years of hard-fought negotiations, the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) has come into force, offering hope that countries will take up their significant but differentiated responsibilities to slow the pace and reduce the severity of climate change.

There is no longer any doubt, however, that measures taken to date to curb climate change

and deal with its future impacts fall short of what is needed to protect biodiversity during the coming period of climate-driven ecosystem changes. All our successful conservation efforts will be reversed without substantial action on two fronts—fostering adaptation by ecosystems, of which humans are an integral part, and mitigating the pace and severity of climate change.

Climate-driven impacts on ecosystems, and consequently on communities that depend on ecosystem services, are already evident. Particularly ominous are those impacts that release more carbon into the atmosphere—reinforcing climate change—and those impacts that further undermine subsistence agriculture. Such feedback from ecosystems to the atmosphere is particularly severe in the Arctic, where melting permafrost, boreal forest fires and erosion of coastal peat lands release methane and carbon dioxide. Dramatic as these recent changes have been, they will pale in comparison to consequences that the loss of Amazon tropical forests would have for biodiversity and global climate.

The human communities that are most vulnerable to rapid climate change and increased climate variability are those already coping with extreme variability and desertification. In semi-arid lands, the loss of even small amounts of soil moisture due to increased evaporation puts thousands of people at risk. Others, such as the Inuit and Pacific Islanders, face the slow but inexorable loss of the landscapes and seascapes on which both their livelihoods and their cultures depend.

Through its own projects and its efforts to support members around the world, the World Conservation Union is deeply committed to reducing the vulnerability and enhancing the adaptive capacity of natural ecosystems and the communities that depend on them. We seek to knit together a Global Adaptation Support Network so that lessons learned in one location can quickly assist management efforts in similar environments elsewhere. We are presently updating some of our own flagship services to ensure that each recognizes the impacts of climate change and promotes adaptation. Examples include our work on species (including the Red List of Threatened Species), protected areas, sustainable water use, marine and forest management and post-tsunami coastal mangrove restoration.

IUCN's members have also called for adaptive strategies to be incorporated in all efforts to address development and biodiversity conservation. Protected and productive landscapes and seascapes are equally at risk from rapid climate change. Maintaining the productivity of farms, forests, rivers and seas and attenuating natural disasters is going to be just as difficult as conserving biodiversity. We will have to re-examine any conventional wisdom on conserving biodiversity and maintaining ecosystem services that assumes a stable climate or ignores climate variability.

We have no room for complacency. The pace of climate change is accelerating faster than that of our remedial efforts. In my opinion, its pace and pervasiveness make climate change the greatest single threat to biodiversity, as well as a complicating factor in efforts to cope with many other threats. We cannot simply rely on the ability of natural and agro-ecosystems to adapt spontaneously, or on our ability to discover and implement successful adaptation strategies everywhere they will be needed. The dangerous gap between adaptive capacity and rapid climate change must be narrowed by substantive action to mitigate emissions.

Fortunately, we have significant opportunities for mitigating climate change while enhancing biodiversity conservation. The efforts of developing countries to gain formal recognition for emissions avoided from deforestation and degradation of tropical forests need due consideration in this regard. At its most recent meeting of the Conference of the Parties, the CBD welcomed the start of the process within the UNFCCC to consider ways and means to reduce emissions from deforestation in developing countries and recognized that effective actions to reduce deforestation could constitute a unique opportunity for biodiversity conservation. The UNFCCC's Subsidiary Body on Scientific and Technological Advice (SBSTA) has held two preparatory workshops on this topic and I trust that their May meeting will report significant progress.

Unfortunately, major obstacles stand in the way of a global consensus on reductions in greenhouse gas emissions from industry, transport, agriculture and natural areas. First, developed countries have not yet moved decisively to take responsibility for the future environmental consequences of their past activities. Second, decarbonising the energy sector will place a burden on rapidly developing economies that developed countries did not encounter when they were industrializing. Third, many countries that will suffer most from climate change have not contributed to the problem and do not have the means to develop measures to cope with this change. And finally, the divergent needs and time frames of individuals, enterprises and governments need to be reconciled.

