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Working with Nature to Tackle Climate Change

Report of the ENCA / BfN Workshop on "Developing ecosystem-based approaches to climate change – why, what and how"

Federal Agency for Nature Conservation

BfN – Skripten 264

2010

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International Academy for Nature Conservation, Isle of Vilm, Germany (22 - 25 June 2009)

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Cover photo: Saltmarsh in the UK
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BfN-Skripten are not available in book trade but can be downloaded from the internet at:
http://www.bfn.de/0502_international.html?&no_cache=1

Publisher: Bundesamt für Naturschutz (BfN)
German Federal Agency for Nature Conservation
Konstantinstrasse 110
53179 Bonn, Germany
URL: http://www.bfn.de

Printed by the printing office of the Federal Ministry of Environment, Nature Conservation and Nuclear Safety.

Printed on 100% recycled paper.

Bonn, Germany 2010

Executive Summary

Globally and locally, the conservation and sustainable use of biodiversity and ecosystem services has the potential to make an important contribution to mitigating climate change and to help human societies adapt to its impacts. However, in the portfolio of approaches currently being used to tackle climate change, too little attention is given to the vital role ecosystem-based approaches can play in our efforts.

This report is based on the outcomes of a workshop which aimed to identify examples of how working with nature can help society to address climate change. The link to nature conservation goals - the key purpose of ENCA member institutions[1] – is twofold, as more effective climate policies will reduce the direct impacts of climate change on nature, and integrated approaches to the management of ecosystems will provide new opportunities for conservation. We found that existing examples of ecosystem-based approaches being implemented throughout Europe (and beyond) not only contribute successfully to reducing greenhouse gas emissions and enhancing sinks, and/or support societal adaptation, but also deliver a number of other benefits such as improved biodiversity conservation, livelihood opportunities or health and recreational benefits.

This suggests that frameworks and instruments are already in place which can support working with nature when implementing climate policy, and participants were able to identify a number of these. However, these do not seem to be implemented to their full potential, therefore, we also sought to explore the key barriers to action and to develop suggestions on how to overcome them. Often these barriers proved to be similar to the factors preventing adequate implementation of environmental legislation or those explaining the reluctance that some sectors of society still show towards adaptation – uncertainty, lack of information and administrative and political settings which prioritise short-term decisions and economic growth over long-term sustainability. Another key challenge is the lack of integration between policy concerning biodiversity and ecosystem services and climate change policy – in particular when it comes to implementation - as well as the fact that current administrative and financial structures in many European countries favour seemingly quick, easy-to-manage hard-engineered and technological solutions.

Ecosystem-based approaches not only deliver multiple benefits, but can also be cost-effective and easily affordable to communities. However, this is not to say that they are the only solution. In many cases, a portfolio of approaches will need to be implemented, including technology, engineering, community capacity building and behavioural changes as well as the appropriate management of ecosystems.

[1] The Heads of European Nature Conservation Agencies have established a network ("ENCA-Network") to strengthen nature conservation in Europe by enhancing cooperation between its members; further information at http://encanet.eu/

There is strong overlap between the drivers of climate change and those of biodiversity loss; for example land-use change, habitat degradation, non-sustainable agriculture, economic and infrastructure development and air pollution. We must work in synergy to address these underlying pressures and thereby improve the well-being of society overall. To effectively tackle biodiversity loss we also need to address climate change, yet equally we should tackle climate change while also addressing biodiversity loss.

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Acronyms and Abbreviations

ADP	Agricultural Development Programme
AEP	Agri-Environmental Programme
BfN	*Bundesamt für Naturschutz* (German Federal Agency for Nature Conservation)
CAP	Common Agricultural Policy (EU)
CBD	Convention on Biological Diversity
COP	Conference of the Parties
EBA	Ecosystem-Based Adaptation
EC	European Commission
ENCA	European Nature Conservation Agencies
EU	European Union
GEF	Global Environment Facility
GHG	Greenhouse Gas
IUCN	The World Conservation Union (International Union for the Conservation of Nature and Natural Resources)
NGO	Non-Governmental Organization
NWP	Nairobi Work Programme
SBSTA	Subsidiary Body for Scientific and Technological Advice (UNFCCC)
SBSTTA	Subsidiary Body on Scientific, Technical and Technological Advice (CBD)
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UNEP	United Nations Environment Program
UNFCCC	United Nations Framework Convention on Climate Change
WCMC	UNEP World Conservation Monitoring Centre
WGRI	Ad Hoc Open-ended Working Group on Review of Implementation (CBD)
WSSD	World Summit on Sustainable Development

Introduction

Climate change is one of the biggest challenges facing humanity. It is already causing adverse effects to natural and managed ecosystems, and to the operation of socio-economic systems, having both indirect as well as direct, impacts on human health and welfare. No country will escape these effects of climate change. Strong and immediate action is needed to reduce greenhouse gas emissions and to develop adaptation strategies to cope with the changes we cannot avoid.

International efforts to tackle both the causes and consequences of climate change are being further developed in the lead up to the next Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC-COP15) in Copenhagen. All sectors, including nature conservation, must play their part in working towards the goals of climate policy in an integrated and sustainable manner.

Globally and locally, the conservation and sustainable use of biodiversity[2] and ecosystem services has the potential to make an important contribution to mitigating climate change and to help human societies adapt to its impacts, whereas continued biodiversity loss and degradation of ecosystems is compromising these efforts.

In April 2009, the CBD Ad Hoc Technical Expert Group (AHTEG) on Biodiversity and Climate Change stated that: *"maintaining natural ecosystems (including their genetic and species diversity) is essential to meet the ultimate objective of the UNFCCC because of their role in the global carbon cycle and because of the wide range of ecosystem services they provide that are essential for human well-being*"[3].

This idea of working with nature to help society in addressing climate change is encapsulated in the concept of ecosystem-based approaches[4] to mitigation and adaptation.

There is strong overlap between the causes of climate change and of biodiversity loss; for example land-use change, habitat degradation, non-sustainable agriculture, economic and infrastructure development and air pollution. We must work in synergy to address these underlying pressures and thereby improve the well-being of society overall. To effectively tackle biodiversity loss we also need to address climate change, yet equally we should tackle climate change while also addressing biodiversity loss.

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2 The Convention on Biological Diversity (CBD) defines biodiversity as the variability among living organisms on the genetic, species and ecosystem level

3 See http://www.cbd.int/climate/

4 This is a relatively new concept which is being further defined and refined in the international community. See for example http://ec.europa.eu/environment/nature/pdf/discussion_paper_climate_change.pdf.

About this Report

Several aspects of the interrelationship between biodiversity and climate change are relevant to the tasks of the ENCA Network[5] and its members. There is a growing body of literature and discussion on all of these, and it is not our intention to repeat what has already been said. Rather, we have sought to contribute some of our own experience on the lessons to be learned from the perspective of European nature conservation agencies.

The members of ENCA play a key role in the management, conservation and restoration of ecosystems in Europe, as well as in the development and implementation of environmental policy. As such we have knowledge and expertise to support the development and implementation of ecosystem-based approaches to help addressing climate change, as well as ensuring that biodiversity and ecosystem services are in the best possible state to cope with climate-related impacts. Therefore it is important we explore the contribution that we, and nature conservation in general, can make to these objectives.

The workshop "Developing ecosystem-based approaches to climate change – why, what and how" brought together participants from ENCA members, NGOs and international organisations, and researchers to provide a wide range of experience and views. All participants attended in their personal capacity as experts on biodiversity and climate change. The findings presented here reflect the main ideas which emerged from the discussions, and do not necessarily mean that there was consensus on every individual point.

The purpose of this workshop was to share experience on how working with nature can help society as a whole to tackle the causes and effects of climate change, provide examples of where this is already happening in practice and lessons that can be learnt, and to contribute to the rapidly growing debate on the role of biodiversity and ecosystem services in framing and implementing climate policy. In particular we wanted to focus on activities in Europe as we feel that there is still too little recognition that working with nature is not just a concept relevant for addressing biodiversity loss and climate change in developing countries. Undeniably, it also has value, and indeed is vital, for modern, industrial societies in Europe and other parts of the world.

We also used the opportunity to exchange experiences and views on existing examples of adaptation activities that are undertaken with the primary goal of protecting biodiversity from negative impacts of climate change, and the way these activities are linked with and may contribute to societal adaptation as a whole.

The discussions and presentations at the workshop highlighted a number of key issues that Governments and their agencies should take into account when designing adaptation, mitigation

[5] The Heads of European Nature Conservation Agencies have established a network ("ENCA-Network") to strengthen nature conservation in Europe by enhancing cooperation between its members; further information at http://encanet.eu/

and nature conservation strategies. Besides recognition of the role of ecosystems in climate change adaptation and their value for societal response and development, major points were the need to protect and maintain biodiversity and ecosystem services under a changing climate, and to reduce and prevent damage to ecosystems through climate change-related action.

This report includes the results of the discussions which took place at the workshop as well as the case studies on either ecosystem-based approaches to climate change mitigation and adaptation that were provided by participants (Annex A), case studies on adaptation for nature conservation (Annex B), and summaries of all other presentations that were made relating to relevant international processes, scientific findings and ongoing activities in the field of biodiversity and climate change (Annex C). From the discussions, we drew out what we see as some key characteristics of ecosystem-based approaches as well as an initial overview of available tools and instruments to promote their implementation, existing barriers and ways to overcome them, and possible next steps on the way forward.

The Relationship between Biodiversity, Ecosystem Services and Climate Change

There are strong links between biodiversity, ecosystem services and climate change on many levels – via direct and indirect impacts (including impacts of human responses to climate change) and the role of ecosystem services both for general human well-being and in our efforts to tackle the causes and consequences of climate change.

As has been pointed out by the Millennium Ecosystem Assessment, the **components of biodiversity** (at the levels of genes, species and ecosystems) **form the basis for the provision of ecosystem services**, many of which are central to human well-being (see Figure 1). However, we cannot determine with certainty which specific genes, species, communities or ecosystems are critical for specific ecosystem services in a given situation. Added to this, changing climate conditions will undoubtedly change these relationships, and so losing any element of biodiversity is likely to reduce the potential for continued provision of ecosystem services. Thus, **any climate change-related measure or policy** – and indeed any other policy - that has negative impacts on biodiversity risks being counter-productive. All such policies and activities should therefore be carefully designed to **minimize negative impacts on biodiversity.**

This would apply to both technical and ecosystem-based options for mitigation and adaptation, since the latter, too, may involve trade-offs between different values and services of an ecosystem. There is a range of available tools to facilitate integrated, environmentally sound planning approaches, e.g. Strategic Environmental Assessment (SEA) and Environmental Impact Assessment (EIA) or the **Ecosystem Approach of the CBD**. The latter is a framework for the integrated handling of all types of management interventions (or non-interventions) that have impacts on a given ecosystem and has been described by the Conference of the Parties to the CBD through a set of guiding principles (see http://www.cbd.int/ecosystem/). Its applicability is very broad and care should be taken not to

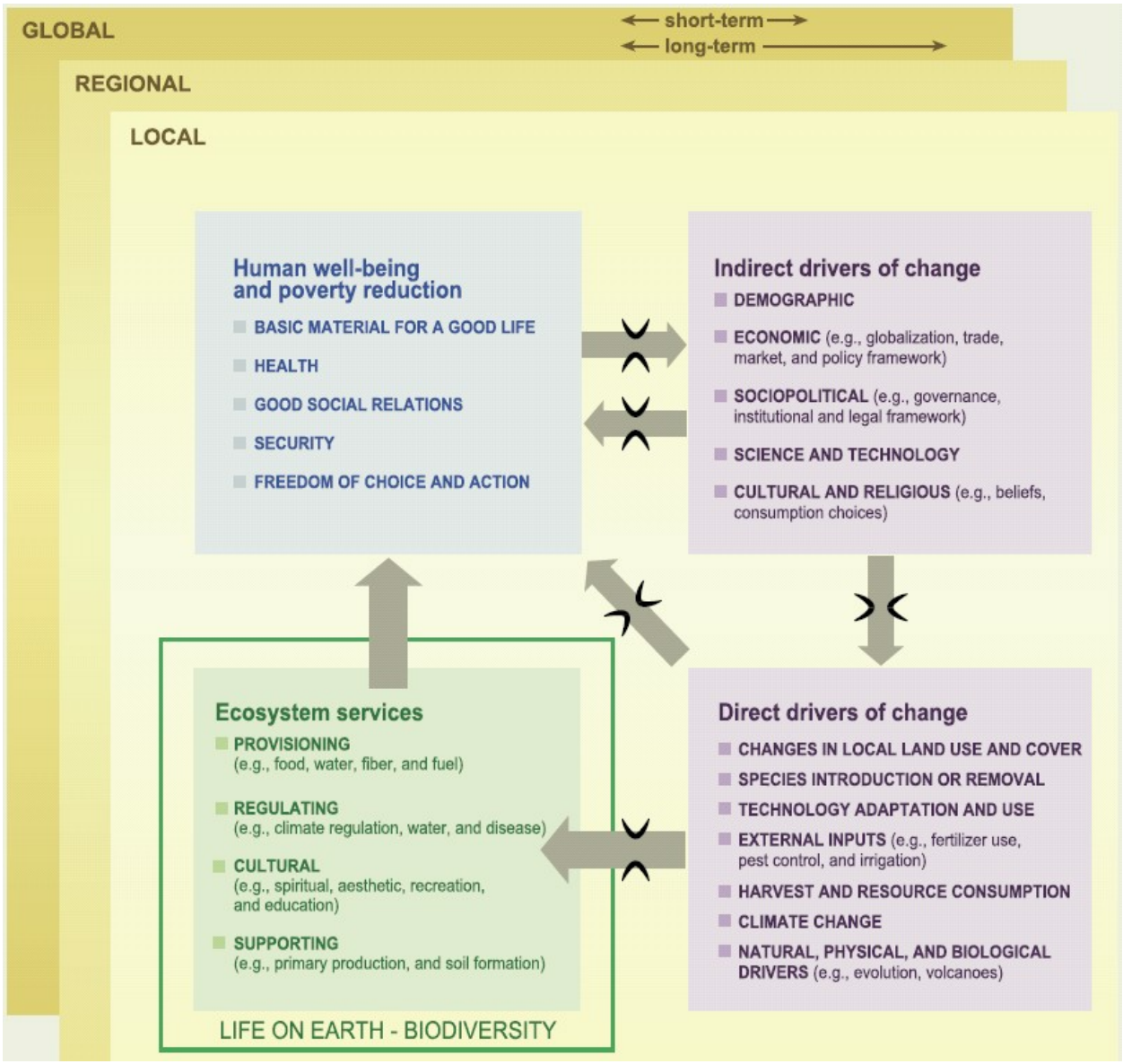

Figure 1: Relationship between biodiversity, ecosystem services and human well-being (Source: Millennium Ecosystem Assessment 2005)

confuse the Ecosystem Approach with the concept of ecosystem-based adaptation or mitigation approaches in this context.

