

# Biodiversity<sup>1</sup>-Climate interactions: adaptation, mitigation and human livelihoods

## Summary of an international meeting held at the Royal Society 12-13 June 2007

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### Summary of key messages

- 1 Climate, biodiversity, and human well-being are inextricably linked. Significant policy objectives for each now exist in international political commitments and country actions. Although our understanding of these processes and their inter-relationships is far from complete we know enough to identify some critically important components for immediate attention and priority areas for research and policy development. New mechanisms will be needed to galvanise work in this area, especially at the inter-governmental level.
- 2 Significant climate change impacts on biodiversity have already been identified with up to 50% of the species studied world-wide observed to be affected. The Inter-governmental Panel on Climate Change (IPCC) working group 2 summary report concludes that if temperature increases exceed 1.5-2°C, 20-30% of plant and animal species assessed will be at risk of extinction.
- 3 The continuing, accelerating loss of biodiversity will compromise the long-term ability of ecosystems to regulate the climate, may accelerate or amplify climate warming and could lead to additional, unforeseen, and potentially irreversible shifts in the earth system. Urgent action now to halt further loss or degradation of biodiversity will help to maintain future options for reducing the extent of climate change and managing its impacts.
- 4 Mitigation and adaptation is urgently required if we are to reduce climate change and its impacts over coming decades. Many of the people most vulnerable to climate change and its impacts are also those that are most dependent on biodiversity. Actions to reduce climate change must maximise the opportunities for implementation of mutually supportive strategies while minimising further impact on the most vulnerable populations and ecosystems.
- 5 New policies are needed to integrate options for meeting biodiversity, climate and sustainable development objectives at the international, national, and local levels. Difficult policy choices will be required and will need to be informed by new science and socio-economic considerations.
- 6 Significant new research effort is required in several areas to improve understanding of biodiversity in the climate system, the impacts of climate change on biodiversity and human populations, their inter-linkages and cross-scale effects. Whereas our understanding of the impact of climate on biodiversity is increasing, our knowledge of the impact of biodiversity on climate is limited. Mitigation and adaptation measures for both climate change and biodiversity loss must be developed with improved understanding of the drivers of each and their interactions.

### Introduction

- 1 In addressing global climate change there is an opportunity to demonstrate that biodiversity can play a role in protecting and improving societal wellbeing. However, there is growing concern that efforts to

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<sup>1</sup> The meeting was based on the CBD definition of biological diversity: "the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.

address climate change may act as an additional driver of biodiversity loss, and ultimately irreversibly compromise future options for responding to climate change.

- 2 In June 2007 the Royal Society hosted a meeting in collaboration with Defra<sup>2</sup>, DFID<sup>3</sup>, JNCC<sup>4</sup>, Kew<sup>5</sup>, the Hadley Centre<sup>6</sup>, and NERC<sup>7</sup>, to investigate the inter-linkages between biodiversity, climate change, and human livelihoods and the potential role for biodiversity management in climate change mitigation and adaptation.
- 3 The aim of the meeting was to bring experts from the biodiversity, climate change, and sustainable development communities together to encourage dialogue and cooperation and to identify opportunities for maximising policy and science synergies. We hope that the main messages to emerge from the meeting will be useful for informing future work and will provide new impetus for active, integrated work programmes on biodiversity, climate change mitigation and adaptation, and human livelihoods.
- 4 The meeting's objectives were:
  - a To raise the profile of biodiversity within the climate change issue and to encourage decision makers to consider biodiversity, climate change, and human livelihoods together when developing strategies for sustainable development, protection of biodiversity, and reduction of climate change and its impacts;
  - b To explore the role and function of biodiversity and ecosystems in the climate system;
  - c To consider the role that biodiversity should play in climate change adaptation and mitigation strategies;
  - d To identify key areas in which biodiversity, climate change, and sustainable development science and policy can be coordinated;
  - e To consider the interactions between human livelihoods, the biosphere and climate in terms of functions and impacts.

## Main discussion

### Role and function of biodiversity and ecosystems in the climate system

5 Ecosystems such as tropical forests, peatlands and the oceans play a major role in climate regulation. Whilst the importance of species and genetic level biodiversity for ecosystem functioning is not fully understood, research suggests that diverse ecological systems tend to be more dynamic and resilient to change, and may play an important role in reducing the impacts of, and enabling adaptation to, climate change.

6 Biodiversity is important in the carbon cycle and other process that regulate climate. Globally, plants absorb and release water and carbon dioxide (CO<sub>2</sub>). They emit biogenic volatile organic compounds such as isoprene, which under certain conditions go on to form ground-level ozone (an important greenhouse gas), and may also be important for cloud seeding. Marine plankton release dimethyl sulphide which influences cloud formation over the oceans. Land-cover characteristics determine albedo - tropical rain forests reflect less sunlight than grasslands. All are affected by changes in ecosystems and many involve significant feedbacks in the climate system. However, improved understanding is required of the role of biodiversity in the structure and function of ecosystems, and particularly those biological processes that are important for climate regulation.