"We must break this logjam. We must develop the knowledge, empower societies and promote the governance necessary for every country to do the best it can to limit emissions of greenhouse gases. We must achieve fair, equitable and effective sharing of responsibilities, and do so quickly."

We must break this logjam. We must develop the knowledge, empower societies and promote the governance necessary for every country to do the best it can to limit emissions of greenhouse gases. We must achieve fair, equitable and effective sharing of responsibilities, and do so quickly.

Perhaps the focus until now has been too much on the mechanisms of how we go forward and not enough on where we want to go. If we were to focus first on the goal of taming climate change, I believe that wide agreement could be found on the future we all seek and the dangers we all wish to avoid. The World Conservation Union (IUCN) is committed to helping forge such a consensus.

Recent scientific findings underline the importance of setting and meeting targets for the level of mid-century atmospheric greenhouse gas concentrations that do not burden the next generation with an impossible choice: catastrophic change in the climate system or devastating disruption to the socio-economic system. Surely, we can find and follow a path that keeps other options open.

Untamed, climate change will be the ultimate "Tragedy of the Commons". We have only one planet and it has only one atmosphere. Everyone suffers when it is polluted. We can avert tragedy if everyone embraces the principles of sustainable development and acts quickly to meet today's needs without foreclosing future opportunities.

Thomas Lovejoy, *President of the Heinz Center for Science, Economics and the Environment*

Climate Change: Implications for Nature

An examination of the temperature of the Earth for the last 100,000 years reveals two important insights. One is that abrupt (rather than gradual) climate change is the norm. The second is that for the last 10,000 years temperature has been unusually stable. That period includes recorded human history, a lot of our unrecorded history, the origin of agriculture and the origin of human settlements. It is obvious that the entire human enterprise depends on the assumption of a stable climate. So disrupting the climate system is even more dangerous than we may have thought.

Particularly disturbing are the implications for the biological underpinnings of civilization. The interface of climate change and biological diversity/conservation has existed as a topic for about 30 years. It was first raised by Robert L. Peters, then of the Conservation Foundation, and not long afterward in a conversation I had with Stephen Schneider, then at the National Center for Atmospheric Research. Peters and I organized the first symposium on the topic in 1987, and later turned that into the edited volume "*Global Warming and Biological Diversity*", which appeared in 1992. This was followed by a completely new volume I edited with Lee Hannah, "*Climate Change and Biodiversity*", which appeared in 2005.

The most important difference between the two volumes is that in the first we dealt with what might happen, whereas in the second there are multiple examples of signals in nature, of plants and animals responding to the climate change that has already taken place. The signals include changes in the timing of various aspects in life cycles (flowering times, such as the grapes in Bordeaux, which now bloom three weeks early; changes in migration dates, nesting and egg laying times etc), changes in distribution both altitudinally and latitudinally, mismatches in relationships between species (when one is cued by day length and the other by temperature), threshold changes in ecosystems (e.g., massive mortality in northwestern North American coniferous forests from the pine bark beetle), as well as effects of retreating ice on species from polar bears to seabirds and rising sea levels on coastal ecosystems and species. In addition we are seeing system changes. The most profound is the acidification of the oceans because of more CO_2 in the atmosphere. For a terrestrial organism the two most important parameters are temperature and rainfall; for an aquatic one it is temperature and pH. In this case, the acidification has grave implications for all organisms that build shells from calcium carbonate, corals among them.

Nature is already on the move, but these signals are basically mild—even trivial. They are really just first symptoms of what is to come. To start with, there is about an equal amount of climate change in store from current greenhouse gas concentrations. Beyond that of course is the yet unanswered question of how much climate change will occur and how much should be permitted. We do know there are inherent challenges to conservation because it is virtually certain that climate change will not be linear and gradual, and that it will be in terms of precipitation as well as temperature. We also know from paleontology that biological communities do not move—like Birnam Wood—as a unit. Rather, individual species move in their own directions and at their own rates with the consequence that familiar ecosystems will disassemble and reassemble into novel assemblages. With so much in flux we will see the balance shift in favor of invasive and weed species. Further, we already see evidence of threshold changes in ecosytems: they will only become more frequent and more wrenching.