Working with nature by protecting and sustainably managing biodiversity and ecosystem services can be a vital tool both for climate change mitigation and adaptation:

- The **protection of biodiversity and use of ecosystem services to contribute to mitigation** can include reducing emissions from Deforestation and Forest Degradation (REDD), conservation and restoration of wetlands and peatlands to retain carbon storage, protection of the vital ocean sink, improved grassland management and environmentally sound agricultural practices (Trumper *et al.* 2009).
- Ensuring the continued provision of ecosystem services and using their potential to deal with new problem situations is an indispensable component of **societal adaptation strategies to climate change.** The wide range of benefits and the underlying importance of the

environment to human society, and the wide range of human activities which involve the environment, emphasise that protecting and sustainably managing biodiversity and ecosystem services should be addressed as a cross-cutting issue.

In addition, conserving biodiversity in the face of climate change is an adaptation goal in itself, as the available scientific literature documents a high risk of significant climate-induced losses of biodiversity over the coming decades[6].

By way of their mandate, members of the ENCA Network have a particular interest in and expertise on **protection and adaptation activities aimed to conserve biodiversity and maintain ecosystem services.** Without healthy and resilient ecosystems the opportunities for working with nature to tackle climate change will not exist and the ecosystem services upon which human society depends will be severely compromised.

Examples of Ecosystem-Based Approaches in Practice

A key aim of the workshop was to identify existing examples of where working with nature is already helping society to tackle climate change, in particular in Europe – but also recognising that lessons can be learnt for Europe from activities in other parts of the world. Table 1 gives an overview of examples that were compiled by the participants. The case studies that were discussed in more detail during the workshop are described in Annexes A and B. They provide further information on some of the measures outlined in the table.

This compilation of examples is by far not complete, there are others and the range of examples is growing. It can be used by policy-makers and practitioners involved in adaptation to identify which ecosystem-based measures may be appropriate to address different climate change impacts.

Table 1: Climate change impacts and potential EBA activities in different sectors/of interest to different sectors

Climate change impact	EBA measures	References
Increasing flood risk	Reduce deforestation	Tollan 2002
	Increase space for rivers	DEFRA 2005, V&W 2006, Rohde *et al.* 2006
	Enhance water storage and retention capacity	Bredemeier & Schüler 2004
	Wetlands restoration	Hey & Philippi 1995, Acreman *et al.* 2007; Watts 2009 and Tanneberger 2009 in this volume
	Introduction of water tolerant crops (maintains vegetation cover in flood-prone areas)	Vij & Tyagi 2007
	Continuous crop cover	Dabney 1998, Meyer *et al.* 1999

[6] See e.g. http://ec.europa.eu/environment/nature/pdf/discussion_paper_climate_change.pdf; Rockström *et al.* 2009

Climate change impact	EBA measures	References
	(Re-)Creation of intertidal habitats that can together with hard structures buffer floods	Mander *et al*. 2007, Mazik *et al*. 2007
	Appropriate cultivation techniques in agriculture	Holland 2004, Harmel *et al.* 2007, Lal *et al*. 2007
	Urban Greening	Alexander 2006, Wilby & Perry 2006
More frequent and intensive heat waves	Urban greening	Wilby & Perry 2006
	Agroforestry – provide shade for crops and livestock	Jose *et al.* 2004; Eichhorn *et al.* 2006
More frequent and intensive storm events	Diversification of forest stands	Colin *et al.* 2008
Reduced precipitation/ increased risk of drought	Continuous cover crops	Joyce *et al.* 2002, Bodner *et al.* 2007
	No tillage	McGee *et al.* 1997, Papendick & Parr 1997, Hemmat & Eskandari 2006; many more examples from around the world
	Agroforestry improves water holding capacity of soils (but can be competitive in drought conditions)	Schroth 1998; Hirota *et al.* 2004
	Different stands in forestry (e.g. broad leaved trees vs. conifers), tree species composition	Noss 2001; Maracchi *et al.* 2005; Robledo & Forner 2005; Spittlehouse 2005; Wattenbach *et al.* 2007
	Removal of water thirsty invasives	Ferreira *et al.* 2000, Le Maitre *et al.* 2002, Coelho *et al.* 2005, RSA Working for Water programme (www.dwaf.gov.za/wfw/)
Increased risk of avalanches/ land slides	Conservation and restoration of protection forests	Höller 2007; Gret-Regamey *et al.* 2008
Increased erosion	Changed agricultural practices (e.g. no tillage)	Papendick & Parr 1997; Mickelson *et al.* 2001; Matson & Vitousek 2006; Lal 2007
	Restoration of peatlands/wetlands	ProAct Network 2008
	Managed realignment: Combined method, trialled in the UK	Pethick 2002; Wolters *et al.* 2005
Increased salinisation	Salt tolerant crops	Yamaguchi & Blumwald 2005
Sea level rise	Restoration of lost estuary habitats	US examples: Hammersmark *et al.* 2005, Hey & Philippi 1995; UK examples: Dixon *et al.* 2008, Thames estuary, UK, Managed realignment (Wallasea Island, Havergate Island UK)
Increased occurrence of pests	Introduction of natural predators Diversification of forest stands/crops	Noss 2001; Maracchi *et al.* 2005; Robledo & Forner 2005; Spittlehouse 2005
Decreased pollination	Help appropriate species move to the area	Hoegh-Guldberg *et al.* 2008; Willis *et al.* 2009

Characterising Ecosystem-Based Approaches to Tackling Climate Change

Following the presentations and discussions among the participants, we identified some characteristics that should be considered when taking decisions about ecosystem-based approaches to climate change mitigation and adaptation. These observations are designed to add to the ongoing discussions in this area[7] and to help practitioners evaluate the relevance of the concept to their own tasks and needs. It is understood that the concept has the potential to grow and evolve with increased scientific understanding of the role of ecosystems in societal adaptation as well as in mitigation, and lessons learnt from practice. The main focus of the discussion was on ecosystem-based adaptation, although many of the characteristics apply to mitigation projects as well.

The following points were made:

1. Ecosystem-based approaches to climate change should be based on natural ecosystems as well as those ecosystems intensively managed by humans. Relevant activities may include conservation of existing ecosystems, restoration of destroyed or degraded ecosystems or creation of "new" ecosystems (e.g. green spaces in urban environments).

2. Benefits from ecosystem based measures can become visible over different time scales. Some types of measures will yield results fairly quickly (e.g. managed realignment), while others will work in the medium or long term (e.g. changes in silvicultural practice).

3. Adaptation to climate change is urgently needed in many sectors of business and society, ranging from agriculture, forestry and water management to nature conservation and human health (see Figure 2). Ecosystem-based approaches can be applied across a large number of these sectors. Characteristically, a single ecosystem-based adaptation activity will often contribute to adaptation goals of several sectors, as the examples and case studies demonstrate. In many cases, the management of biodiversity and ecosystem services for mitigation also provides adaptation benefits at the same time and vice versa.

4. The management of biodiversity and ecosystem services for tackling climate change, if well designed, can also provide a number of wider benefits such as health benefits through reduced air pollution, improved livelihoods and improved productivity from agriculture. The potential for co-benefits to biodiversity conservation is often immediately apparent, and provides one of the strong arguments in favour of the approach. However, it is by no means a matter of course that such benefits will be realised, as the management of ecosystems to optimize carbon sequestration or certain adaptation services (e.g. water retention) may in some cases involve trade-offs with other services. Explicit consideration of all relevant functions and services of an

[7] See e.g. http://ec.europa.eu/environment/nature/pdf/discussion_paper_climate_change.pdf, Trumper *et al.* 2009

ecosystem will enable decision-makers to avoid such risks and enhance the overall contribution of mitigation and adaptation activities to human well-being.

5. Ecosystem-based measures should be designed and implemented in a case-specific manner, depending, among other factors, on geographic scale, stakeholders, biogeographic and climatic conditions. The results need to be monitored and reported to increase understanding and lessons learnt and document benefits.

6. Ecosystem-based approaches, with their multiple benefits, should be considered as part of a portfolio of measures that includes engineering and technological solutions, disaster risk reduction and building adaptive capacity. However, recognition of their potential contribution needs to be strengthened. Without the inclusion of ecosystem-based approaches to both mitigation and adaptation, society runs a high risk of not being able to deal adequately with the causes or consequences of climate change, leading to a reduction in the quality of life for all of society, in particular the poorest and most vulnerable[8].

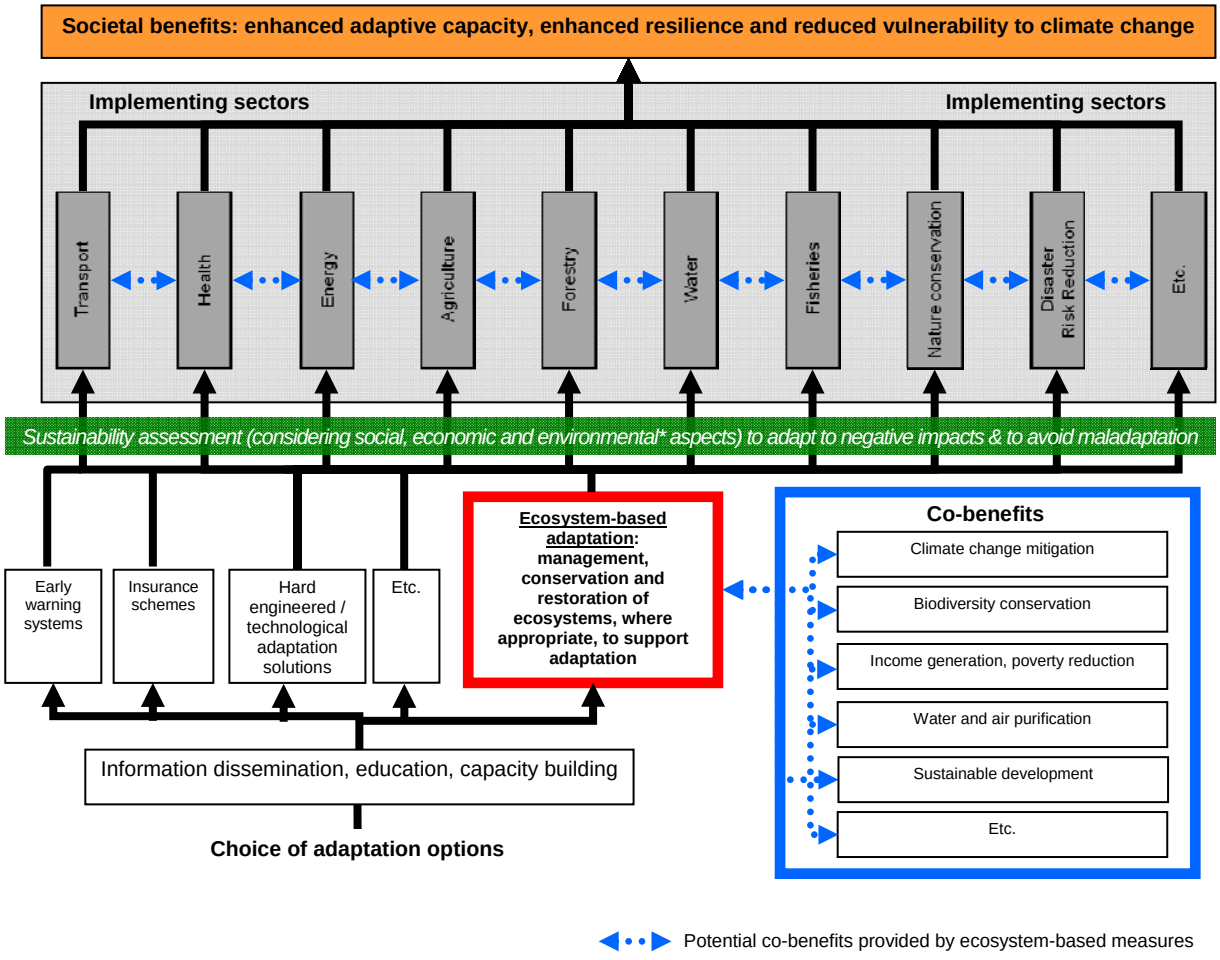

Figure 2: The role of ecosystem-based adaptation measures in an overall strategy for societal adaptation

[8] See e.g. http://ec.europa.eu/environment/nature/pdf/discussion_paper_climate_change.pdf

Possible Frameworks and Means for Implementing Ecosystem-Based Approaches

The workshop identified policies, legislation and other frameworks at international, European and national level that could support the implementation of ecosystem-based approaches to climate change mitigation and adaptation in different sectors, including biodiversity conservation. Again, the main focus of the discussion was on adaptation. The following overview is based on participants' experience, rather than on exhaustive research, yet may provide a useful guide to the range of requirements and opportunities for ecosystem-based approaches which already exist in current policy and legislation.

International Levers

- Action on climate change is driven by the **UNFCCC** which requires Parties to the Convention to take action on mitigation and adaptation, with the ultimate goal to achieve that the degree and rate of climate change is limited at a level which would allow ecosystems to adapt naturally, avoid threats to food production and enable sustainable economic development. Parties are also required to take measures to minimize negative economic, social or environmental impacts of their activities to mitigate or adapt to climate change. Thus, the availability of a wide range of appropriate methods and approaches (including ecosystem-based approaches) can help to increase the ability of countries to achieve these objectives. The Nairobi Work Programme and the Bali Action Plan include provisions for and encourage action on adaptation. Under the negotiations leading towards Copenhagen, a number of approaches are being considered in the context of adaptation, including ecosystem based approaches. It is hoped that these approaches will be explicitly supported in the expected Copenhagen agreed outcome. With regard to mitigation, the Convention requires Parties to promote conservation and sustainable management of sinks and reservoirs of greenhouse gases including terrestrial, coastal and marine ecosystems. More specific provisions for land use, land use change and forestry are contained in the Kyoto Protocol. It is expected that policy approaches and positive incentives on issues relating to reducing emissions from deforestation and forest degradation in developing countries (REDD) will become part of a Copenhagen agreement.
- The **Convention on Biological Diversity** (CBD) requires Parties to conserve biological diversity and use it sustainably, providing an additional rationale for ecosystem-based approaches which are often more likely to achieve this goal than engineered infrastructure methods. The Conference of the Parties to the CBD has taken a number of decisions on the subject of biodiversity and climate change, including urging Parties to take appropriate actions to address the impacts of climate change as well as the positive and negative impacts of climate change mitigation and adaptation activities on biodiversity. More recently it convened an Ad Hoc Technical Expert Group (AHTEG) on biodiversity and climate change to provide biodiversity-relevant information to the

UNFCCC, focusing on the interlinkages between the conservation and sustainable use of biodiversity and climate change adaptation and mitigation activities[9].

