


BIODIVERSITY AND CLIMATE CHANGE

Making use of the findings of the IPCC's Fifth Assessment Report

Convention on Biological Diversity

1. A PRIMER ON THE IPPC AND 5th ASSESSMENT REPORT

What is the IPCC?

In a nutshell, the inter-governmental panel on climate change (IPCC) is a scientific intergovernmental body comprised of the world's leading experts on climate change. The IPCC was established by the World Meteorological Organization (WMO) and United Nations Environment Programme (UNEP) to assess scientific, technical and socio-economic information relevant for the understanding of climate change, its potential impacts and options for adaptation and mitigation. It is open to all Members of the UN and of WMO.

What does the IPCC do?

The IPCC produces reports that support the United Nations Framework Convention on Climate Change (UNFCCC) and their objective to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system". These reports are utilized by many audiences for raising awareness on climate change, producing information on which to base policy and programmes addressing climate change, and for guiding further research on climate change for a broad range of scientists from different disciplines.

Photo credits: Comstock/Thinkstock (top right); IPCC (bottom left)

The Fifth Assessment

The most comprehensive assessment of scientific knowledge on climate change

IPCC reports are prepared by experts selected by the Bureau, based on nominations by governments and observer organizations, to serve as IPCC Lead Authors. AR5 is comprised of four reports : the synthesis report and the three IPCC Working Groups' contributions dealing with:

Each report contains its own Summary for Policymakers (SPM) which is approved in detail by all member countries of the IPCC and represents a formally agreed statement on key findings and uncertainties. The SYR is written in language intended for policy makers and packages all the material contained within the IPCC Assessment Reports and Special Reports.

Why is AR5 Important and Relevant to Biodiversity?

There is consensus among scientists that climate change affects biodiversity and that it is a likely to become one of the most significant drivers of biodiversity loss by the end of the century. Conserving natural terrestrial, freshwater and marine ecosystems and restoring degraded ecosystems (including their genetic and species diversity) is essential for the overall goals of both the Convention on Biological Diversity (CBD) and the UNFCCC. Ecosystems provide a wide range of ecosystem services that are essential for human well-being and sustainable development and play a key role in the global carbon cycle and in adapting to climate change.

Biodiversity can support efforts to reduce the negative effects of climate change. Conserved or restored habitats can remove carbon dioxide from the atmosphere, thus helping to address climate change by storing carbon (for example, reducing emissions from deforestation and forest degradation and restoring degraded wetlands). Moreover, conserving intact ecosystems, such as mangroves and salt marshes, for instance, can help reduce the disastrous impacts of climate change such as flooding and storm surges, which are predicted to occur with more frequency and intensity.

The new assessment report by the IPCC outlines several impacts that affect the achievement of the Aichi Targets and Strategic Plan of the CBD

Observed Impacts and Affected Aichi Targets [1]