"Climate change of course is not new in the history of life on earth but what is new is the massive conversion of landscapes from natural ones to various forms of human use. Those basically constitute an obstacle course for species dispersing in response to climate change."

Obviously there is a tremendous agenda on the energy side of climate change (including non-biological sequestration), but also there is a crying need for a new paradigm for conservation. Climate change of course is not new in the history of life on Earth, but what is new is the massive conversion of landscapes from natural ones to various forms of human use. These basically constitute an obstacle course for species dispersing in response to climate change. While there has been some consideration of helping species move through these obstacle courses (termed "assisted migration"), it is clear that it will only be useful in a small number of cases.

So, one of the most important measures is to improve connectivity in landscapes, in essence making them more permeable to dispersal. Often the connectivity is useful for other purposes as in the restoration of riparian vegetation to protect freshwater ecosystems. Enhancing connectivity, together with reduction of other stresses (e.g. more conventional pollution), are two general proscriptions for enhancing plant and animal capability to survive climate disruption. For species on low islands and at the tops of elevations, however, there will be no place to go, so they become part of the later argument for really curtailing further climate change as much as possible.

There will inevitably be questioning of the value of the current array of protected areas in the world because they will not be able to fulfill the purposes for which they were originally set aside. Existing protected areas in fact become even more important for conservation because they are the safe havens from which future biogeographic patterns will emerge. Conservation will in fact only become more important: we will need more conservation to cope with climate change.

There is one extremely important area of conservation that can help address climate change itself, namely forest conservation. The most recent IPCC report estimates that currently 23% of greenhouse gas emissions come from the destruction of forests, primarily tropical ones, so reducing that makes a direct contribution to limiting climate change. This has been the sleeper issue of climate change and is finally being addressed under the rubric of "avoided deforestation". There are technical and legal problems needing resolution to be sure, but addressing this issue vigorously must be high on the global agenda. Reforestation (natural forest), of course, makes a contribution in terms of sequestering CO_2, can enhance connectivity and have positive biodiversity value.

Probably the single most important thing conservation can do is help form the consensus of where the line should be drawn on climate change. It is already clear that the biological world is the most sensitive of all the concerns about climate change impact. With change rippling through the natural world and an equal amount of climate change already on the docket from existing greenhouse gas concentrations, it is clear that "dangerous anthropogenic interference" is already at hand. Coral reefs alone tell us that.

The most dangerous aspect of the discussion is that voices for nature are rarely heard and as a consequence possible concentration levels of two and three times pre-industrial levels are discussed almost nonchalantly. I believe that double pre-industrial (i.e., 560 ppm) will be disastrous for life on Earth, and that even 450 will be very disruptive. This is hard to prove, but any biologist looking at the response already occurring and thinking about an additional amount of climate change would conclude there is a biological emergency at hand. Some may wave their hands and conclude it is impossible to do anything about the current course, but in my view that is blinkered thinking. Whatever the flaws of the Stern report, it is correct that climate change will constitute a greater cost to society than the cost of addressing it. That has always been the case in environmental debates, and surely is so when the very biological underpinnings of our civilization are at such grave risk.

Camille Parmesan, *Associate Professor of Integrative Biology, University of Texas at Austin*

Evolution or Extinction?

Will global warming lead to the sixth mass extinction event? Or will life be more resilient? Will the teeming biodiversity that we now enjoy collapse down to a few, extremely hardy souls, or will evolution save the day? Climate change is a natural part of Earth's history, so why worry? Answers are even now upon us—both extinctions and adaptations are already happening, and both will continue to shape life as we know it over the coming centuries and millennia.