European Directives, Strategies and Frameworks

At the European level (both EU and more widely) there are a number of legislative frameworks and strategies which either explicitly promote or provide a basis for ecosystem-based approaches and interventions in biodiversity and ecosystem services management to increase resilience of natural systems and maintain their value for climate change mitigation and adaptation:

- The **Bern Convention**, which has been signed by all ENCA member countries, has made a number of recommendations and provided practical guidance on the protection of biodiversity in the face of climate change. In a recent recommendation, the Standing Committee encouraged Contracting Parties to take care that adaptation and mitigation measures conform with biological diversity conservation, and to raise awareness of the large potential for synergies when addressing biodiversity loss and climate change in an integrated manner.
- The EU White Paper on Adaptation to Climate Change published in April 2009 highlights the important role biodiversity and ecosystem services can play in supporting societal adaptation. Cross-sector and integrated approaches are identified as a crucial characteristic of successful adaptation, along with the importance of both national and sub-national action.[10]
- The EU Ad Hoc Working Group on Biodiversity and Climate Change has recently produced the discussion paper "*Towards a strategy on climate change, biodiversity and ecosystem services"*, which provides a series of recommendations on how to better integrate activities on biodiversity and climate change in order to promote ecosystem-based approaches.[11]

A large number of EU Directives and Strategies offer a foundation on which to promote ecosystem-based approaches to climate change, and increased resilience of ecosystem services and biodiversity. While some may not refer directly to climate change or adaptation, they nevertheless provide concepts, requirements or funding opportunities which are highly relevant for achieving integrated and sustainable management of ecosystems – for example the catchment-based approach of the Water Framework Directive. The following is a non-exhaustive list of strategies and directives which may be useful tools in this regard:

- Water Framework Directive: promotes good ecological status which helps maintain water quality (threatened by temperature rises, increasing low water periods and floods)

[9] Secretariat of the Convention on Biological Diversity (2009). Connecting Biodiversity and Climate Change Mitigation and Adaptation: Report of the Second Ad Hoc Technical Expert Group on Biodiversity and Climate Change. Montreal, Technical Series No. 41, 126 pages; URL: http://www.cbd.int/doc/publications/cbd-ts-41-en.pdf

[10] ENCA has produced a statement setting out its views on the EU white paper. Available at http://encanet.eu/home/uploads/media/Statement_ENCA_2_2009_CCA.pdf

[11] see http://ec.europa.eu/environment/nature/pdf/discussion_paper_climate_change.pdf. This paper also sets out a number of actions that each sector could or should take to support the integration of biodiversity and climate policies (p33).

and limit unsustainable abstraction; takes a catchment-based approach to the management of water-related activities.

- Floods Directive: demands establishment of flood risk management plans that take account of costs and benefits of measures, potential flood water retention areas, soil and water management, spatial planning, land use and nature conservation.
- Water Scarcity and Drought Strategy: addresses the need to reduce water demand and it provides some levers for ecosystem-based approaches, e.g. recommendation to improve land use planning and support sustainable agriculture in water-stressed river basins.
- Habitats and Birds Directives: establishment of protected sites and species protection throughout the natural ranges of species, increasing the resilience of biodiversity and protecting a wide range of ecosystem services.
- EU Biodiversity Strategy and Action Plan: the Action Plan demands measures to substantially strengthen the resilience of EU biodiversity to climate change and to ensure that climate change adaptation or mitigation activities deliver biodiversity benefits; the Action Plan's mid-term assessment underlines the need for better recognition of the critical role of healthy ecosystems in strengthening resilience to environmental stresses and the need to maximize synergies between climate change mitigation and adaptation measures, and the conservation and sustainable use of biodiversity.
- Common Agricultural Policy (CAP) and rural development funds: Agri-environment schemes can play a vital role in both protecting or enhancing ecosystem services and improving the resilience of biodiversity and communities to climate change. With a review proposed for 2013 it will be crucial to ensure ecosystem-based approaches (e.g. agricultural practices which contribute to soil and water conservation) are supported by future agricultural and rural development funding.
- Structural and Cohesion funds: can be used to promote and finance ecosystem-based approaches. Given the multiple benefits that ecosystem-based approaches bring, these can further strengthen the goals of promoting economic development and reducing the vulnerability of the poorer regions of Europe.
- Environmental Impact Assessment and Strategic Environmental Assessment: these tools for the appraisal of projects and plans can ensure that major projects are more resilient to future climate change by including the use of ecosystem-based approaches to ensure a high level of sustainability.
- EU Soil Thematic Strategy: recommends the protection and sustainable use of soils and the restoration of degraded soils, taking into account all the functions that soils can perform.
- EU Forestry Strategy: emphasizes the importance of the multifunctional role of forests and sustainable forest management for society.
- Common Fisheries Policy: aims to progressively move towards a long-term, scientifically sound and ecosystem-based approach to fisheries management.

- Marine Strategy Framework Directive: promotes good environmental status of EU marine waters and the integrated management of human activities.

National level

While legislative frameworks and policy processes vary across Europe, there are a number of common tools and opportunities which can be used in all countries to promote the concept of working with nature to tackle climate change, at the national and sub-national level.

- National legislation supporting EC legislation: in the process of transposition of EC directives and strategies into national law and in their implementation, national governments, legislators and authorities can identify opportunities to promote ecosystem-based approaches, for example with the implementation of the Water Framework Directive or through use of article 10 of the Habitats Directive.
- National Adaptation Strategies: a number of European countries now have national adaptation strategies and are developing implementation and action plans. Some countries, such as the UK also have Climate Change Laws. The implementation and further development of these laws and strategies is an ideal opportunity to promote ecosystem-based approaches as a cost-effective and sustainable means of compliance.
- Spatial planning: Ecosystem-based adaptation in particular needs effective support from the spatial planning system – which exists in all countries. For example requirements for integrated urban green space could be built into planning requirements for new developments as has been done in some instances in the UK.
- Development assistance to EU Overseas Territories and other developing countries should promote and include use of ecosystem-based approaches where appropriate.

Potential Challenges and Ways Forward

Despite the wide range of tools and frameworks available and the increasing evidence of clear benefits from ecosystem-based approaches, there is still only poor uptake of these approaches and actions that promote biodiversity and ecosystem service resilience. From the case studies and the experience of the participants, we have undertaken an initial analysis of those barriers and challenges and the means to address them (see table 2).

Table 2: Challenges and Means to Address Ecosystem-Based Approaches

CHALLENGES	**POTENTIAL SOLUTIONS**
Institutional Barriers	
Political and economic cycles are often short-term and focused on quick, current practice-fixes (such as hard engineered solutions), the long-term costs and benefits of different approaches can be seen as irrelevant to the decision-makers of the time	Start by promoting those ecosystem-based approaches which can bring quick wins (e.g. reduced drainage of wetlands or easy-to-implement changes in agricultural production methods) Reinforce the role of sustainability assessment to promote long-term thinking
There is poor implementation and enforcement of existing environment-related legislation, much of which (as identified above) could play a role in supporting ecosystem–based approaches for adaptation and mitigation.	Raise awareness of importance (and multiple benefits) of environment, biodiversity and ecosystem services, to influence priority setting and enforcement
Governance and integration of adaptation across institutions, sectors or territories at various scales is still in its infancy, posing problems for ecosystem approaches which are often local in nature, but require national and/or transboundary co-operation	Use opportunities of national adaptation strategies to promote integration mechanisms across institutions, sectors or territories Use of EU funding mechanisms for transboundary activities such as Interreg to promote co-operation across borders and provide demonstration projects Raise awareness of ecosystem-based approaches and the need for new forms of co-operation with governments, stakeholders and relevant parties on all levels

Dealing with scientific uncertainty and shortage of information	
Lack of well documented examples of ecosystem-based approaches or monitoring of their effectiveness	Review existing conservation and ecosystem management work to identify adaptation and mitigation benefits which may not have been the driver for the project and thus may not be monitored directly Collate current examples of ecosystem-based approaches
Decision-makers, politicians and the public have little understanding of and confidence in the benefits of ecosystem-based approaches, especially in Europe where they are less common	Ensure studies of ecosystem-based approaches are presented in ways accessible to decision-makers, including taking them to see projects for first-hand experience Better quantification of the benefits of ecosystem-based projects so that their benefits can be widely disseminated using case-studies from existing projects, including through the media Outline multiple benefits which can be achieved from using ecosystem-based approaches Emphasise mitigation potential of ecosystem restoration and management
Novelty of ecosystem-based approaches means that there is a lack of information and data on the benefits, costs and effectiveness of this approach. This makes it difficult to undertake cost-benefit analysis and other assessments which are often required for funding and policy decisions.	Promote and facilitate research on the economic costs and benefits of ecosystem management to address climate change Use available environmental costing methodologies to assess the value of existing projects Ensure long-term monitoring programmes of activities related to biodiversity and ecosystem services include variables relevant in the context of climate change to enable the collation of evidence on the costs and benefits of ecosystem-based approaches

Uncertainty around the consequences of climate change is often used as a reason to delay action	Emphasise the importance of risk-management approaches and demonstrate that we already work with uncertainty in a number of areas Highlight the impacts that climate change is already having and the need to take action to address those
Working across sectors	
Ecosystem-based approaches often require cross-sector working, which is challenging in part due to the sectoral organisation of institutions, funding mechanisms etc.	Emphasize the benefits ecosystem-based approaches can bring to other sectors (for example urban greenspace can also reduce energy costs for buildings due to its cooling effect) Promote cross-sector partnerships through national adaptation strategies and ear-marked funds for integrated activities
Adaptation goals in different sectors may conflict, and environmental objectives are often given a lesser priority than economic ones.	Identify and promote 'win-win-win' solutions (see Paterson, Annex A) Use impact assessment tools to help manage conflicts Ensure that the full value of biodiversity and ecosystem services is considered in decision-making processes and assessment frameworks, in order to reflect the true costs and benefits of different options for action; this can be supported e.g. by developing and promoting simple methodologies for incorporating the value of biodiversity and ecosystem services in cost-benefit analysis

Climate policy and policy related to biodiversity and ecosystem services lack integration at the strategic level, making it hard to identify synergies and implement such policies in a synergistic manner	Promote collaboration between decision-makers from both fields of policy through personal contact and joint development of options for action (both formal and informal). Highlight the synergies to be gained from integrating climate and biodiversity and ecosystem services policies
Cultural barriers	
Perceived roles of nature managers, farmers, businesses and other compartmentalized sector stakeholders. This leads to a lack of trust and understanding and entrenched positions.	Use existing funding mechanisms (for example agri-environment schemes) to promote the development of partnerships Ensure provision of accessible advice and information for stakeholders, including examples of good practice, to demonstrate the benefits of working with nature Increasing interest in corporate social responsibility and sustainability can provide opportunities to implement ecosystem-based approaches

Unwillingness to change established behaviours and practice favours business-as-usual approaches	Present information on the benefits of working with nature in a way that appeals to decision-makers and stakeholders (e.g. by linking information on cost–benefit ratios to examples demonstrating ease of application) Use existing (and influence emerging) strategies, regulations and incentives from the field of climate policy to promote behaviour change (e.g. including release and sequestration of carbon through ecosystem management activities in cap and trade schemes to incentivize emissions reductions) Use window of opportunity when hard structures serving adaptation purposes come to the end-of-life to promote replacement with ecosystem-based approaches using innovative funding mechanisms
Largely private land ownership and historical rights may prevent new approaches and addressing community interests	Undertake targeted awareness-raising about benefits of ecosystem-based approaches, e.g. through community meetings Promote involvement and transparency by identifying specific targets where necessary Secure adequate funding for preparatory processes to engage both private landowners and the wider community
Cultural and organizational inertia resulting from expertise and skills being historically focused on delivering engineered solutions (e.g. within coastal defence agencies a high proportion of staff will have an engineering background and few have expertise relating to ecosystem management)	Build capacity of decision-makers by providing easily accessible information and first-hand experience for alternative approaches Promote ecosystem-based approaches in educational and other professional development institutions in all sectors for which “business as usual” may favour unsustainable practices

Administrative and Financial challenges	
Available funding streams may be inflexible and targeted for the delivery of engineered solutions such that a combination of ecosystem-based approaches and engineered solutions is more difficult to fund	Make decision-makers who design funding streams aware that ecosystem-based approaches are cost-effective and deliver societal benefits, and should therefore be as eligible for funding as hard engineering approaches. Promoting ecosystem-based approaches is not about requesting more money for conservation!
One-off availability of funding to address adaptation issues may favour engineered approaches due to a greater need for continued management in the case of ecosystem-based approaches, difficulties of obtaining on-going funding, and/or uncertainties related to the amount of future maintenance costs	On-going funding programmes are needed to retain longer-term ecosystem-based schemes, incorporating a longer evaluation and returns period.
Perverse incentives promoting short-term unsustainable actions (e.g. promotion of irrigation infrastructure in areas with decreasing ground water availability)	Policies and programmes should be checked for climate resilience and environmental impact over the long term, basing the assessment on principles of sustainable adaptation and applying the Ecosystem Approach to ensure adverse impacts on biodiversity and ecosystem services are avoided.

Recommendations

The sharing of experiences, knowledge and case studies at the workshop highlighted the major contribution that ecosystem-based approaches can make to help society cope with climate change. The multiple co-benefits of nature-based approaches also led participants to identify the following recommendations to promote ecosystem-based approaches as an important component in addressing climate change for society across the globe.

- The Copenhagen agreement must include recognition of the role ecosystem-based approaches can play in implementing mitigation and adaptation activities; and recognise the need for financial and capacity building mechanisms to support such approaches.
- Governments, supported by statutory agencies and other decision-makers, should implement ecosystem-based approaches at national and sub-national level without delay, taking particular care to avail themselves of the opportunities for synergies between mitigation and adaptation as well as for co-benefits to biodiversity conservation and other societal interests.
- Society and governments should take immediate action to conserve and restore terrestrial and marine biodiversity and ecosystem services, because these provide the basis for cost-effective adaptation and mitigation, as well as being essential for ongoing societal security. This includes enhancing the natural adaptive capacity of species and ecosystems to climate change and reducing other, non-climate stresses (such as pollution, habitat loss and degradation).
- There are some similar underlying causes to biodiversity loss and climate change - for example land-use change, industrial development and habitat degradation. This reinforces the need to address climate change, biodiversity and ecosystem services in an integrated manner, at international, national and regional scales. Ignoring the co-benefits of this approach, and of cross-sector partnerships, will make both goals much harder to achieve.