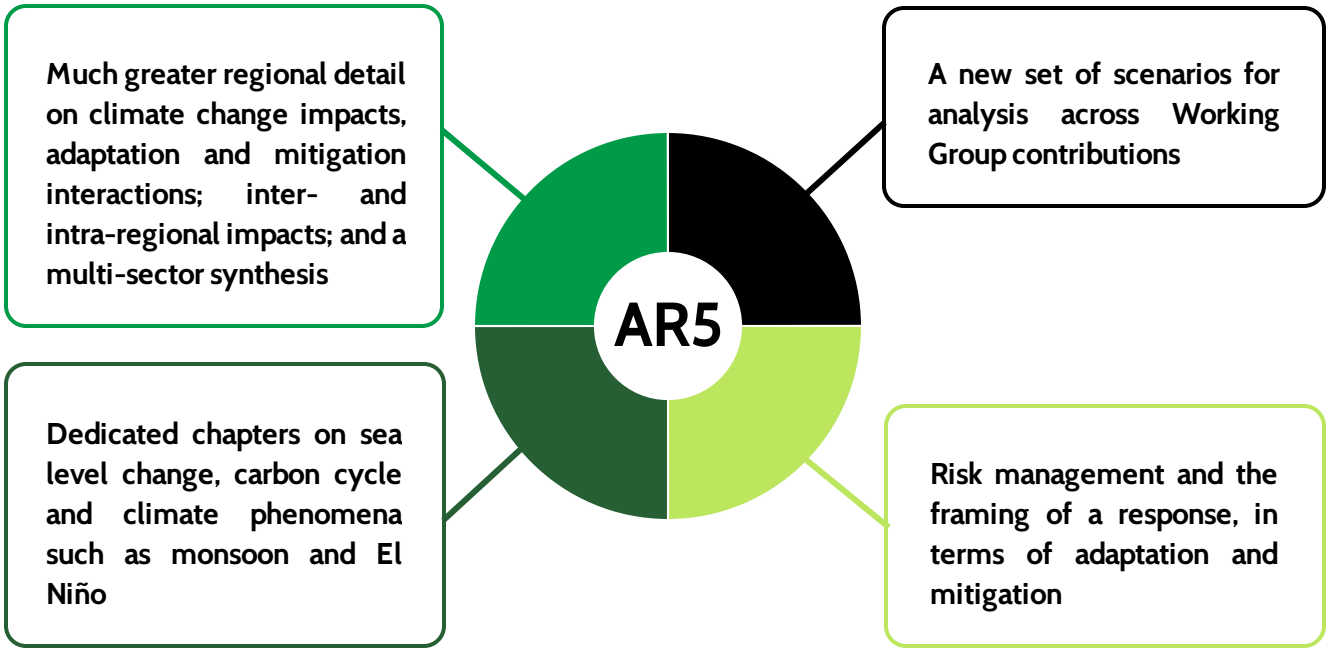
Targets	Impacts
7 12	Changing precipitation or melting snow and ice are altering hydrological systems, affecting water resources in terms of quantity and quality
5 7 10 12 13	Many terrestrial, freshwater, and marine species have shifted their geographic ranges, seasonal activities, migration patterns, abundances, and species interactions in response to ongoing climate change
7	Decreases in crop yields have been more common than increases
7 12	Changes in temperature and rainfall have altered the distribution of some waterborne illnesses and disease vectors
14	Heightened vulnerability to climate risks depending on degree of social, economic, political or other kind of marginalization
7 12 13	Climate-related extremes, including heat waves, droughts, floods, cyclones, and wildfires alter ecosystems, disrupt food production and water supply, and alter livelihoods

[1] IPCC AR5 WGII Summary for Policymakers

So what is new in AR5?

IPCC's Fourth Assessment Report was published in 2007. What's different in AR5 is that there's a greater emphasis on assessing the socio-economic aspects of climate change and its implications for sustainable development.

Some new features of AR5 include:



Additionally, several cross-cutting themes addressed in AR5 include:

- Water and Earth System: Changed, Impacts and Responses
- Carbon Cycle including Ocean Acidification (see Meeting Report)
- Ice Sheets and Sea-Level Rise (See Meeting Report)
- Mitigation, Adaptation and Sustainable Development
- Scientific information relevant to Article 2 of the UNFCCC referring to the "... stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interferences with the climate system".

For further reading, please refer to:
The IPCC AR5 website, which contains an overview of different chapters and explains the process of producing the AR5, timelines, in addition to an information leaflet http://www.ipcc.ch/activities/activities.shtml

2. INTEGRATING AR5 FINDINGS INTO NBSAP THREAT ASSESSMENTS

Introduction

In outlining guidance for the development of National Biodiversity Strategy and Action Plans (NBSAPs), the Conference of the Parties (COP) to the Convention on Biological Diversity (CBD) calls for the identification of, "the main threats to biodiversity, including direct and indirect drivers of biodiversity change".[2] Observed changes in climate have already begun to affect biodiversity, including through changing the timing of key life events, increasing vulnerability to pests and natural disasters, and changing habitat conditions. In fact the Fifth Assessment Report (AR5) of the Inter-governmental Panel on Climate Change (IPCC) confirms that climate change impacts have been felt on all continents and oceans.