The study of impacts of climate change is not a new topic in biology. It has a rich history in the scientific literature, since long before there were political ramifications. Way back in 1917, a scientist named Grinnell concluded that the geographic boundaries of many species were determined by climate—individuals living at the edge of their range were living in as extreme an environment as the species could tolerate and survive. The history of biological research is full of studies of the impacts of weather and climate change on wild species. During the 1930s and 1940s, the climate in northern Europe "ameliorated," bringing warm summers and mild winters. Researchers published a plethora of papers about earlier spring flowers and northward expansions of the ranges of birds and butterflies. In the 1960s and 1970s, European climatic conditions became "harsh", with cold and wet summers starting about 1950. A second wave of papers came out documenting the lateness of spring flowers and the southward contractions of the same species of birds and butterflies that had earlier expanded northwards. Given the dynamic nature of Nature, it's no wonder that the public is confused about whether or not to worry about global warming.

Why is human-driven warming any different from recent natural variation in climate, such as that experienced in northern Europe over the 20th century? The answer is simple. Natural warming and cooling trends have been like a lone car on a deserted highway not bothering to stay in a lane: the wobbles back and forth have been relatively small, short term, and there's a strong tendency to move back to the middle. Global mean temperature has hardly changed in the past 10,000 years. But now we are changing from an earth with temperatures that fluctuate a bit, to one that will be warming into the foreseeable future. Whether you imagine this as the car heading off onto a new, unexplored highway, or just going into the ditch—a major climatic shift is in progress. If we want to predict the impacts of human-caused change in global climate, our best clues can be found by looking, not at biological impacts of twentieth-century fluctuations, but much further back in time to when climate truly did show shifts of the magnitude that we now anticipate.

If we look over the past few hundred-thousand years, we see in the fossil records that the freezing and warming cycles of the Pleistocene glaciations caused massive relocation of plants and animals. Range shifts of thousands of kilometres were common as Earth went from a glacial age (when much of Europe and North America were covered in ice), to an interglacial age (as we're in now). If we go even further back, to when Earth was much warmer than today (several million years ago), we see that many species *did* go extinct in the transition from this "hot" Earth to the Pleistocene "cool" Earth. Most species that were adapted to "hot" Earth are long gone. Species that survived are adapted to a relatively cool Earth. Human-driven global warming is taking us into a future, which is warmer than it has been for thousands, and possibly for millions, of years—to an Earth that will lie outside the evolutionary experience of many plants and animals currently living. It will be no surprise if these species suffer high extinction rates.

"Birds arriving for their spring migration, butterflies emerging from overwintering, trees leafing out after winter dormancy and the first blooms of flowers are all about two weeks earlier than they were 30 years ago…"

Less than 10 years ago, as this information was sinking in, biologists were struggling to foresee the future. Which species would be most sensitive to global warming? How many species would go extinct? Would there be winners as well as losers? I was involved in several independent teams struggling with these questions—from conservation organizations like the IUCN to scientific panels like the IPCC—and the conclusions were remarkably similar. While no one felt that predictions about particular species could be made, the consensus was that the species most affected by global warming would be those restricted to cold climate habitats, like Earth's poles or mountain tops, and those able to tolerate only a narrow range of temperatures (e.g. tropical corals). Less than a decade later, those very predictions have been borne out.

Mountain species are following the climates to which they are adapted by shifting their ranges to higher elevations. However, for a population already at the top of its mountain, the preferred elevation now contains only sky. In many regions, high-elevation species are being pushed off their mountaintops. We see this in the American pika—an adorable little mammal well known to mountain back-packers for skittering along talus slopes carrying flowers in its mouth. We see it again in an icon for European naturalists—the Apollo butterfly—whose translucent white wings with their bright red patches glide effortlessly between craggy mountains. The Apollo butterfly and the pika have lost many of their lowest populations and are gradually becoming confined to only the highest mountains.