Conclusions and Next Steps

The workshop was convened in recognition of the need for further guidance and the identification of practical examples of how working with nature helps society to meet its climate change goals. We focused on experiences which demonstrate successful action in Europe, both because this is where the ENCA agencies work and because understanding and engagement with these types of approaches to adaptation and mitigation is still limited in Europe as compared to other regions.

Our discussions confirmed that ecosystem-based approaches can be cost-effective, easily affordable to communities and will often deliver multiple benefits beyond climate change

goals. A key challenge to their implementation is the lack of integration between policy on biodiversity and ecosystem services and climate change policy – in particular when it comes to implementation of such policies - as well as the fact that the current administrative and financial structures in many European countries favour seemingly quick, easy-to-manage hard-engineered and technological solutions. This is not to say that ecosystem-based approaches are the only solution. In many cases, a portfolio of approaches will need to be implemented, including technology, engineering, community capacity building and changes of behaviour. Currently, though, too little attention is given to the role of biodiversity and ecosystem services in this portfolio: this must change.

Support from and implementation by European countries will also help to raise the profile of these approaches in the international community and move the climate change agenda forward to deliver both mitigation and adaptation more effectively.

In order to continue to build momentum on this topic and support developments at international and European level, it was suggested that ENCA and its members should undertake a number of actions (below) and will continue to work in partnership with the broader community that is evolving around the issue:

- ENCA agencies can play a leading role in promoting the opportunities for ecosystem-based adaptation activities and to increase understanding and knowledge of possible measures.
- ENCA should support the development of practical actions to deliver ecosystem-based approaches in our own countries where appropriate.
- ENCA should contribute to the collation of case studies in the European biodiversity Clearing House Mechanism developed by the EEA, as well as in the CBD database on ecosystem-based adaptation.
- When the EU Adaptation Clearing House Mechanism is established, ENCA can also ensure that case studies are provided there for the benefit of adaptation practitioners.
- It would be particularly helpful if ENCA could undertake a meta-analysis of the case studies and their success factors to provide practitioners with more technical guidance.
- We encourage ENCA to contribute to the Nairobi Work Programme, e.g. by becoming a partner in it and providing relevant information.

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ANNEX A

CASE STUDIES ON ECOSYSTEM-BASED APPROACHES FOR ADAPTATION TO AND MITIGATION OF CLIMATE CHANGE

The Adoption of No-Till or Low-Till Cultivation in Arable Agricultural Systems

JAMES PATERSON

Background

No-till agriculture is a cultivation system designed to reduce the number of cultivation passes in an arable crop rotation. In normal arable systems, after harvest the stubble field is usually ploughed to invert the topsoil layer; further cultivation is then required to create a fine, friable seedbed ready for drilling the next crop. This process reduces soil organic matter and often leaves unvegetated earth exposed during the winter months. No-till is a truly pan-European strategy and could be adopted in arid agri-ecosystems in the south as well as temperate regions.

Intervention

Farmers, local authorities (there are examples of local authorities getting involved with farmers to promote sustainable farming to reduce the impacts of floods downstream); governments and EU (incentives); insurance companies may start to get involved at the farm scale, too.

Drivers for Change

Increasing incidence of drought may force farmers to adopt no-till practice; also, flood impacts may encourage local authorities to get more involved.

Adaptation Outcome

Maintain or increase crop yield in drought incidences; reduce soil erosion from excessive water run-off.

Socio-Economic Benefits

Reduce energy inputs; increase farm profits.

Environmental Benefits

Reduced erosion, soil water runoff, pollution; increased soil biodiversity, increase vegetation biodiversity

Sustainability / Funding

Very sustainable, particularly as no-till could improve profitability for farmers; possible funding could come from EU CAP if the scheme evolves to incorporate climate change mitigation-adaptation benefits.

Barriers / Lessons Learnt

Careful implementation is required – needs knowledgeable management and is not an easy fix. Education and guidance is essential for appropriate implementation

Conclusions

No-till cultivation offers numerous opportunities to adapt to various aspects of climate change and is a feasible and viable course of action for many farmers. Careful implementation is required but this can be overcome by adequate training and guidance. The benefits for below-ground and above-ground biodiversity can be significant both on site and off site.

Wallasea Island Wild Coast Project – Benefits for Biodiversity, Flood Defence and Recreation

OLLY WATTS

Background

The RSPB's Wallasea Island Wild Coast Project is a 700-ha multifunctional coastal wetland which includes 400-ha of intertidal habitat, created behind currently unsustainable sea defences.

Intervention

The scheme will convert a large area of arable farmland back to coastal wetland. The plan comprises five 'cells', one of which has the potential to act as a flood storage area and help reduce flood risk across the estuary on large surge tides. Before the intertidal habitat is created, land levels will be raised behind the current seawalls, through the beneficial use of inert, recovered, tunnelled material from the London Crossrail project (a new rail link across London). This will minimize any potential detrimental effects on the rest of the estuary caused by a large increase in the volume of water entering and leaving it. Wide, gently sloping, higher areas of land between individual cells will be managed as 'sea level rise adaptation zones'. These are designed to help ensure that a range of intertidal habitats continue to be present at a range of higher sea levels.

Drivers for Change

Sea level rise, unsustainable coastal defences, and loss of coastal intertidal habitat

Adaptation Outcome

Sustainable multifunctional wetlands providing wildlife habitat, flood protection, recreation and tourism. Without this intervention, natural breaching of the existing flood defences during storms is predicted to lead to significant flooding of the island, and increased stress on coastal defences elsewhere on the adjacent estuary.

Socio-Economic Co-Benefits

New recreational and educational resources, including several kilometres of new footpaths. Also uses spoil from a major engineering project (Crossrail).

Environmental Co-Benefits

The newly created coastal habitats will help offset historical and predicted future losses of coastal habitat, and address future flood protection risks. It will also have the potential to act as a carbon sink. Without this intervention, natural breaching of the existing flood defences during storms is predicted to lead to significant flooding of the island, and increased stress on coastal defences elsewhere on the adjacent estuary.

Sustainability / Funding

Material for raising land level gained from spoil from Crossrail project. The functioning wetland replaces existing hard engineered flood defences.

Project partners include Crossrail and the Environment Agency.

Conclusions

The Wallasea Island Wild Coast Project is the largest and most important coastal habitat creation scheme in Europe, close to the Thames Gateway, Europe's largest growth area.

Figure 1: The Wallasea Island Wild Coast Project – aerial view

The Role of Ecosystems in Adaptation Strategies: Islands on the Water Experiences[12]

YABANEX BATISTA

Introduction

Climate change is already affecting human communities everywhere and is altering the function of ecosystems and the ecosystem services upon which all humans depend. Islands, coastal areas and its communities are particularly vulnerable to climate change and are in the front line of current and future impacts. Sea-level rise threatens the very existence of low-lying island. As sea level increases, sea water intrusion into freshwater sources, including ground water, will affect the limited water supplies islands can access. Increasing sea temperatures are already causing coral bleaching, which affects the livelihoods of many costal communities and fisheries industry. The increased severity of storms and other natural disasters related to climate change also pose increasing challenges.

Ecosystem and the services these provide are an angular piece of the many adaptation strategies and actions that will need to be adopted as the world adapts to climate change. This case study focuses on the experience in the Kimbe Bay area in Papua New Guinea in which both human needs and principles of coral reef resilience to withstand impacts from climate change are incorporated in the design of a marine protected area network, and how this can be applied in the wider regional and international context.

The Coral Triangle Initiative: Island and Costal Nations Take Action

Since 2006, three important initiatives; the Micronesia Challenge, the Caribbean Challenge and the Coral Triangle Initiative have been launched to take concerted and concrete action on safeguarding and minimizing the degradation of the natural resources upon which these regions depend. The three initiatives recognize that without the incorporation of climate change considerations into their ecosystem conservation strategies, the communities that depend on these

The Micronesia Challenge
In 2006, five Micronesian governments—the Federated States of Micronesia, the Republic of Palau, the Republic of the Marshall Islands, the U.S. Territory of Guam, and the U.S. Commonwealth of the Northern Mariana Islands—joined together in committing to effectively conserve at least 30% of the near-shore marine resources and 20% of the terrestrial resources across Micronesia by 2020.

The Caribbean Challenge
Launched at the 9th Conference of the Parties to the Convention on Biological Diversity in 2008, it is a commitment by eight Caribbean nations — Antigua & Barbuda, Bahamas, Dominican Republic, Grenada, Jamaica, St. Kitts & Nevis, St. Lucia and St. Vincent & the Grenadines —to expand their marine near shore area under protection to 20% and develop conservation finance mechanisms to support national systems of protected areas by 2020.

[12] Acknowledgements
TNC: Rod Salm, Alison Green, Gerald Miles, James Hardcastle, Paul Lokani, Trevor Sandwith, Chrissy Shwinn and many more
Coral Triangle Initiative www.cti-secretariat.net
Micronesia Challenge www.micronesiachallenge.org
Caribbean Challenge http://www.nature.org/initiatives/protectedareas/features/art24943.html

resources and their national economies will not be able to cope with the current and future changes.

The Coral Triangle Initiative on Coral Reefs, Fisheries and Food security (CTI) was launched in May 2009 during the World Ocean Conference (Manado, Indonesia) by Indonesia, the Philippines, Malaysia, Papua New Guinea, Salomon Islands and Timor Leste as a joint effort among countries and partners to safeguard the important marine resources and ecosystem services provided by the regions inhabitants and the country's economies.

Stretching for 5.7 million km² and across six countries, the Coral Triangle is home to the highest diversity of marine life on earth, with over 75% of known coral species, over 30% of the world's coral reefs, over 3,000 species of fish, and the greatest extent of mangrove forests of any region in the world. These extraordinary marine biological resources directly sustain the lives of over 120 million people and benefit millions more worldwide, supporting the by providing direct livelihood, income and food security benefits; supporting the multi-billion dollar fisheries industry; and contributing to a growing nature-based tourism industry; among others benefits.

The Coral Triangle has endured as a global refuge for coral reefs over numerous previous climate changes. In the past, when the seas warmed and cooled and sea levels rose and fell, the reefs of the Coral Triangle survived and passed coral larvae along ocean currents to give life to new reefs over vast tracts of the Indo-Pacific, including the iconic Great Barrier Reef. The future of many of the world's coral reefs depends in huge part on the survival of reefs in the Coral Triangle.

MPA Design Resilience Principles

Effective Management
Protect reefs from direct threats such as boat and diver damage, pollution, sedimentation, and destructive fishing (including overfishing) and keeping them healthy. The healthier the reefs, the more resilient the corals are, the greater the chance of successful recruitment, and the more likely they will be to bounce back after a catastrophic event.

Representation and Replication
Protection of multiple examples of the full range of coral habitat types, including critical habitats of target species reduces risk. Replication of each habitat type at multiple locations reduces the risk of any one type being totally lost during a major bleaching event or hurricane, for example.

Critical Areas
Protection of reef communities that are naturally positioned to survive global threats because these are protected by such environmental factors as natural cooling, shading, screening, and any other factors that help corals become stress hardened as well as internal factors resulting from the genetics of the corals, and others. These refuges provide secure and essential sources of larvae to enhance the replenishment and recovery of reefs damaged by bleaching, hurricanes, or other events.

Connectivity
Understanding how and where the larvae of corals and other reef species are distributed enables managers to identify source and sink reefs and to link these into a network of protected areas that is mutually replenishing. In this way, coral habitats that are damaged by bleaching or other causes can be repopulated by larvae from healthy reefs that are positioned up current. Connectivity should also be considered among reefs and neighboring habitats, especially seagrass beds, mangroves, and back-reef lagoons that provide important fish nurseries and nutrients, and watersheds and adjacent coastal lands, which are sources of freshwater, sediments and pollutants.

Kimbe Bay: Resilience in Practice

Kimbe Bay in Papua New Guinea, and part of the Coral Triangle, is home to thousands of people who rely on its coral reefs for their food and livelihoods. Like many coastal areas around the world, Kimbe Bay's rich marine biodiversity also suffers from the impacts of climate change: warmer ocean temperatures and rising sea levels. In the face of climate change,

local communities in Kimbe Bay will need lasting ecosystem-based adaptation approaches that help maintain and/or restore the integrity of natural ecosystems so that these can continue to provide for their livelihoods and protect against an ever-changing climate.

Working with partners in Kimbe Bay, Papua New Guinea, The Nature Conservancy (TNC) has designed one of the first marine protected area networks that incorporates both human needs and principles of coral reef resilience to withstand impacts from climate change. Applying the resilience principles briefly described in the box on the right, the MPA design captures reefs with high biodiversity, high coral cover and areas known to be resistant to bleaching. The risk to climate change is spread by including at least three examples of all different reef types (inshore and offshore reef systems of different kinds, like the inshore fringing and patch reefs seen here, as well as from both the east and west sides of the bay because they have different levels of exposure to waves and currents and different assemblages of coral and fish species). The design also addresses connectivity by the size and spacing of the MPAs: the MPAs are large enough to be self seeding for the species whose larvae do not move far and are spaced close enough for the longer distance dispersers.

TNC and partners are now working to implement the MPAs and strengthen the legal framework for the network. With the assistance of local communities, management plans are being completed for Tarobi and Lolobau, two of the 14 areas identified in the MPA design. By the end of 2009, partners hope to implement half of the MPA design. Local government and TNC are also working on local legislation that will allow local communities to enforce the protection of their marine areas. As TNC and its partners strive to create effectively managed, large-scale and resilient MPAs, the lessons learned in Kimbe Bay will help ensure the survival of coral reef ecosystems in other areas.

Enhancing Connectivity across the Pacific

The Kimbe Bay approach is now being replicated across the Coral Triangle and beyond. As a global refuge for corals, the Coral Triangle is connected along the flow of ocean currents to other reef systems across the Pacific. By establishing resilient MPA networks through Micronesia across the stepping stones of the Pacific to Hawaii, which is an end point in coral distribution and relies heavily on imported larvae for the survival of its reefs, and to Palmyra, which is the last stop and jumping off point for larval connectivity to the west coast of Central America, The Nature Conservancy hopes to contribute to coral reefs ecosystems resilience across the Pacific in the face of climate change, and to the sustainable livelihoods of the communities that depend on these resources for their survival.