These observed changes are only one aspect of climate change threats to biodiversity. The AR5 states clearly that, "a large fraction of terrestrial and freshwater species faces increased extinction risk under projected climate change during and beyond the 21st century". The AR5 contains a number of findings on the global and regional scale that practitioners may find useful when integrating climate change into NBSAP threat assessments. Some of these findings are presented below, many more can be found in the Working Group II report.[3] It is important to note, however, that AR5 identifies a number of challenges with regards to the integration of climate change threats within biodiversity planning. In particular, understanding future vulnerability among complex inter-related ecological systems is difficult.

Furthermore, it is challenging to integrate human actions, including exposure to other anthropogenic threats, into natural systems projections.

Global threats

1. Observed Impacts

The AR5 highlights a number of changes at the species and ecosystem level that can be, at least in part, attributed to climate change. These changes are increasing vulnerability, exacerbating existing pressures, changing species appearance, and altering the composition of ecosystems.

Examples of some of the observed impacts of climate change as presented in the AR5 are listed in figure 1 below. While attributing changes to a single driver is often difficult, it should be noted that the AR5 is characterized by a significantly greater body of scientific evidence when compared to the Fourth Assessment Report. As such, confidence with regards to attribution has increased in a number of cases.

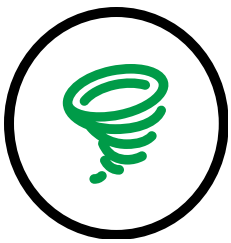
II. Projected Impacts

In addition to including current threats to biodiversity, NBSAPs should consider projected future impacts. In this regard, the summarization of a number of studies and models contained in AR5 can prove to be very useful for biodiversity practitioners who are developing or revising NBSAPs.

[2] Decision IX/8. paragraph 85

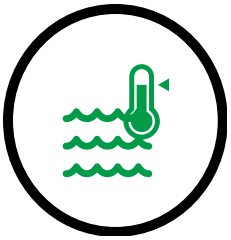
[3] Climate Change 2014: Impacts, Adaptation and Vulnerability. htttp://www.ipcc.ch/report/ar5/wg2/

Figure 1: Examples of Climate Change Impacts – AR5



Increased extreme weather events

- Increased vulnerability of ecosystems to climate variability
- Higher instances of wildfires

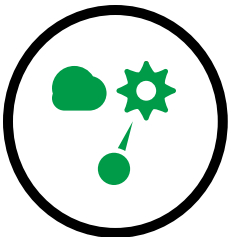


Warming ocean temperatures

- Coral bleaching
- Changes in species distribution
- Reduction in maximum body size of warm water species

Changing precipitation and melting snow/ice

- Increased water stress
- Reduction in water quality
- Increased vulnerability



Changes in air temperatures and seasonal patterns

- Changes in timing of life events
- Shifts in migration patterns
- Increased tree mortality in some areas

The AR5 is particularly rich in information on climate change impacts on marine species and ecosystems. Conclusions range from the very general (warming is changing predator-prey dynamics), to the very specific (some warm water reefs are experiencing species replacement and coral cover loss). Perhaps one of the most significant AR5 conclusions on marine ecosystems is the finding that hypoxic areas ("dead zones") are increasing in number and size.

Perhaps one of the most significant AR5 conclusions on marine ecosystems is the finding that hypoxic areas ("dead zones") are increasing in number and size.These dead zones are expected to exacerbate human pressures on fisheries with negative consequences expected for commercially relevant fish species. To draw more detailed ties to livelihoods, the AR5 notes that studies have revealed that ocean acidification, attributed to climate change could cost the global economy over 100 billion US$ by 2100 from losses in shellfish production alone.

With regards to terrestrial species, the AR5 outlines a broad risk of climate change impacts to terrestrial ecosystems, and consequently, to ecosystem services. The extent of the risk is, however, tied to the extent of warming. If average temperatures increase by about 1.4°C or more by 2046-2065, 'abrupt and irreversible' changes in the appearance and functioning of ecosystems becomes a high risk. These climate change risks are expected to, not only impact ecosystems, but also biodiversity-based livelihoods as well as the livelihoods of communities who are reliant upon ecosystem provisioning services.