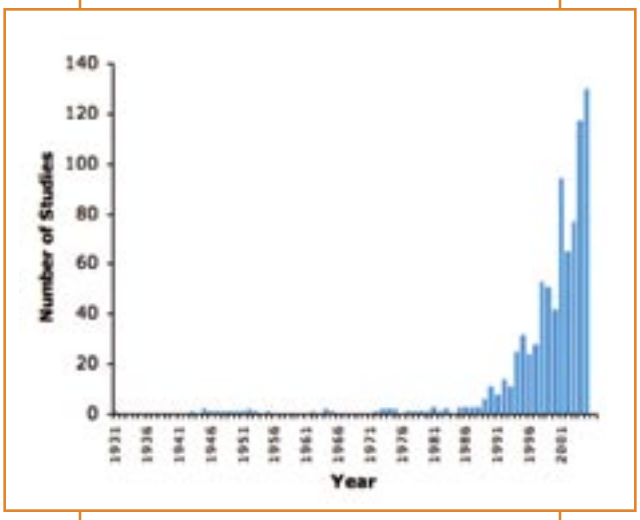
What of the ultimate "cold-Earth" species—those whose habitat is actually floating sea ice. Surprisingly, none have gone completely extinct; but as sea ice declines, populations

are declining in numbers, and their ranges are slowly contracting poleward. The emperor and adelie penguins have declined by 70%–95% at their most equatorial populations in Antarctica (along the Palmer Penninsula) as sea ice has steadily shrunk or disappeared. But more worrying for their long-term future is that even some populations closest to the South Pole have declined. The Arctic has its own martyrs. There's an emerging debate as to whether the polar bear should be the first species to have its official cause of decline listed as "global warming" under the U.S. Endangered Species Act.

At the other end of spectrum, systems that we associate with hot beaches, bath-warm waters and cold drinks—species that we might think would be hot-adapted—are also suffering. Sixteen percent of tropical coral reefs worldwide were killed off by heat during the single extreme El Niño of 1997/1998. A coming threat is the increasing acidity of the oceans. The pH of tropical waters has already dropped from 8.2 to 8.1 as carbon dioxide is absorbed and converted to carbonic acid. As pH continues to drop, the ability of animals to construct hard shells will decline dramatically. Some coral biologists fear that "business as usual" projections could lead to tropical corals being unable to build and maintain reefs by 2050.

We're seeing impacts of current warming on every continent and in every ocean. We're also seeing very similar responses in very different types of organisms—from butterflies in Finland to fish in the North Sea, from foxes in Canada to trees in Sweden, from birds in Antarctica to starfish in Monterey Bay, California. Forty-percent of wild species are showing changes in their distributions—shifting their ranges north and south towards the poles and up mountains. An astonishing 62% are showing changes in their seasonal timing—spring is earlier and fall is later. Birds arriving for their spring migration, butterflies emerging from overwintering, trees leafing out after winter dormancy and the first blooms of flowers are all about two weeks earlier than they were 30 years ago across the northern hemisphere. My colleague, economist Gary Yohe, recognized that this was what economists would call a "globally coherent" signal of climate change impacts in natural systems across the world. This coherence—this systematic pattern—is important because it tells us that species and systems for which we don't have any data are likely to be showing similar responses to those with detailed, long-term data. Globally, we estimated that half of all wild plants and animals have been affected by recent, human-driven climate change.

While geographic patterns of humans contracting different diseases is well-documented, the distributions in the wild of organisms that cause those diseases are often not well-studied. However, parasites that cause tropical diseases are not fundamentally different from other wild species. We therefore expect them to respond in the same way as more charismatic species for which we have better long-term data on their natural distributions. Just as tropical birds and butterflies have spread into Europe and the USA, we expect, then, that parasites and their vectors will extend their ranges from the tropics towards the poles, introducing human diseases as they invade new areas. In fact, human health is already being affected. For the year 2000, the WHO estimated that 6% of malaria infections, 7% of dengue fever cases and 2.4% of diarrhea



could be attributed to climate change. This is principally due to increased frequency and intensity of flood events, which in turn have been linked to human-driven global warming. These numbers are likely to grow as these diseases expand their geographic ranges.