Restoring Peatlands and Applying Concepts for Sustainable Management in Belarus – Climate Change Mitigation with Economic and Biodiversity Benefits

FRANZISKA TANNEBERGER

The drained peatlands of temperate Europe (especially Germany, Poland, Belarus, Ukraine, and Russia) constitute an important source of greenhouse gas (GHG) emissions and are – after Southeast Asia – the second most important global hotspot in this respect (PARISH *et al.* 2008). Moreover, drainage and subsequent peat exploitation and land reclamation have caused a massive loss of biodiversity. In Belarus, more than half (1,505,000 ha) of the total of 2,939,000 ha of peatland (= 15% of the total land area) are drained (TANAVITSKAYA & KOZULIN 2008). Since the beginning of the 1990s, socio-economic changes and soil degradation have led to a declining use of drained peatlands in Central Europe and ambitious peatland rewetting programmes are currently being implemented.

A new large peatland restoration project started in September 2008: "Restoring Peatlands and applying Concepts for Sustainable Management in Belarus - A Climate Change Mitigation project with Economic and Biodiversity Benefits (THIELE *et al.* 2009). The project builds on the peatland restoration experience of a UNDP-GEF project and aims at rewetting 15,000 hectares of drained peatland, therewith avoiding the emission of an estimated 100,000 to of carbon dioxide equivalents per year. Preparations for further peatland restoration projects in Belarus, Ukraine and Russia are currently underway.

The socio-economic benefits expected from the project include at the national scale the income from the sale of carbon credits on the voluntary market and at a local and regional scale the (short-term) participation of engineering companies etc. in restoration work and the (long-term) sustainable use of the biomass from the restored peatlands under wet conditions. Such so-called 'paludicultures' (WICHTMANN & JOOSTEN 2007) are a promising approach to meet the challenges of global change. A feasibility study on the use of biomass from rewetted peatlands is carried out in Belarus, accompanied by harvesting trials. Local communities currently heating with peat briquettes from drained peatlands are potential users of peatland biomass briquettes from rewetted peatlands. Thus, they also provide extra climate benefits by substituting fossil fuels. Paludiculture also benefits biodiversity, e.g. by maintaining suitable habitat conditions for species such as the Aquatic Warbler (*Acrocephalus paludicola*), the only globally threatened passerine species of continental Europe (TANNEBERGER et al. 2009).

The environmental benefits expected from the project include the reduction of greenhouse gas emissions (and the renewal of carbon sequestration), the improvement of the regional air and water quality, the prevention of peat fires (and of the related release of radionuclides from the Chernobyl accident), the restoration of habitats of threatened species and an

increase in biodiversity, and the long-term maintenance of valuable plant and animal communities by paludiculture.

This project could successfully start thanks to the strong dedication of the Belarusian government (namely the Ministry of Natural Resources and Environmental Protection of the Republic of Belarus) to peatland restoration and the successful preparatory work of several European NGOs (JOOSTEN 2007). The project is set up by the Royal Society for the Protection of Birds, UK, the Michael Succow Foundation, Germany, and APB-BirdLife Belarus, and financed by Germany through KfW Entwicklungsbank in the framework of the International Climate Protection Initiative of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU). The long-term aim is to sustain funding for future peatland restoration from the revenues of carbon credit sale.

One of the main barriers of the peatland restoration is the fact that peatlands are not yet eligible at compliance markets. It is hoped and lobbied for a new policy after 2012.

The rewetting of peatlands can be a win-win-win situation (for climate and biodiversity protection as well as for national and local economies) and the current project will show the benefits and constraints related to it.

Acknowledgements

We thank the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) for financing the project II.C. 53 as well as the *Centrum für internationale Migration und Entwicklung* (CIM) and the Royal Society for the Protection of Birds (RSPB) for financing two expert positions in Belarus.

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ANNEX B

CASE STUDIES ON ADAPTATION FOR NATURE CONSERVATION

Adapting the Landscape to Climate Change - Examples of Climate Corridors for Several Ecosystems

D.C.J. VAN DER HOEK, M. VONK[13] AND C. VOS[14]

Background and Intervention

Despite the implementation of mitigation strategies, climate change is taking place. Since climate is a key driving force for ecological processes, climate change is likely to exert considerable effects on ecosystems. Important effects on nature are: temperature rise will affect the potential range of habitats and species (suitable climate zones are shifting), while extreme weather events, such as more extreme precipitation and periods of extreme drought, increase population fluctuations. Shifts in species distribution will occur and environmental conditions will change too, e.g. increased drought stress in summer and more dynamic (ground)water levels. The overall effect of this additional threat will be an increase of the risk on biodiversity loss and a decrease of the resilience of ecosystems and therefore the ability to adapt.

Although the Dutch nature areas are highly fragmented and under heavy pressure from increasing economy and human population growth, a great diversity of nature exists. The Netherlands is a delta region and have international responsibility for various types of wetlands habitats like the delta, rivers, wetlands, Waddensea and coastal dunes. In the Netherlands the National Ecological Network (NEN), backbone of Dutch nature policy, was developed and should be finalized by 2018. This network plays an important part in enlarging and connecting the Dutch Natura-2000 areas.

Recently the question is being asked whether the NEN is an effective strategy to cope with climate change or that additional measures are necessary to make ecosystems more resilient to the effects of climate change. This question will be answered in an assessment called 'Climate proofing nature, an overview of adaptation strategies' (VONK *et al.*, in prep). This study contributes to improve the quality of political and administrative decision-making. An integrated approach is considered paramount. Policy relevance is the prime concern in this study and the research has to be scientifically sound.

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[14] ALTERRA Wageningen University and Research Centre, The Netherlands

Adaptation Strategies

The following adaptation strategies were developed in order to increase the conditions for ecosystem resilience: (1) Enlarge nature areas to dampen population fluctuations as an answer to weather extremes. Large areas give natural processes the space they need to work, provide space for species that can only survive in large areas and in those areas it is easier and cheaper to secure the right environmental and water conditions. (2) Connect nature areas on regional, national and international scale in order to increase the spatial cohesion. This creates possibilities for species to reach new suitable habitats (VOS *et al*. 2008). (3) Improve environmental conditions within nature areas. (4) Create multifunctional buffer zones outside the nature areas.

Before defining the strategy for different ecosystems the following aspects were identified: (1) The nature areas too small because of climate change. (2) The bottlenecks in migration for species with different dispersal capacity. (3) The locations with potential for ecosystems, based on environmental conditions.

As an adaptation of the NEN, a so called 'Wetland climate corridor' for wetlands was designed: a broad planning zone where the adaptation strategies will be implemented (Figure 1) (Nature Balance, 2008). It consists of stronghold areas which are large enough to house key populations for most target species (VERBOOM *et al*. 2001). It also includes broad connecting zones between the strongholds within which patches (stepping stones) need to be enlarged, connected with additional habitat, and environmental conditions need to be improved. Also transboundary connections are necessary so species could move. The Dutch wetlands form a stronghold in NW-Europe. Rivers like the Rhine can account for large scale (international) connectivity. Along banks of Rhine occur not many wetlands but there are many nature development plans. International cooperation needs to find the most effective solutions.

The assessment presents also a 'map of adaptation' for several other ecosystems like heath land, coastal dunes and forest and finally a national adaptation map.

Resulting Benefits

As mentioned, in large areas it is easier and cheaper to secure the right environmental and water conditions. For the final implementation of the 'Wetland climate corridor' it is important to know what the opportunities for multifunctional adaptation are. Especially measures taken to avoid flooding along the large rivers (water safety) may have potential for wetland development (e.g. the 'Room for the River' Programme). The costs will be lower on balance than when the goals are approached separately. Furthermore, wetland areas provide services for other functions as recreation or freshwater storage. Also natural elements in the

agricultural landscape (green veining) have multifunctional benefits for recreation quality, ecological quality and economic value like pest control and pollination.

Lessons Learnt

In order to reduce the vulnerability of ecosystems to climate change and to make the policy for the conservation of ecosystems climate change proof it is needed to increase ecosystem resilience and to profit from synergy with other functions. Another lesson is to work on international connections and to identify main ecological corridors in Europe in order to make the European nature and Natura-2000 network climate change proof. Concepts of 'gradient' and 'dynamic' may offer new opportunities. The concept of 'gradient' is characterized by gradual transitions from freshwater to saltwater, from nutrient-poor to nutrient-rich conditions and from wet to dry conditions. The concept of 'dynamic' means that these conditions change over time. One of the major concerns is that nature cannot adapt adequately and therefore current biodiversity conservation goals are under pressure. The introduction of dynamics in nature policy instead of conservation of static targets species and habitats might be necessary.

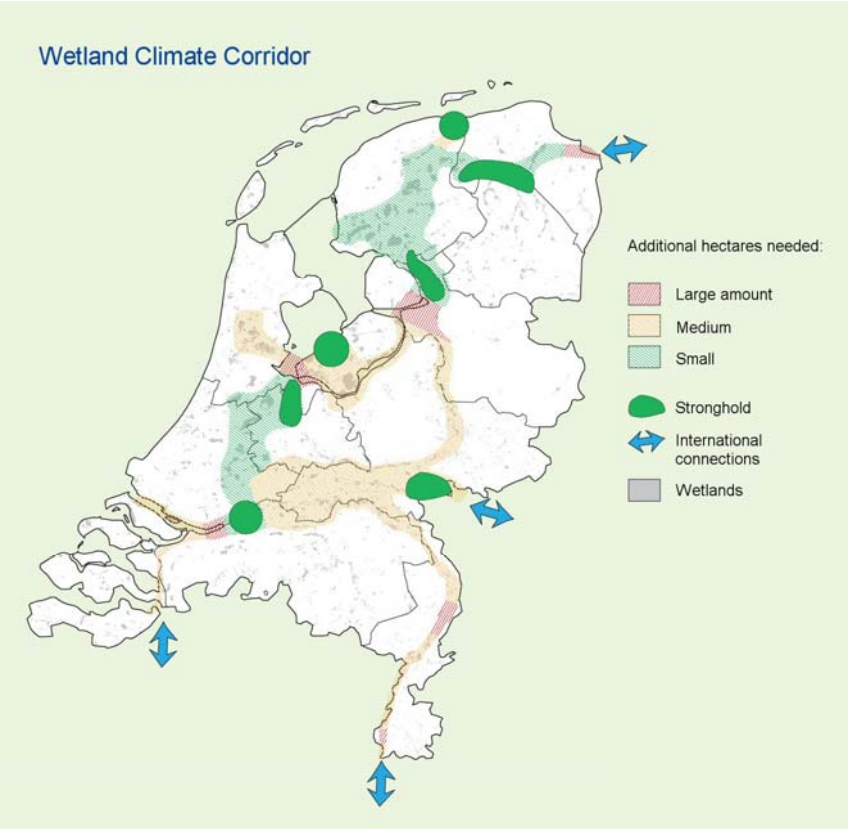

Figure 1: Design of the 'Wetland Climate Corridor' what makes the wetland ecosystems more resilient to climate change (NATURE BALANCE 2008).

Conclusions

The realization of the NEN in its current form has not yet made nature sufficiently resilient to absorb the consequences of future climate change. A modification of the NEN is necessary. The creation of a 'Wetland climate corridor' is one of the options. For the other ecosystems specific adaptation maps are available.

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Restoration and Management of Habitats in Finland

AIMO SAANO

Background

Drainage of mires

Finland's mires were drained for two thirds in the period from 1960 to the 1990's for the anticipated growing forestry needs. Ditching and tree planting were done all over the country, often in vain: tree productivity appeared low and forestry unprofitable. Significant harm was done to the network of natural mire habitats and the ecosystem services provided by them.

Clear-cutting of forests

Dense road construction and extensive logging together with subsequent ground ploughing in the period from 1950 to the 1990's have led to young, homogeneous and isolated forest stands.

Losses in traditional agricultural landscape

The concentration of production towards a small number of automated large units has led to the deterioration of traditional rural habitats.

Intervention

The Metsähallitus Natural Heritage Services and Regional Environmental Centres initiated several interventions: Ditches in the drained mires are blocked with tree trunks, branches, vegetation and peat from the same mire. Selected sites of forests are restored to a status that enables natural succession. Prescribed burning, increase of dead and decaying trees as well as creation of small gaps in the stands are further measures taken. Best preserved and only slightly deteriorated rural habitats are restored with priority and thereafter maintained by small-scale forestry and agriculture using traditional or close-to-traditional techniques.

Funding for these measures comes primarily from the METSO programme 2003-2012 financed by the state of Finland. In addition, EU Life –projects have financed parts of the activities.

Results

- Flooding and sudden overflows of rain water are prevented by improved capacity of the restored mires to reserve waters from more frequent and severe rainfalls.
- Ground water levels are maintained stable.

- Quality of drinking water is kept high.
- Leakage of waters with high amounts of carcinogenic humus compounds from the mires is blocked from mixing with the waters used for ecosystem services.
- Forests restored to close-to-natural status augment resilience of the environment to extreme fluctuations of climate.
- Diversity of habitats and species as well as their interactions is kept capable of buffering the negative changes.
- Threat from pests, diseases and alien invasive species is diluted.
- Air quality is kept good and stable due to large variety of forest types.
- Rural livelihoods are kept alive.
- Sudden breaks in wholesale food supply cannot cause humanitarian crises.

Socio-Economic Benefits

Employment of local excavator entrepreneurs, local small-scale logging companies, close-to-traditional agricultural farms and nature tourism companies generate income and social wealth in the region.

Environmental Benefits

Former deteriorated mires are converted from greenhouse gas sources to greenhouse gas sinks and long-term storages. Mire, forest and rural habitats are preserved diverse and connected with each other. Species of fauna, flora, fungi and other organisms maintain chances to disperse to locations securing best their existence and further evolution.

The results of the intervention increase sustainability in several ways:

- Ecologically – no chemical treatments are used, effects in mires and forests are long-lasting and self-maintained after the enforced commencement stage, and small-area initiation input gives large-area positive effects in mire restoration.
- Socially – positive adaptation effect on the society without preferences or discrimination
- Economically – most of the adaptation effects are self-maintained without need for continuous funding. Rural habitat management is conducive to local and environmentally friendly livelihoods.
- Culturally – no offences to any cultural minorities, strengthening of rural tradition awareness

Barriers and Lessons Learnt

The state owns only 30% of the land area, mostly in the northern part of Finland. Thus in the southern part of Finland restoration and habitat management projects needs to be preceded by multi-stage participatory processes.

Mire restoration postulates hydrological and ecological monitoring and occasionally corrective measures as the catchment areas and watercourses are interconnected in many ways.

Conclusions

Restoration and management of habitats is a sustainable and cost-efficient way of ensuring and improving society's adaptation to climate change.