Regional Threats

As the impacts of climate change on species and ecosystems are, in many cases, location specific, the AR5 contains a significant amount of information on regional threats. For example, the AR5 states that:

- Climate change has already contributed to the extinction of many species of amphibians in Central America
- In the Arctic, climate change is impacting traditional knowledge, innovations and practices
- Climate change is expected to result in changes in species and ecosystem structure in the Amazon forest, increasing risks for biodiversity
- Warming in the boreal-tundra system will transform the species composition, land cover, drainage, and permafrost extent

Regional threats are also brought out in AR5 through the identification of highly vulnerable ecosystems, particularly Arctic ecosystems and coral reefs. For example, AR5 concludes that marine biodiversity and coastal ecosystems in the Arctic are especially at risk from increasing water temperatures and stratification as well as ocean acidification.

The reason for this vulnerability is tied to limited adaptive capacity among species and ecosystems that have developed highly specialized adaptations to very specific conditions. According to the AR5 the Arctic region and coral reefs are so vulnerable that risks to biodiversity emerge even with global average temperature increases of only 2°C. Additional regions and ecosystems identified as being particularly vulnerable by the AR5 include the Amazon forest, the boreal-tundra, coastal wetlands, mountain ecosystems, and some freshwater ecosystems.

With regards to regional specific marine threats, AR5 notes that climate change is expected to increase species richness at mid and high latitudes but to decrease richness at tropical latitudes. This shift will increase invasive alien species in high latitudes while resulting in local extinctions in the tropics as well as semi-enclosed seas. Furthermore, in the Arctic and Antarctic, reductions in sea-ice will also impact the distribution of marine species including ice dependent species such as polar bears.

Figure 2: Region-specific Climate Change Impacts – AR5

Australasia	Changes in water resources Threats to coastal ecosystems Increased vulnerability of biodiversity	**Europe**	Reductions in alpine plant habitat Threats to mangroves, sea grass beds, coral reefs and salt marshes Introduction and expansion of invasive alien species
North America	Increased vulnerability of ecosystems Particular vulnerability to climate extremes	**Central/ South America**	Increased rates of species extinction Threats to mangroves and coral reefs Increased vulnerability of fish stocks
Asia	Changes to plant distribution, growth and timing of seasonal activities Threats to mangroves, sea grass beds, coral reefs and salt marches	**Africa**	Range shifts in southern extinction Changes in species composition especially in arid and semi-arid forests Changes in water resources

3.INTEGRATING AR5 INTO BIODIVERSITY ACTION PLANS: REDUCING THE VULNERABILITY OF BIODIVERSITY

Introduction

National Biodiversity Strategy and Action Plans (NBSAPs) are one of the key tools called for in Article 6 of the Convention on Biological Diversity (CBD) to address threats to biodiversity. As climate change is emerging as a significant threat to many populations, species and ecosystems, the development or revision of NBSAPs should include actions to reduce the vulnerability of biodiversity.

The Fifth Assessment Report (AR5) of the Inter-governmental Panel on Climate Change (IPCC)[4] highlights the threats facing biodiversity as a result of climate change, concluding that if global average temperature increases reach 4°C climate change will likely become the dominant driver of ecosystem changes and loss. In light of this projection, AR5 presents a number of options to reduce the vulnerability of biodiversity to the negative impacts of climate change.

These can be broadly categorized as i) actions to help species and ecosystems adapt to specific climate change impacts, and ii) ecosystem based approaches to adaptation. Throughout the AR5, adaptation is defined as, "efforts to decrease vulnerability or exposure and/or increase resilience or adaptive capacity".

The AR5 also discusses the role of climate change mitigation in reducing the vulnerability of biodiversity although mitigation actions may be beyond the scope or mandate of many NBSAPs.

Helping Species and Ecosystems Adaptation

The AR5 notes that hard adaptation options remain the most common approach. These include engineered approaches such as sea walls, improved drainage systems and other engineered and technological approaches. Such approaches, however, are not often suited to address climate change impacts on populations, species or ecosystems.

There are, according to the AR5, a number of tools and sources of information that are useful for biodiversity adaptation. For example, scenarios can address some of the uncertainty associated with future projections by bundling development pathways with climate change risks and policy implications. The AR5 also highlights the potential importance of traditional knowledge, innovations and practices to climate change adaptation.