We can already see more severe effects of disease spread in the wild world, particularly for a group of amphibians appropriately named "harlequin" frogs. These bespeckled jewels of the clouds have served as poster-children for preservation of tropical cloud forests. Ironically, now that many sites have successfully been protected, global warming has crept from behind and staked its claim. Seventy-four species of cloud forest harlequin frogs have gone extinct in Central America. They aren't dying because they're too hot, but because climatic conditions have now become perfect for a deadly fungus. As this fungus invades the mountains, even some of the highest elevation species have been lost.

Some species, those with short generation times like insects, are showing genetic adaptation—evolution—in response to climate change. Unfortunately, these changes are small and unlikely to protect species from climate-caused extinction. Even though the frequencies of existing "hot-adapted" genotypes are increasing across populations in many species, truly new traits are not emerging. We are not seeing new mutations that would allow species to exist in climates outside their previous range of tolerance. In other words, species can play around with the genetic variation they already have, but evolving new, even "hotter" adapted genotypes, is a process that's likely to be too slow to keep pace with rapid, human-driven climate change.

The good news is some northern-hemisphere species are able to move their ranges faster than we thought they could as climate warms at their northern range boundaries. These are species that already had a few individuals that were good at moving. The proportion of "movers" has increased at the range boundaries, and this local evolution has allowed these species to expand northward into new territories very rapidly. More good news is that some species that are adapted to a wide array of environments—globally common, or what we call "weedy" or urban species—will be most likely to persist.

So what will life on Earth look like over the lives of people now being born? There's obviously a range of possibilities, depending on how policy-makers and the public, as individuals, decide to change our habits. What are the possible future worlds? Even the minimum projections—of another 1.8°C—are more than twice what we've already seen. All of the changes I talk about above have occurred with just 0.7°C warming. "Business as usual" projections are for another 4°C rise; with some models estimating over 6°C rise in global temperature. These higher projections represent a climate the Earth hasn't had long-term exposure to for several million years—outside the evolutionary history of much of life on Earth now. Temperature changes of that magnitude (> 6°C) in the past have often led to substantial extinction events, especially if the climate change was rapid. We need to implement major emission reductions now so that we keep future global warming down to those lower projections—down to "just" another 1.8°C. We can't afford the worst-case scenario either in terms of conservation of biodiversity, human health, or our economic stability.

Anilla Cherian, *Ph.D., Environmental Consultant* [1]

An Inescapable Truth:

Responses to global climate change need to be linked to the conservation and sustainable management and use of biodiversity resources.

Invoking the precautionary principle, the article calls for new and improved efforts to understand and address the linkages between global climate change and biodiversity loss. Improved knowledge and work on the linkages between the two Rio Conventions are especially relevant for developing countries, particularly Small Island Developing States (SIDS) and least developed countries (LDCs), because the adverse effects of climate change imposes severe stresses on existing fragile and vulnerable natural resources. Efforts to assess and respond to the adverse impacts of global climate change on biodiversity loss, and more importantly, efforts to ensure that the sustainable management, conservation and use of biodiversity resources can contribute towards effective adaptation to climate change, are especially urgent for developing countries.

Exercising precaution is widely recognized as a critical concept in addressing global public health concerns, and one which global public health advocates closely adhere to. Unfortunately, the precautionary principle appears to be a rather neglected concept in responding to global environmental challenges such as climate change and biodiversity loss. The scope, dynamic nature and long-term horizons of the global environmental problems have resulted in cautious, ad hoc global response mechanisms and measures, but ignoring the precautionary principle and avoiding effective, responsive action at the global level comes with its own catastrophic perils.

The peculiar irony of the precautionary principle is its explicit recognition that the lack of "full scientific certainty" should not be used as a reason for avoiding or delaying cost-effective and efficient response measures related to grave and irreversible threats. Here, it should be noted that Article 3.3 of the United Nations Framework Convention on Climate Change (UNFCCC) specifically states that Parties Òshould take precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing such measures."