7 Ecosystems also deliver a range of other services of importance to human wellbeing. In addition to providing climate regulating services, ecosystems can deliver a range of other benefits to society such as the supply of food, fibre, and water and air purification.

<sup>2</sup> UK Department for Environment, Food and Rural Affairs.

<sup>3</sup> UK Department for International Development.

<sup>4</sup> UK Joint Nature Conservation Committee.

<sup>5</sup> Royal Botanical Gardens Kew.

<sup>6</sup> Hadley Centre, UK Meteorological Office.

<sup>7</sup> UK Natural Environment Research Council.

## Role of biodiversity in climate change adaptation and mitigation strategies

8 Biodiversity loss is escalating and climate change is accelerating. Biodiversity protection may in its own right contribute to adaptation and mitigation objectives, for example land use change is a major driver of biodiversity loss and greenhouse gas emissions. Appropriate management can therefore result in mutual benefits by reducing emissions, climate change impacts and biodiversity loss, whilst also improving human livelihoods. Such win-win-win solutions should be a political and scientific priority.

9 Under future climate change a more dynamic approach to biodiversity management will be required and may include ecosystem management for enhanced resilience under climate change. A combination of approaches, such as protected areas, ecological networks, and broader landscape management will be necessary, however how these should be applied under climate change requires significant new research. Ecosystem management based on the identification, evaluation, and weighting of the relative risks posed to biodiversity in the context of risks to human wellbeing and climate will become more important.

10 While biodiversity management may potentially result in win-win-win solutions, in many cases politically difficult trade-offs will be required. Decision-making frameworks must be transparent and enable activity to reduce negative impacts. Community based, de-centralised, market focused adaptation and mitigation projects should be implemented to build best practice and to test whether win-win-win situations are feasible.

11 Good governance is critical for ensuring that political objectives are effectively delivered, especially where these need to be integrated across sectors. Equity, and cost and benefit sharing issues also need to be considered and resolved. International institutions have an important role to play in providing guidance for the development and implementation of climate change strategies. However national adaptation and mitigation programmes should be prepared according to national and local characteristics and address specific challenges and opportunities. Top-down approaches may be appropriate for the setting of national strategic objectives. However, bottom-up approaches will be most appropriate for identifying solutions, priority setting, and programme design and implementation.

## Opportunities for coordination of policy and science on biodiversity, climate change, and sustainable development

12 Due to the interdependencies between biodiversity and climate it is possible to develop strategies that achieve mutually supportive outcomes. However, tools are not yet available for prioritising ecosystems for research or management under the integrated framework recommended here. One approach would be to strategically prioritise ecosystems on the basis of their importance in the climate system, biodiversity, and for human livelihoods. Their "relative climate value" could be explored in terms of the function provided by each (eg albedo, carbon cycling), and compared against their biodiversity value, human livelihoods value, adaptation potential, and intervention potential. This would provide a transparent framework for assessing where management (or research) effort should be placed as a priority and would enable the identification of where trade-offs will be required, or alternatively, where win-win-win solutions may be possible.

13 Currently, there are limited international management or governance structures in place for implementing projects at trans-national levels or over the longer term. International Conventions such as the CBD<sup>8</sup>, UNFCCC<sup>9</sup>, UNCCD<sup>10</sup>, Ramsar<sup>11</sup>, CMS<sup>12</sup>, and WHC<sup>13</sup>, have taken positive steps in collaborating and taking integrated action on biodiversity and climate change. While the mandates and independence of the other international Conventions must be respected, strengthening and extending the cooperation of

<sup>8</sup> Convention on Biological Diversity.

<sup>9</sup> United Nations Framework Convention on Climate Change.

<sup>10</sup> United Nations Convention to Combat Desertification.

<sup>11</sup> The Ramsar Convention on Wetlands.

<sup>12</sup> Convention on Migratory Species.

<sup>13</sup> UNESCO Convention concerning the Protection of the World Cultural and Natural Heritage.

Convention secretariats and respective national focal points should be encouraged. Initiatives by other institutions and processes (such as the G8 and Global Environment Facility) should also be encouraged. A flagship project could include an IPCC special report on the interactions between climate change, biodiversity and ecosystem services, and human wellbeing.

14 Inadequate human and societal capacity is a major impediment to the achievement of international biodiversity, climate change, and sustainable development objectives, particularly in developing countries. Efforts to establish and increase capacity for implementation of the international environmental Conventions would provide an opportunity for developing integrated capability at both the strategic and grass-roots levels. This will require the development of new mechanisms and methods for assessing progress against policy objectives, and best practice guides for policy development and implementation.

## Interactions between human livelihoods, biodiversity, and climate in terms of functions and impacts

15 Climate change is already disrupting species interactions and ecological relationships. Under future change ecological interactions will be disrupted and new species assemblages will be formed with unpredictable results. One of the consequences of changes in inter-species dynamics will be alteration of predator-prey and host-pathogen relationships many of which may impact on human health and productive sectors (eg agriculture, forestry and fisheries), with likely economic consequences. However, there has been very little research on the mechanisms or implications of such changes.