[4] Climate Change 2014: Impacts, Adaptation and Vulnerability. http://www.ipcc.ch/report/ar5/wg2/

Overall, however, the AR5 cites the reduction of other threats as a key adaptation strategy for biodiversity. Specific actions can include:

- **Reducing habitat fragmentation**
- **Maintaining genetic diversity**
- **Assisted migration / translocation**
- **Manipulating disturbance regimes.**

As a concrete example, AR5 concludes that reducing deforestation and managing wildfires in the Amazon will decrease the risk of abrupt ecosystem change as a result of climate change.

Challenges

As a concrete example, AR5 concludes that reducing deforestation and managing wildfires in the Amazon will decrease the risk of abrupt ecosystem change as a result of climate change. Also related to cost, the AR5 notes that, in order to successfully adapt to climate change, developing countries will require several tens of billions of dollars by 2030. Furthermore, there remain a number of data needs, including long term ecosystem monitoring to avoid tipping points.

Ecosystem-based Approaches to Adaptation

The AR5 adopted the description of ecosystem-based adaptation (EbA) put forth by the Second Ad hoc Technical Expert Group on Biodiversity and Climate change, "the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change".

The AR5 notes that there is an increasing recognition of EbA. The value of ecosystem services was acknowledged in 50% of 44 National Adaptation Plans of Action (NAPA) assessed, while 22% of assessed NAPAs included the use of ecosystem services in projects.

The types of EbA activities mentioned in the AR5 include:

- **The management and establishment of protected areas and conservation agreements**
- **Coastal and wetland maintenance and restoration**
- **Adaptive forest management**
- **The use of agro-ecosystems in farming systems**
- **Ecotourism activities**
- **Direct species management**

Overall, the AR5 notes that integrated approaches to ecosystem management, especially when considering water and marine and coastal areas, are a key feature of many EbA projects. Such integrated approaches also contribute to the ability of EbA to deliver additional social and environmental benefits while reducing the change of maladaptation.

Challenges

Despite the rapid expansion of EbA, the AR5 identifies the need for improved valuation of ecosystem services as a significant challenge to further implementation. This is of particular note as EbA has been identified as a cost effective response to many climate change challenges, where the value of ecosystem services have been recognized.

For example, EbA has been employed widely in coastal communities exposed to natural disasters where the use of coastal wetlands as a buffer has been well researched. However land-based EbA, which has by and large received less attention from researchers, features significantly less in the AR5.

Ecosystems and Climate Change Mitigation

In addition to exploring the links between biodiversity and climate change adaptation, AR5 considers the role of deforestation, land use change and agriculture in the emission of greenhouse gasses. The AR5 also recognizes, the role of mangrove, sea grass, and salt marsh ecosystems as important carbon stores

As such, AR5 offers a number of suggestions for ecosystem management that can contribute to climate change mitigation, many of which also contribute to biodiversity conservation and sustainable use. For example, AR5 cites no-till farming, reforestation, restoration of degraded peatlands and grasslands, cropland set asides, and agroforestry as mitigation actions.

A discussion on reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries (REDD+) also features in AR5. With regards to biodiversity, REDD+ considers multiple benefits including for biodiversity and calls on the avoidance of biodiversity loss in its safeguards framework.[5]

Finally, in linking adaptation to mitigation, AR5 notes that since mitigation reduces the rate and magnitude of warming, it increases the time available for climate change adaptation.

Front page photo credits:
Top left: UN Photo/Fred Noy 2006. Top right: UN Photo/Evan Schneider 2004.
Bottom left: Christine Estrada 2014. Bottom right: John A. Anderson 2008.

For further information, please refer to the links below.
Climate change and biodiversity: **www.cbd.int/climate**
IPCC Fifth Assessment Report (AR5) : **https://www.ipcc.ch/index.htm**

5 Warsaw Framework for REDD+. http://unfccc.int/methods/redd/idems/8180.php
Photo credit: UN Photo/Evan Schneider 2009

Secretariat of the Convention on Biological Diversity
United Nations Environment Programme
413 St-Jacques O., Suite 800
Montreal, QC., H2Y 1N9
Canada
Tel.: 1 (514) 288-2220
E-mail: secretariat@cbd.int
Website: http://www.cbd.int

Graphic design: Hannane Sellali

UNEP

Convention on Biological Diversity