The Preamble to the Convention on Biological Diversity (CBD) also references similar language stating that, "…where there is a threat of significant reduction or loss of biological diversity, lack of full scientific certainty should not be used as reason for postponing measures to avoid or minimize such a threat." Despite being enshrined in the both the CBD and the UNFCCC, the precautionary principle has not catalyzed the requisite global action needed to undertake the kind of far-reaching adaptation and mitigation measures that are required to fully address climate change and biodiversity loss.

However, the release this February, of "Climate Change 2007: The Physical Science Basis", the report of Working Group I of the Intergovernmental Panel on Climate Change (IPCC), may help to frame a more energized global commitment towards defining new opportunities and rules of engagement for responding to the problem. The report, which was produced by around 600 authors from 40 countries, and reviewed, by over 620 experts and governments, is an affirmation of a global scientific consensus. Its Summary for Policy-Makers (SPM), which was reviewed line-by-line by representatives from 113 governments during the 10th Session of Working Group I in February 2007, states unambiguously that the warming of the climate system is "unequivocal". So now the question is whether the release of the IPCC 4th Assessment Report will set off a seismic change in policy responses to the global climate change problem.

In light of the recent IPCC findings, and keeping in mind the precautionary principle, one area where urgent action is needed is an improved understanding of the linkages between biodiversity resources and global climate change, both in terms of impacts and response measures. Highlighting the significance of the impacts of global climate change on biodiversity loss, the CBD, in its role as the first global, comprehensive convention to address all aspects of biological diversity (genetic resources, species, and ecosystems), has recently called for focused attention on the possible linkages between the work of the United Nations Framework Convention on Climate Change and the Kyoto Protocol

and itself. The CBD established an ad hoc technical expert group in 2001 to carry out an assessment of the interlinkages between biodiversity and climate change.

The rationale for the current article are directly derived from the CBD's call to focus on the linkages between global climate change and biodiversity loss, and are based specifically on the key findings of the report entitled, "Interlinkages between Biological Diversity and Climate Change" prepared by the technical expert group in 2003.[2] The report concluded that there are significant opportunities for adapting to climate change while enhancing the conservation of biodiversity.

There is little doubt that the cause and effect relationship between global climate change and biodiversity loss has grave consequences for a number of developing countries that are repositories of unique and endemic biodiversity resources. Despite being repositories of some of the world's most unique and diverse species and ecosystems, many developing countries, in particular Small Island Developing States (SIDS) and least developed countries (LDCs), lack the necessary technical, economic and institutional capacity to ensure the long-term conservation of unique species of flora and fauna. Factors such as limited national capacities and resources, ecosystem fragility, high incidence of endemism, and the extreme vulnerability to natural and anthropogenic disasters make the conservation and sustainable management of biodiversity difficult challenges to address and overcome in these countries.

What is troubling is that although global climate change has been recognized as an important cause of biodiversity loss; what is less well understood are the ways and means by which the conservation and sustainable management and use of biodiversity resources are key factors in effective climate change adaptation measures. There are two crucial but inter-related issues that need to be urgently addressed from a developing country perspective:

- Adverse effects of climate change are a major cause for the loss of valuable and unique biodiversity resources in developing countries that are least able to respond and adapt to this challenge; and,
- Sustainable management, conservation and use of biodiversity resources can contribute towards effective adaptation to climate change.

From the perspective of this article, it is important to point out that in context of global climate change, "adaptation" refers to adjustments (in processes, structures and policies) that are made in response to actual or expected climatic stimuli or their effects. The overall aim of adaptation is to reduce a system's (national, local or ecosystem) vulnerability to global climate change and to ease its adverse impacts.[3] The report of the technical expert group convened by the CBD notes that adaptation is necessary not only for the projected changes in climate but also because climate change is already affecting many ecosystems. Climate change-related adaptation options that have been identified could include: activities aimed at conserving and restoring native ecosystems, managing habitats for rare, threatened, and endangered species, and protecting and enhancing ecosystem services.