Establishment of a South-North Fennoscandian Green Belt

AIMO SAANO

Background

Large entities of well-preserved pine-dominated old-growth forests have been preserved along the 1,000 km of border between Finland and Russia from the Baltic Sea to the Barents Sea. Roughly, this area equals to that of Finland's 35 present national parks all together. Since the beginning of 1990's the belt of the preserved areas has been called Fennoscandian Green Belt among Finnish and Russian nature conservationists. The nature conservation areas already established along the border form its backbone, but the areas between them add numerous ecological, economic, cultural and social values and bonds to the belt.

Intervention

Finnish-Russian twin-parks cooperation strengthens nature conservation, recreation, education and cultural development across the border. Political and administrative activities prevent deterioration of non-protected areas and preserve them as part of the belt. International scientific research collaboration provides evidence of the capacity of the belt for adaptation to climate change. The following organisations are involved in the project:

- EU commission in form of the TACIS project ENVRUS 9704 (1999-2001)
- Finnish-Russian Working Group on Nature Conservation
- Russian Academy of Sciences, Karelian Research Centre, Petrozavodsk
- Metsähallitus Natural Heritage Services
- NGOs and many individual activists in Russia and Finland

Funding comes from EU projects, from the Finnish Ministry of Environment, from the Russian Academy of Sciences and from the Finnish Academy.

Results

The preservation of a south-north green belt with east-west dimensions greatly improves the resilience of communities to the increase of extreme winds, rainfalls or droughts. The dimensions, over 1,000 km in south-north direction, and tens to hundreds of kilometres in east-west direction, are meaningful and unfortunately rare in European scale. The belt connects several watersheds. Supply with pure water resources will be secured with concerted work along the border.

Socio-Economic Benefits

Nature tourism generates income and social wealth along the belt. The communities within and around the belt favour the formation of new and possibly large networks, which in turn ensures lasting livelihoods. Cooperation across the border nurtured by the green belt activities lower the socio-economic and cultural barrier between EU and Russia.

Environmental Benefits

Large areas for habitats and their connectivity secure vital ecosystems and biome populations, which in turn provide broad genetic variability and ensure resilience. Species of fauna, flora, fungi and other organisms maintain chances to disperse to locations securing best their existence and further evolution. The long south-north extension of the belt offers a special value for the cold-loving organisms which will have a long corridor of pine-dominant habitats. East-west cross-border conservation efforts get improved chances for ensuring preservation of watercourses that are home to precious salmon, trout and freshwater pearl mussel populations. Large carnivores (brown bear, wolf, wolverine, and lynx) and herbivores (wild deer) can be monitored more efficiently and pouching can be more effectively prevented.

The results of the intervention increase sustainability in several ways:

- Ecologically – no harmful methods are needed anywhere, conservation of threatened habitats and species as well as belt connectivity are enhanced.
- Socially – positive adaptation effect on the society without preferences or discrimination
- Economically – promotion of cross-border cooperation on all levels is conducive to local and environmentally friendly livelihoods.
- Culturally – no offences towards any cultural communities or minorities, instead international research, cultural, economical and administrative exchange and joint projects are strengthened.

Barriers and Lessons Learnt

Logging interests in the Republic of Karelia and in the Murmansk region and interests on potential summer villa areas on the northern shore of Lake Ladoga in Russia threaten the success of the project. In Finland some land-owners may fear for expropriation of their lands close to the border.

Engagement of all social interest groups is important in the building-up and development of the Fennoscandian Green Belt.

Outlook

The further development of the Fennoscandian Green Belt concept and its enhanced implementation would be a substantial tool for the EU to better adapt to climate change. As the area is large and involves many local administrative units on both sides of the border, the process cannot be expected to be fast unless the governments on both sides make a joint programme for it and unless the EU takes this up as a subject in the EU-Russian cooperation.

The Network of Ecological Compensation Areas in Switzerland

CHRISTIAN SCHLATTER[15] & CHRISTIAN SCHADER[16],

Background

Since 1993, the Swiss law and Ordinance on Direct Payments for Agriculture (ODP) enables farmers to be compensated for ecological measures. A catalogue lists different possible measures which can be implemented at farm level both to create space for nature and biodiversity and to generate an alternative income for farmers. Measures include the maintenance of e. g. semi-natural structures in the landscape such as high-stem trees, hedges, pastures and meadows which are not intensively used (detailed catalogue: ART 2009). Succeeding a fast increase in the number of these areas, stagnation has been observed (BIODIVERSITYMONITORING 2009). Additionally, it has become evident, that many compensation areas are in unfavourable conditions for biodiversity and their quality, especially species richness, is low. This motivated the extension of the ODP with an additional ordinance which tackles two main points: Ordinance on Regional Promotion of Quality and Networking of Ecological Compensation Areas in Agriculture (OEQ 2001).

Objectives

The OEQ for ecological compensation areas provides a mean to create corridors in the agriculturally utilised landscape. It asks for a general and independent analysis of the network capacities and possibilities within a landscape, encompassing at least several municipalities. This process is called “landscape development plan”. Once this concept, including a rough biological/ecological analysis of species and habitats, as well as a map indicating the adequate places for establishing compensation areas, is formulated and approved by the cantons, the farmers in the studied areas will have the possibility to extend ecological compensation areas or to adapt their maintenance in order to obtain additional payments.

Enhanced linkage of single compensation areas within a network increases the possibility of exchange between meta-populations and thus the resilience within the ecosystem, especially in the context of climate change.

Involved organisations and stakeholders are:

- Swiss Ordinance on Direct Payments
- Local authorities (cantons) to implement and adapt laws and ordinances on regional level and create additional financial incentives

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- NGOs pushing the local authorities to perform the landscape analysis
- Farmers who implement the ecological compensation areas

Results

Since the implementation of the Ordinance on ecological quality and networking, 23% of all existing compensation areas receive payments for providing additional ecological quality (13% in the plains and 34% in the mountains, BDM 2006). These areas provide increased resilience as the species are able to migrate and disperse as a strategy of adaptation to external pressure, specifically climate change.

Many positive effects have been reported: Increased food provision (ASCHWANDEN *et al.* 2005) and increased habitat suitability leading to higher densities in field hares (HEYNEN 2008) or skylark (STÖCKLI *et al*. 2006).

Although many different species benefit from these measures, mainly common and widespread species are favoured by these adaptation possibilities (HERZOG & WALTER 2005).

Socio-Economic Benefits

In addition to the farmers benefiting from higher incomes due to direct payments, the local community receives an added value through a diverse and appealing landscape character which itself holds a higher potential for tourism. Additionally, the possibilities of ecological compensation measures provide an important alternative for farmers to diversify their income.

Environmental Benefits

Large corridors across the open, agriculturally used landscape support the active and effective population dispersal and exchange, ensuring resilience for species and increasing their chances for survival. Specifically, the combination of ecological compensation areas and nature conservation sites provides an interesting approach for an effective setup of a natural network for the dispersal and migration of most animal and plant species (KLEIJN *et al*. 2006).

Achievements and Challenges

Due to a strong link between the agricultural sector and policy, the system of ecological compensation areas has a rather stable basis, even though considerable amounts of money are involved. The positive perception of the ecological compensation areas as well as the backing of nature conservation in the Swiss population makes the system a successful and broadly supported instrument for nature conservation in agriculture.

Due to the national character of the OEQ and the local implementation (at the level of cantons and municipalities), however, the programme shows specific regional facets in its implementation which hampers the comparison between regions. The low interest in establishing ecological compensation areas in sites with good conditions for agricultural production causes problems in terms of gaps in the network. This results in the fact that in less intensively used mountain areas, the areas and share of qualitatively high level ecological compensation areas are higher than in the high-productive lowland areas.

Additionally, the focus on agriculture leads to undesired impacts since other sectors such as nature conservation or tourism are not considered adequately.

Long-winded adjustment processes are to be expected when implementing a nation-wide programme on ecological compensation.

Conclusions

Ecological compensation within the ordinance on direct payments provides a powerful and comprehensive approach to cover the important ecosystems within agricultural areas. Its extension with quality requirements gives an important basis for the effective setup of a network which holds the capability of resilience.

Due to its highly administrative character and strong policy involvement, it is not a very dynamic instrument to encounter adaptation for climate change. However, the relatively complicated and time demanding process for implementing the system is compensated by the resulting broad-scaled network of ecological compensation areas.

Further considerations, such as specific issues for climate change adaptation, need more time for being implemented.

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Restoration and Management of River Habitats in Switzerland

CHRISTIAN SCHLATTER, BENEDIKT NOTTER & PASCALE STEINER

Background

A large proportion of Switzerland's 65,300 km of rivers (scale 1:25,000; BUWAL 1998b) has been heavily modified to canalised and concrete river beds. 538 hydropower plants with an output of at least 300 kW are installed in the Swiss river system (BFE 2004). Many of them are situated in lower areas, which are crucial for the migration of aquatic species in order to access the whole river system. Safety measures (prevention against flooding in spring time), the use of hydropower, and the creation of additional surface for e.g. agricultural use, have been the main reasons leading to fundamental changes in the morphological characteristics of the Swiss river system. There are a large number of barriers for migratory freshwater species, especially for fishes. The modification of major rivers to subdue floodplains for agriculture started in the 18th and 19th century, however, the bulk of the construction work – mainly for hydropower production and flood protection – was carried out in the 20th century. Nowadays, 25% of Switzerland's rivers are morphologically heavily modified and over 88,000 barriers of more than 50 cm height (and thus impassable by migratory fish species) exist; in the areas below 600 m a.s.l. 50% of the rivers are even classified as heavily modified (NOTTER *et al.* 2006).

According to the recent laws on water management and water protection, compensation measures for hydropower stations are mandatory to obtain new licences for electricity production (e.g. sufficient residual flow, fish ladders).

Additional stress on aquatic organisms results from cooling water discharge (nuclear power plants, etc.) and from water removal, which can lead to serious situations during droughts, which was e.g. the case in the summer of 2003.

A recent study (NOTTER & STAUB 2009) shows that the habitat of the brown trout (*Salmo trutta fario*) is likely to change drastically in the next decades: With the temperature increase of 1 to 5.5°C predicted for Switzerland by the year 2050 (BFE 2004), the potential habitat area of the brown trout could decrease by 6 to 44% (see Fig. 1).

Under the most optimist scenario, only the river courses in the lowest areas (lower Aare, Rhine, Rhone below Lake Geneva) will warm to an average July water temperature of over 19°C (which makes them unsuitable as brown trout habitat); however, under the scenario with the highest temperature increase, most rivers outside the Alps and Jura mountains will reach this mean temperature in July. This implies that the brown trout will have to retreat

into those areas most heavily affected by artificial migratory barriers, i.e. the areas between 600 and 1,200 m a.s.l.

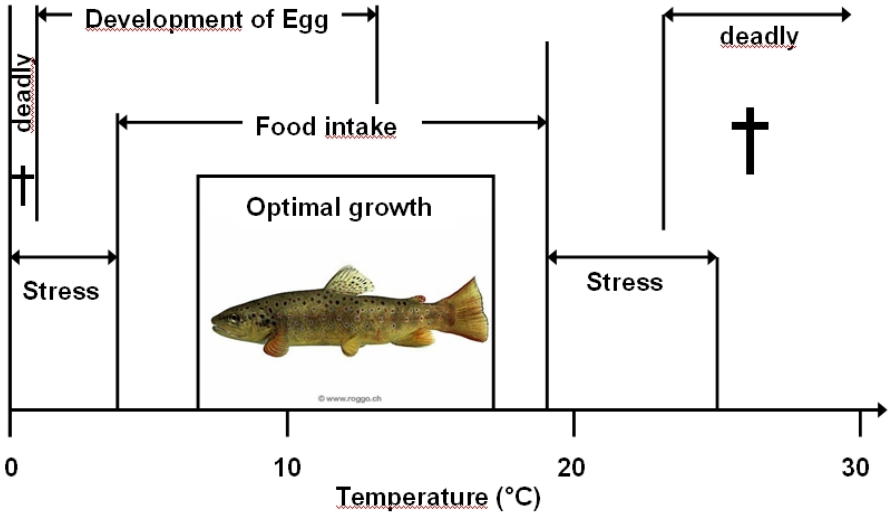

Fig.1: Temperature spectrum for brown trout (Salmo trutta fario) (adapted after KÜTTEL et al. 2002, photo: © www.roggo.ch)

Tab. 1: Scenarios for changes in river temperature and effects on length of rivers suitable as habitats for Brown trout (Salmo trutta fario) (NOTTER & STAUB, 2009)

	1973-1987	1988-2002	2050 - Low air temp. increase (approx. 1°C)			2050 - Medium air temp. increase (approx. 2.5°C)			2050 - High air temp. increase (approx. 5.5°C)		
	Habitat	Habitat	Habitat	Abs. decrease	Rel. decrease [%]	Habitat	Abs. decrease	Rel. decrease [%]	Habitat	Abs. decrease	Rel. decrease [%]
Length [km]	20,600	20,500	20,300	**200**	**1**	19,400	**1,100**	**5**	13,800	**6,700**	**33**
Area [ha]	18,300	16,800	15,800	**1,000**	**6**	14,000	**2,800**	**17**	9,400	**7,400**	**44**

An increased natural adaptation capacity of river systems which are in a natural or near to natural state has been observed as a secondary effect of increased connectivity and dispersal ability in rivers. The advantage thereof is the strengthening of natural occurring species which prevent invasive species from colonising the river network (Mürle *et al.* 2008).

Adaptation Strategy

Power plants renewing their license are required to introduce facilities to allow fish migration, which is of great importance for those species spawning in the upper, cooler parts of the river system (like brown trout or salmon). Such fish passes or ladders are usually local bypasses made of concrete, which allow the fishes to follow the current.

Additionally, a broad coalition of NGOs has been initiating river restoration and revitalisation measures which are likely to be starting in the next years.

Regulatory requirements for the removal of water include minimum residual flows and minimising the increase of the water temperature by activities using river water for cooling purposes.

Similar steps are taken to allow the natural dispersal of castor on land, usually consisting of wooden constructions or boardwalks to give the animals the opportunity to pass barriers in the rivers and to avoid dangerous passing on infrastructure such as streets, etc.

Involved organisations are:

- NGOs
- FOEN, local authorities
- Hydropower Companies

Funding comes primarily from private companies, which in many cases are heavily supported by the national administration.

Expected Outcomes

The Swiss national electricity policy is supporting the use of hydropower. High prices are encouraging the adaptation needed to produce such electricity.

The above mentioned measures are expected to generate benefits different levels: With flexibility in the migration of the brown trout, this important fish for private hobby fishing will assure that fishing remain a widespread activity within the society. Additionally, natural river systems maintain attractive for tourism and provide well-being in terms of trekking and hiking possibilities along the river systems. Hydropower companies are able to certify their actions which allow them to sell their products (electricity) as nature-respecting, bringing higher prices (nature-star).