16 Shifts in the extremes of climatic parameters such as temperature and moisture will have an impact on biodiversity although it is difficult to predict to what extent because the ability of many species or ecosystems to respond to changes in climatic extremes is unknown. However, it is expected that many will not be able to adjust to the rate and magnitude of climate change expected over forthcoming decades. Improved understanding of how far these climatic parameters will shift, and the duration and variability of such shifts, will help to inform biodiversity impact assessments and may be useful for the development of remedial management plans. Palaeo-ecological studies may be useful for informing such assessments.

17 Increasing CO<sub>2</sub> emissions are also causing acidification of the world's oceans. Although all marine ecosystems may be affected by ocean acidification, coral reefs are likely to be most severely impacted with implications for biodiversity and for human livelihoods as many millions of people rely on coral reefs for subsistence, commercial and recreational fisheries.

## Communication

18 The interdependencies of the issues of climate change, biodiversity, and human livelihoods must be actively communicated to all levels and sectors of society. The messages are simple;

- climate change is unequivocal;
- adaptation is necessary to cope with inevitable changes;
- mitigation is essential to avoid most dangerous climate change;
- biodiversity is fundamental to human wellbeing and climate regulation and must be central to the development of adaptation and mitigation programmes.

19 Communicating success stories can be a powerful tool for encouraging positive action and the adoption of new practices. However, the urgency of these issues must be translated into terms that are meaningful to different groups in society. The impacts and benefits of taking action, and the costs of inaction, will have more resonance with society if these are communicated in a way that is directly relevant. This is particularly important at the grass roots level as it is here that biodiversity and ecosystems will be actively managed, and at this scale that human livelihoods will be most directly impacted by biodiversity loss and climate change.

20 The climate change community has been successful at communicating the complex science of climate change by using simple metrics to communicate the concepts. Communicating the complexity of the biodiversity issue has not had the same success. Policy makers rely on indicators representing different

aspects of biodiversity and no simple tools for communicating biodiversity have yet been agreed. Top level political agreement on the CBD 2010 target and subsequent endorsement at the World Summit on Sustainable Development (WSSD) and the UN General Assembly to significantly reduce the rate of biodiversity loss is a significant step. Now incorporated as a Millennium Development Goal, effort is needed to extend the focus beyond 2010 and to measure progress using strong science and the best data.

21 The 2006 UK Government Stern Report on the economics of climate change has had a major impact on decision makers around the world. However, the report did not reflect the full costs of climate change impacts on biodiversity and ecosystems. A more balanced treatment of the issues of climate change and biodiversity depends on a comparable economic assessment of the costs associated with biodiversity loss as agreed by the G8+5 Environment Ministers in the Potsdam Initiative - *Biological Diversity 2010* statement in March 2007.

## Research

22 An internationally strategic approach and wider mechanisms are required to coordinate long-term research on biodiversity, climate, and human livelihoods. These research communities must work more closely together as the exchange of data and other information will be fundamental for progressing research in these areas.

23 To improve our understanding of biodiversity in underpinning ecosystem structure and function, in climate regulation, and in human livelihoods, research into the mechanisms of biodiversity function in these contexts is essential. Biodiversity and climate change inter-relationships require further research and evaluation by the scientific community, and in particular, the hypothesis that systems with high biological diversity are more resilient to global change than less diverse systems requires testing.

24 By focusing research on ecosystems important in the climate system (eg peatlands) in areas where biodiversity is changing rapidly or at a large scale, or where there are major impacts on human livelihoods, we would increase our understanding of the mechanisms of change, feedbacks in the system, and effects of interactions of global change drivers. Palaeo-ecological information is not currently used to its full potential and may be helpful for improving understanding of how past climate change has affected biodiversity and for informing investigations into the importance of biodiversity for climate regulation.

25 Earth system models provide an important tool for understanding and assessing future climate change and its impacts. The accuracy of these would be improved by including key ecological and physiological processes and more sophisticated representation of the links between biodiversity and human-wellbeing. While it is unclear what level of complexity is required to improve the accuracy of these models it is possible to test model sensitivity to such information. Improved understanding of local and regional climate processes is required for informing climate change prediction and development of adaptation options. There is a similar need for biodiversity assessments. More powerful and sophisticated climate models will be required to undertake this work.

26 Development of scenarios for impacts on biodiversity and ecosystem services under different levels of climate change are necessary for informing the development of management priorities and would be helpful for identifying potentially dangerous levels of biodiversity loss.

## Next steps

27 At the meeting it was recognised that dealing with such a broad range of issues across both the scientific and policy communities is a significant challenge. Solutions will need to be innovative, socially inclusive, and immediate. An unprecedented level of cooperation will be required from all policy and scientific communities to act on the combined threats of climate change, continued biodiversity loss, and human livelihoods.

28 The outcomes from this meeting will be presented at a side event at CBD SBSTTA in July 2007 and a full meeting report will be launched in December 2007 at the UNFCCC Conference of the Parties in Bali, Indonesia.

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