Examples of climate change adaptation measures that simultaneously address biodiversity loss include: community based activities that are aimed at improving the health of coral reefs which in turn allows reefs to be more resilient to increased water temperature and reduce bleaching. Another example is the protection and restoration of coastal ecosystems, such as mangrove and salt marsh vegetation, which can protect coastlines from the impacts of climate induced sea-level rise, and also have biodiversity benefits.[4]

Recognizing the impacts of climate change on biodiversity and response measures, the CBD noted at its fifth meeting that there is significant evidence that climate change is the primary cause of the recent, severe and extensive coral bleaching, and that this evidence is sufficient to warrant remedial measures being taken in line with the precautionary approach. In addition, the CBD notes that differential responses to climate change by species and ecosystems may lead to disruptions and biodiversity loss and may also increase threats from invasive alien species.[5]

Developing countries face a number of capacity, institutional and resource constraints in responding to global environmental challenges. Work that is focused on understanding the linkages between of the most pressing global environmental challenges makes sense in the face of serious constraints and in terms of pooling resources effectively.

Clearly, a two-pronged strategy is required. The first prong would be to enable developing countries to undertake comprehensive assessments of the adverse effects on global climate change on biodiversity resources, with a particular emphasis in identifying global climate change-related impacts on specially threatened, or extremely vulnerable, ecosystems and habitats. The second prong would be to improve knowledge management and responsive capacity amongst developing countries about the linkages between the sustainable management, conservation and use of biodiversity resources and adaptation responses to global climate change.

What is at stake is the nagging reminder of the precautionary principle, that "too little" or "too late" action will mean insurmountable costs. With every new hurricane and monsoon season, and with the tragic aftermath of extreme weather-related events in 2004-2005 all over the world, concepts such as: the increased intensity and frequency of extreme weather-related events, sea-level surges, inundation of poor and vulnerable coastal communities, endemic habitat and species loss and the destruction of fragile ecosystems no longer seem so far-removed. The inescapable truth is the linkages between the impacts of global climate change on biodiversity resources, and an improved understanding of relevant climate change-related adaptation measures that are based on the principles of sustainable management, conservation and use of biodiversity resources, matters for all, and not just developing countries.

"Clearly, a two pronged strategy is required. The first prong would be to enable developing countries to undertake, comprehensive assessments of the adverse effects on global climate change on biodiversity resources, with a particular emphasis in identifying global climate change related impacts on specially threatened or extremely vulnerable ecosystems and habitats."

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1. This article has been prepared by Dr. A. Cherian, an independent consultant who has worked on climate change, energy and biodiversity initiatives/projects for range of UN agencies including UNDP and UNDESA, the World Bank-GEF, the University of West Indies, and the Rockefeller Foundation The paper may not be cited or otherwise transmitted without permission.

2. Convention on Biological Diversity (CBD), "Interlinkages between Biological Diversity and Climate Change" prepared by the *Ad hoc* Technical Expert Group on Biological Diversity and Climate Change. (CBD. Technical Series No. 10) 2003. Available on the internet at http://www.biodiv.org/doc/publications/cbd-ts-10.pdf

3. Additional information on adaptation and vulnerability can be obtained from the technical and policy assessments prepared by the Intergovernmental Panel on Climate Change.

4. BD, op.cit.., pg. 76 and 80.

5. CBD/SBSTTA, "The impact of climate change on biological diversity and response measures", and "Overview of the interlinkages between biological diversity and climate change." UNEP/CBD/SBSTTA/6/11, page 10-17.

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"The time has come to realize that investing in the resilience of ecosystems will ensure that future generations are not only bequeathed the dazzling variety of nature we take for granted, but are also much better able to cope with the less stable climate they will unfortunately inherit."

—Ahmed Djoghlaf, EXECUTIVE SECRETARY, CONVENTION ON BIOLOGICAL DIVERSITY

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