There is also evidence that the interventions are reducing the risks of floods in early summer.

Both the provision of a network of habitats and strengthening of the river systems as a whole seem to be considerable effects resulting from these measures and leading to fitter autochthonous populations being able to face threats such as climate change or invasive alien species.

Barriers

The possibilities of adjusting concessions for hydroelectricity power plants to the legal titles (e.g. minimal residual flows) are limited due to the long concession duration of 80 years. Many hydro

power plants have been built before the implementation of the corresponding laws in 1991 and, therefore, a considerable number of hydropower plants exist with no residual flows.

Starting to demand compensation measures to encourage migration along the whole river system from the very beginning and strictly following the procedures for giving concessions is a very promising approach.

Conclusions

River restoration and management is a sustainable and cost-efficient way of biodiversity conservation in river and aquatic habitats. In addition, such measures provide a very promising way of adaptation to climate change. The positive effects of enabling upstream migration of fish by removing anthropogenic obstacles or making them passable must be further enhanced by decreasing other stress factors as anthropogenic warming of rivers, pollution reduction and others.

This set of measures for conservation looking at the ecosystem as a whole shows cost-efficient and society relevant ways for species/ecosystems to adapt to climate change.

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Managing Climate Change Impacts at the Bosherston Lakes SAC in Wales: Developing an Adaptive Approach

CLIVE WALMSLEY

Background

Bosherston Lakes Special Area of Conservation (SAC) is a very shallow, artificially-created lake system, lying close to the sea in Pembrokeshire, Wales. It is designated for its internationally important stonewort (*Chara* spp.) lake vegetation. At present, Bosherston Lakes is in an unfavourable condition due to a combination of eutrophication and inadequate *Chara* cover despite ongoing management within the lake and catchment. Climate change scenarios for the UK (UKCIP02: Hulme *et al*. 2002) suggest that winters will be warmer and wetter, while summers become warmer and drier, with sea level rise and an increase in extreme events contributing to impacts on the Lakes in future. There has been some suggestion that the site will not be viable as a freshwater lake in future. As a result of the perceived vulnerability of the SAC to sea-level rise and climate change, research was undertaken to assess the risk and develop an approach to future management (Holman *et al*., 2009).

Adaptation Strategy

The assessment of the impacts of climate change using the UKCIP02 scenarios and monitoring data for water temperature and salinity, and tidal heights suggested that over the next 50 years climate change will largely increase most of the pre-existing pressures on the site, such as droughts, sediment input and eutrophication, rather than introduce new pressures; with the exception of an increased, though low probability, of salinity 'spikes' caused by short periods of seawater entry during extreme combinations of sea level rise, tide and tidal surges.

As a result of considered analysis of the modeling and monitoring data for the site, it was recognized that a phased adaptive management approach to adaptation was required:

- In the short-term further action to enhance the current conservation interests by reducing other sources of harm e.g. continuation of extensive catchment and in-lake work to improve the water quality and reduce eutrophication were identified as the priority.
- In the medium term - activities that will increase the resilience of the system to future change are required, such as an alien species management warning system or raising spring lake water levels to reduce the risk of summer drought impacts, along with improvements in coastal protection infrastructure, e.g. ensuring maintenance of the coastal dam and developing a surge management plan to block ingress of sea-water at times of high risk.
- In the long-term, probably beyond the next 50 years, a potential managed transition from freshwater lake to a brackish lagoon should be considered in part of the site,

although this will need to be reviewed as new evidence relating to sea-level rise and the extent of its likely impacts become available.

Resulting Benefits

There was a risk that climate change would be seen as justification for abandoning the management of Bosherston Lakes despite the lack of any analytical evidence to justify this. The research assessment for this site has demonstrated that no immediate or dramatic change to site management is required at present. The study also provides support for further work to tackle the eutrophication problem at the site. There is also a potential benefit in terms of reassurance of the local community that no dramatic impacts or action are required in the short-term.

Lessons Learnt

Monitoring data for the key drivers of change at the site were invaluable for this assessment. Uncertainty in terms of climate change scenarios and impacts make an adaptive phased approach to adaptation action an effective way of reducing risks.

Conclusions

A critical appraisal of monitoring data and model outputs has proved invaluable for assessing the implications of climate change on this site and developing a long-term phased approach to adaptation. Without such appraisal there is a risk that inappropriate adaptation measures could have been taken.

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Developing Adaptation Options to Address Sea-Level Inundation and River Flooding Risks at Cors Fochno on the Dyfi Estuary, Wales

CLIVE WALMSLEY

Background

Cors Fochno Special Area of Conservation (SAC) is the largest area of near-natural estuarine raised bog in Britain. It is part of the Dyfi Biosphere Reserve, one of nine such UNESCO recognised reserves in the UK. The Cors Fochno bog is vulnerable to climate change impacts because it is situated behind coastal defences and adjacent to a canalized river. Sea-level rise could potentially jeopardize the future viability of this key wetland site. With sea-level rise, the maintenance of 7 km of largely peat banks with no source of new material is not a viable option. A long-term strategic approach to managing coastal defences for the SAC, the neighbouring community of Borth and the Dyfi estuary is needed so a range of management options for Cors Fochno have been evaluated using hydraulic modelling of fluvial and tidal flood risk.

Adaptation Strategy

The effectiveness of a series of defence options was evaluated under baseflow, mean annual flood, 10-year or 100-year return period flooding scenarios and additionally climate scenarios for a projected 20% increase in fluvial flooding and 40 cm sea-level rise. Modelling suggests that a minimal intervention approach with no adaptation response would lead to extensive saline flooding of the wider floodplain and SAC wetland area in future. Several flood prevention options were demonstrated to protect most of the floodplain from saline flooding, even under a projected increase in sea level of 40 cm by 2055. Each of the options differed substantially in cost and the extent to which natural hydrological features are restored. The modelling of the options provides a basis for consultations on how best to integrate nature conservation requirements into flood risk and water-level management planning for the area.

Resulting Benefits

The use of hydraulic modelling has enabled the feasibility of several approaches to climate change risk management for the area to be explored but it has not helped identify a ‘right’ option. It helps frame a discussion with others on the future of the site and the adjacent community as the options also consider the protection of key settlements from saline and fluvial flooding. The adaptation options can potentially deliver flood protection, habitat restoration and a site with a more sustainable hydrological regime and natural appearance.

Lessons Learnt

Given that there is no ‘right’ option, there remains a need for wider consultation for decision-making and a danger that a ‘business as usual’ approach is an easy option. However, by considering the need for flood protection of local communities and the SAC site in an integrated way should allow a better dialogue for agreeing future management.

Conclusions

A site-based assessment of long-term impacts and management options for adaptation has proved invaluable. But, there are still significant barriers to agreeing a way forward and difficult conservation management choices. Under a changing climate, restoration of tidal flats or brackish marsh with an element of managed retreat is potentially a better long-term prospect than the restoration of marshy grassland behind reinforced sea defences. Implementation of landscape-scale restoration and management beyond the site will require strategic prioritisation and public consultation.

ANNEX C

CURRENT INTERNATIONAL AND REGIONAL POLICY PROCESSES AND BACKGROUND STUDIES

Selected Outcomes of the CBD Ad Hoc Technical Expert Group on Biodiversity and Climate Change

CORDULA EPPLE

At the ninth meeting of the Conference of the Parties to the CBD in May 2008, a decision was taken to establish an expert group which would develop scientific and technical advice concerning the interlinkages of biodiversity and climate change with special reference to the ongoing processes under the United Nations Framework Convention on Climate Change (UNFCCC), including the negotiations guided by the Bali Action Plan and the implementation of the Nairobi work programme on impacts, vulnerability and adaptation to climate change.

The terms of reference of this (second[17]) Ad Hoc Technical Expert Group (AHTEG) on Biodiversity and Climate Change, as laid down in COP Decision IX/16, specify a broad set of issues to be addressed, such as the potential benefits and risks to biodiversity from activities to reduce emissions from deforestation and forest degradation, the opportunities for synergy between climate change mitigation and biodiversity conservation in other ecosystems than forests (incl. peatlands, tundra and grasslands), the benefits to society of using ecosystem services for climate change adaptation and the potential benefits and risks to biodiversity from adaptation activities in other sectors. Based on this work, the group was asked to develop advice on the integration of biodiversity conservation and sustainable use into climate change mitigation and adaptation activities.

The first meeting of the AHTEG (with an emphasis on issues related to mitigation) took place from 17 to 21 November 2008 in London, while the second meeting (focussing on adaptation issues) was held from 18 to 22 April 2009 in Helsinki. At the time of writing, the report from the two meetings was undergoing peer review. Once finalised, it will be published in the CBD Technical Series[18] and made available to CBD and UNFCCC parties for consideration in their future work.

Some of the preliminary findings identified during the two meetings are:

[17] The first AHTEG on biodiversity and climate change met four times in 2001-2003. The report has been published as CBD Technical Series 10, see http://www.cbd.int/doc/publications/cbd-ts-10.pdf

[18] http://www.cbd.int/ts/

a) With regard to mitigation:

- Multiple benefits for both the UNFCCC and the CBD can be achieved by maintaining natural and restoring degraded ecosystems, if mechanisms are designed and managed appropriately. For example, the design of potential REDD[19] mechanisms (including the carbon accounting scheme, definition of reference scenarios, time frame, etc.) has important implications for biodiversity.
- Mitigation activities should take into account the landscape context; e. g. in largely intact forested landscapes, mitigation can be best achieved through avoiding emissions by protecting existing carbon stocks, whereas in landscapes whose forests have already been largely cleared and degraded, increasing carbon stocks by appropriately designed reforestation or afforestation measures may be the best option.
- Co-benefits for biodiversity conservation can be promoted by focussing REDD on areas of high carbon stocks and high biodiversity.

b) With regard to adaptation:

- Adaptation activities that make use of biodiversity and associated ecosystem services (ecosystem-based adaptation) can generate multiple environmental and societal benefits.
- Ecosystem-based adaptation may include the management, conservation and restoration of ecosystems. Such measures may be more cost-effective and more easily accessible to poor rural communities than measures based on hard infrastructure and engineering.
- Ecosystem-based adaptation may require managing ecosystems to provide particular services at the expense of others. Decisions should therefore recognise potential trade-offs and be subject to risk assessment, scenario planning and adaptive management approaches.
- Impacts of sector adaptation strategies on biodiversity and ecosystem services vary; strategic environmental assessments, environmental impact assessments and technology impact assessments may be applied to reduce negative impacts, increase positive impacts and minimize the risk of mal-adaptation.
- All adaptation activities should aim to maintain or enhance the natural adaptive capacity of species and ecosystems. This will increase the effectiveness of the activities (by ensuring the continued provision of ecosystem services) as well as biodiversity co-benefits.
- The full value of biodiversity and ecosystem services should be considered in decision-making on adaptation and in the design of incentives.

Other material contained in the preliminary report which might be of interest to the ENCA Interest Group on Climate Change Adaptation and its members includes:

- information on tools and methodologies for the assessment of climate change impacts on biodiversity as well as for the analysis of the value of biodiversity for adaptation;

[19] Reducing Emissions from Deforestation and Forest Degradation in Developing Countries

- case studies and references on ecosystem-based adaptation, including studies on the economic benefits derived from linking the conservation and sustainable use of biodiversity with climate change adaptation.

Building on the information provided by the AHTEG, further steps could be taken within the framework of the ENCA network to:

- compile additional information illustrating the potential of ecosystem-based activities to contribute to climate change mitigation and adaptation in the European context;
- identify starting points on the European and national level in order to translate the recommendations into action; and
- send a clear message to European and national politicians and negotiators in order to support appropriate consideration of biodiversity and ecosystem services in future decisions on the international climate regime.

For a full consideration of the AHTEG findings, please refer to the draft report, which is currently available at: http://www.cbd.int/climate/meetings/ahteg-bdcc-02-02/ahteg-bdcc-02-02-findings-review-en.pdf, or the final report once it is published.

The Nairobi Work Programme on Impacts, Vulnerability and Adaptation to Climate Change - Understanding Vulnerability, Fostering Adaptation

ROCIO LICHTE[20]

Introduction

Issues related to adaptation are being discussed under various tracks under the subsidiary bodies under the UNFCCC:

- The Nairobi Work Programme (NWP) is discussed in negotiations under the Subsidiary Body for Scientific and Technological Advice (SBSTA);
- The Subsidiary Body for Implementation (SBI) deals with issues related to the implementation of action to respond to the adverse effects of climate change;
- Most importantly this year (2009) is the work of the future process under the Ad Hoc Working Group on Long-Term Cooperative Action under the Convention (AWG-LCA) which is working towards an agreed outcome in Copenhagen on climate change.

All these three tracks are related to other processes and mandates within the UNFCCC process, including those on finance, technology, research and systematic observation and capacity building.

The Nairobi Work Programme on Impacts, Vulnerability and Adaptation to Climate Change

The Nairobi Work Programme (NWP) is a 5 year programme (2005-2010) aiming to assist all Parties, in particular developing countries, including the least developed countries and small island developing States to:

- improve their understanding and assessment of impacts, vulnerability and adaptation to climate change;
- make informed decisions on practical adaptation actions and measures to respond to climate change on a sound scientific, technical and socio-economic basis, taking into account current and future climate change and variability.

It is structured and implemented around the following nine complementary work areas:

1. Methods and tools
2. Data and observations
3. Climate modelling, scenarios and downscaling
4. Climate related risks and extreme events

[20] Observer to the meeting

5. Socio-economic information
6. Adaptation planning and practices
7. Research
8. Technologies for adaptation
9. Economic diversification

The NWP is jointly implemented by Parties and all partner organisations, i.e. intergovernmental and non-governmental organizations, the private sector, communities and other stakeholders. It is implemented through a range of modalities including: workshops and meetings; drawing on knowledge and experience; web-based resources including compendiums; submissions from Parties and organisations; reports and technical papers; and others. Actions are catalysed across all nine work areas of the NWP. Its outcomes are disseminated as widely as possible and participation by all relevant stakeholders is encouraged. To date, the programme has engaged over 130 partner organisations, including UN agencies, IGOs, NGOs, research institutions and private sector entities.

The NWP has become an important knowledge hub on adaptation worldwide proving a range of knowledge and information products, e.g. on methods and tools, experiences, good practices, lessons learned, as well as information on needs, gaps and priority actions, updates on relevant ongoing activities; and also enables access to expertise for all adaptation practitioners.

Identification of gaps and needs on the one hand and supply of information on the other hand

Gaps and needs and potential actions to be undertaken under the work areas of the NWP are identified and highlighted in **Calls for Action** and thereby communicated to a wider adaptation community. So far, eight calls for action have been issued, based on input from experts at meetings and workshops. On the other hand, NWP partners supply information on their adaptation activities being carried out, and pledge further action in line with the goals of the NWP as well as in answer to calls for action. To date, around 90 **Action Pledges** have been made by more than 30 partners in support of the NWP.

What the NWP can deliver:

As the primary knowledge sharing and learning platform on adaptation under the UNFCCC process, the NWP delivers, among others, the following:

- A wide range of actions to produce and disseminate knowledge, information and data on and for climate impact and vulnerability assessment, and/or for adaptation planning and implementation;
- A diverse range of adaptation knowledge products and services delivered through a variety of media, including website, printed publications and CDs;
- A mechanism for facilitating mutual learning and collaboration across sectors, regions and stakeholder groups;

- A linkage between activities undertaken by partner organizations and the needs and priorities of the Parties.

It can also help to target work on adaptation at addressing gaps, needs and priorities identified by Parties and hence increase relevance; connect with other practitioners and experts for learning and collaboration; publicise work being carried out on adaptation; and assist in linking work to international policy discussions.

AWG-LCA Negotiations Related to Adaptation under the Bali Action Plan

Enhanced action on adaptation constitutes one of the main pillars for an expected climate change agreed outcome in Copenhagen at COP 15 in December 2009.

As a result of the 6th session of the AWG-LCA negotiations (1-12 June 2009, Bonn, where a negotiating text by the Chair (FCCC/AWGLCA/2009/8) was made available), a revised negotiating text (FCCC/AWGLCA/2009/INF.9) was issued reflecting general comments by Parties on structure and content of the text, including reservations, objections, proposed additions and modifications. The section on adaptation presently contains text related to objectives, scope and guiding principles; implementation; means of implementation; risk reduction and management; institutional arrangements; and elements related to review.

Next Steps

The current text is expected to be further negotiated and revised by Parties during the upcoming UNFCCC meetings leading to the negotiations in Copenhagen (10 - 14 August in Bonn; 28 Sept - 9 October in Bangkok; 2 - 6 November in Barcelona).

Discussion Paper on Climate Change, Ecosystems and Biodiversity

KARIN ZAUNBERGER

A discussion paper entitled “Towards a Strategy on Climate Change, Ecosystems and Biodiversity”[21] is currently being developed by the EU Ad Hoc Expert Working Group on Biodiversity and Climate Change. The Group consists of Member State Representatives, Commission staff, scientists and civil society[22]. The paper was widely discussed and finalised at the meeting of the working group on 15 July 2009. The paper is not a negotiated text and therefore does not represent an official position of the European Commission. It aims to provide information and recommendation taking into account most recent scientific findings.

The paper showcases the link and interdependency between biodiversity and ecosystems, ecosystem services and climate change. It makes the case that working with nature rather than against it offers opportunities to involve people and build responsibility to allow sustainable development within the ecological limits for a future which holds opportunity for welfare, equity, security and human development. Therefore the maintenance and restoration of diverse, functioning ecosystems across the wider terrestrial, freshwater and marine environment must be a guiding principle as we move forward to climate proof our policies.

The paper consists of three main parts including an executive summary and two sections: 1) "The Way Forward" and 2) "The Climate Change – Biodiversity Nexus". Sections 1 and 2 are framed by a brief introduction and a post scriptum. A reference list and potential annexes provide further information.

The executive summary sets the scene and tries to attract the reader’s attention. It highlights six areas of action inspired by the outcome of the climate change session at the Conference “Biodiversity Protection – Beyond 2010”, held 27-28 April 2009[23].

The identified areas of action are:

1. Use ecosystem-based approaches achieving multiple benefits
2. Act now
3. Engage all sectors
4. Communicate and collaborate
5. Increase understanding
6. Ensure appropriate funding

[21] see http://ec.europa.eu/environment/nature/pdf/discussion_paper_climate_change.pdf

[22] For more information on the group, its mandate and work please consult the CIRCA website: http://circa.europa.eu/Public/irc/env/biodiversity_climate/home. No login is needed. Simply click on the library tag to access the documents.

[23] See http://ec.europa.eu/environment/nature/biodiversity/conference/index_en.htm

Section 1 “The Way Forward” is divided into six subsections developing further the bullet points in the executive summary. Suggestions for concrete actions and longer term recommendations are presented in nine Action Boxes:

1. **Integrated and Ecosystem Based Approaches** including maintenance and restoration of wetlands, forest and oceans, use of natural approaches to control and adapt to coastal erosion (e.g. restoration of mangrove) and greening of the cities.
2. **International Dimension** including suggestions with a view to the new climate agreement and the need for enhanced collaboration between the Rio Conventions.
3. **Immediate Action** stressing synergy and no-regret actions and the need to reduce the other pressures on the environment to increase resilience and reduce vulnerability.
4. **Buying Time** stressing the need for adaptation measures for biodiversity grouped under “protect – enlarge and connect” which aim to maintain diversity and enhance connectivity.
5. **Engagement of Other Sectors** reminding to fully implement the EU Biodiversity Action Plan and including a table with specific suggestions for some key sectors (agriculture, regional policy, fisheries, water, forestry, transport, energy, development policy and tourism).
6. **Communication and Collaboration** emphasising the need for awareness campaigns, education, building of capacity and partnerships.
7. **Increase Understanding** identifying a number of pertinent research gaps.
8. **Monitoring** highlighting the need for long-term monitoring.
9. **Funding** encouraging the full use of existing instruments and exploring the development of new ones.

Section 2 “The Climate Change – Biodiversity Nexus” gives further background to the action points and recommendations taking into account also recent scientific information published after 2006 and therefore not included in AR 4. It is divided into three subsections: 1) the role of biodiversity & ecosystems and ecosystems services in relation to climate change, 2) the threats of climate change with regards to the achievements of nature conservation and climate change policy goals, and 3) the potential for co-benefits including examples. Information boxes provide general background with regards to ecosystem services, TEEB, other EU policies, political statements with regarding the link between biodiversity and climate change, synergies between adaptation and mitigation. An additional information box “ecosystem-based adaptation creates benefits for people” is suggested.

The post scriptum presents a final reflection elaborating on the link between biodiversity loss, climate change and poverty reduction and concludes that in the face of looming tipping points acting on climate change and biodiversity loss both swiftly and in an integrated manner is the only rational insurance strategy against irreversible damage.

Estimating the Cost of Adaptation Measures: Forest Ecosystems in India

ELENA OJEA

Background

Currently, countries lack estimates of the costs to be incurred to adapt to climate change impacts. There are uncertainties concerning the impacts of climate change on biodiversity with its ecosystems, species and genetic diversity, which are even greater in developing countries. Current estimates of adaptation needs in developing countries and their costs are very few and rather crude. Up to date, estimates of adaptation costs have focused on the additional costs of including adaptation in their investments with only general estimates and few information on the different adaptation options to be applied. Moreover, there is no agreed methodology for estimating adaptation costs.

Against this background, the Energy and Resources Institute (TERI) in India and the Basque Centre for Climate Change (BC3)[24] have started a joint program with the objective of estimating the costs of the measures that India requires to adapt to climate change. The study is ongoing and covers different sectors such as health, water, agriculture and ecosystems. In the following, we will present the work done to date in the forest ecosystems sector.

Methodology

From the literature we identified the main adaptation options proposed for climate change impacts on forest ecosystems in India. Forest ecosystems were chosen because there is more information on impacts and adaptation available than for other ecosystems.

Although specific actions are needed to adapt to climate change impacts, current estimates of adaptation costs are often based on one single adaptation measure such as increasing protected area size. Moreover, there is an emphasis on the USA and other OECD countries, with only a few studies for developing countries. Improving the knowledge on climate change adaptation costs will allow policy-makers to optimise strategies for the implementation of adaptation policies. The resulting numbers are very high, however, other current estimates are few and rather crude and their methodology is based on current global investment shortfalls in protected areas. These estimates are derived from strong assumptions and lack a direct link between the magnitude of the impact and the amount of

[24] Participating researchers are: Anil Markandya, Arabinda Mishra, Ranjan Ghosh, Suruchi Bhadwal, Aline Chabai, Julia Martín-Ortega and Elena Ojea.

adaptation. Although these measures are of course helpful, there is a need to develop a more detailed methodology for the estimation of adaptation costs.

Socio-Economic Aspects

In the project presented here, we take into account more details, e. g.: identification of vulnerable areas; identification of the positive or negative direction of the impacts on each area; linking adaptation options for specific impacts; valuing the costs of these specific adaptation requirements (see table 1). The project is still in process and first results are expected for fall 2009.

Table 1: Proposed methodology for measuring adaptation costs

1. **Identification of the vulnerable zones**
2. **Quantification of direct climate change impacts**
3. **Identification of adaptation options:** CRITERIA for selecting the adaptation options:
   - Relevance: there's an impact of significant relevance to be avoided
   - Scale of action: magnitude of the adaptation option
   - Effectiveness: effect of the measure on avoiding the impact
   - Feasibility: real possibility of applying the adaptation option
4. **Identification of per unit cost of the adaptation measure**
5. **Identification of indirect impacts, qualitatively**
6. **Total costs**

Conclusions and Outlook

At this stage, some conclusions can be derived from the literature review and from international reports covering the costs of adaptation.

Countries lack estimates of the costs to be incurred to adapt to climate change, and this gap is larger for ecosystem-based adaptation. Current estimates are on a global scale and very crude. The methodology is still discussed and developing; controversies exist between bottom-up *versus* top down approaches, the issue of adaptation deficit, the adaptation timeframe or the residual damage. This project aims to overcome these gaps and proposes a methodology that can be applied at a regional scale and where adaptation options are feasible and linked to specific impacts.

The project is only a first step and especially relevant for developing countries. Given the lack of a consensus on how to estimate adaptation costs, the proposed methodology can significantly contribute to the literature and help policy makers to get aware of the magnitude of the economic dimension of adaptation. However, this is work in progress and the empirical applications of this methodology will tell soon how it can be improved.

German Forestry and Climate Change: Silvicultural Adaptation Strategies with Focus on Nature Conservation Aspects

ALBERT REIF, JÜRGEN BAUHUS, RAFFAEL KRATZER, ULRIKE BRUCKER & ANDREAS SCHMIEDINGER

Background

Climate change scenarios assume that the future annual temperature in Germany will increase from at least 1.6 K up to 3.8 K until 2080. The prospective precipitation can be characterized by an increasing regional and seasonal variability (ZEBISCH *et al*. 2005). The predicted climatic change might increase the frequency of extreme events (summer dryness / drought, storms, forest fire, floods) (IPPC 2007). Also forestry will be substantially affected by the consequences of climatic change**.**

Forest ecosystems are reacting very sensitive to these changes of abiotic site factors. Trees are long- living organisms not able to leave their habitat. The rate of the climate change most likely will overstress the adaptation capacity of many tree species on many sites. Central European forest ecosystems will change in a more or less continuous or abrupt succession process, which affects the ecological, social and economical functions of forests and forestry.

Objectives and Methodology

Climate change affects the vigour of tree species and the state, structure and species composition of forests (KÖLLING & ZIMMERMANN 2007, KÖLLING 2008). Less adapted tree species are more vulnerable to drought and pests. As a consequence the mortality of important forest tree species, the production risks in managed forests, and the turnover rates in species composition will increase.

We conclude that forest management measures have to support the resistance and resilience of forest stands in order to withstand the effects of climatic change and to achieve adaptation to climatic change. This leads to considerations about forest composition and management.

The objective of the project presented here (duration: 01.01. - 15.11.2009) is to analyse recommendations and support programmes of the forest authorities in the different federal states of Germany concerning tree-selection and other silvicultural adaptation strategies. The results are being discussed focusing on potential conflicts and synergies between actors of forest management and nature conservation. A rapid assessment by means of interviews and questionnaires provides the basis for an overview of the current debates, the prevailing opinions, and the proposed mitigation measures.

Challenges

There are still huge knowledge gaps concerning the adaptive capacity of tree species to climate change. Thus more research on the ecology and adaptation strategies of tree species is needed.

A challenge is to stimulate private forest owners to transform pure conifer forests into stands mixed with deciduous trees. These conversions cannot be forced by law. Approximately 65% of the forested area in Germany is private owned or belongs to communities (BMELV 2004).

Outlook

Climate change will have negative effects on forests in Germany. In times of rapid climate change it seems to be important to develop and implement suitable forest adaptation strategies and to review specific management practises.

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Nature Reserve Adaptation Informs Ecosystem-Based Approaches

OLLY WATTS

Strategic and practical experience of climate change adaptation at nature reserves gives some useful insights into implementing ecosystem-based adaptation.

The RSPB's nature reserves represent a microcosm of the UK, ranging from coastal mudflats to some of the highest mountains in the UK; from wetlands and meadows to heathlands, moorland, fen and bog. Understanding the impacts of climate change and adapting our land management across our estate, with over 200 nature reserves covering more than 140,000 hectares, is a challenge in which the RSPB is now actively engaged.

A twin track strategic approach guides the RSPB's practical adaptation action. Foremost now, increasing resilience aims to build strong populations in current locations, to reduce non-climate pressures, and to develop management to reduce climate impacts. Increasingly in the future, developing accommodation actions will help wildlife track suitable climate conditions, seek to maintain a coherent network of protected sites under changing climate conditions, and to encourage more sustainably managed and wildlife friendly landscapes.

Knowledge of the impact of future climate conditions on species and sites is central to developing effective adaptation. Yet we expect there will always be substantial knowledge gaps and so integrating uncertainty about the future is also a key part of management planning. The RSPB has gained initial, broad information about the impact of climate change through a study modelling the changing location of suitable climate conditions for Europe's breeding birds[25]. The averaged results for all species at a 3°C average global temperature increase are eye-opening: the centre of future potential range moves by nearly 550 km; the predicted extent of suitable climate space for a species contracts by 20%; there is only 40% overlap with current range; and 75% of species are likely to decline.

The RSPB has also made assessments for generic actions for its priority species. These focus on habitat management and reducing key stresses for building resilience; and habitat creation, landscape scale action and translocation for developing accommodation.

The RSPB's nature reserve planning is informed by regional climatic projections for a 2°C average global temperature increase, as well as by on the ground impacts. Already, wetlands in south-east England are being affected by drier summers. Accepting partial drying, management is focusing on retaining core wetland features, with wider areas between them, which may vary in extent between years. Creating reservoirs, reducing water seepage losses, employing

[25] Brian Huntley, Rhys E Green, Yvonne C Collingham and Stephen G Willis 2007. *A climatic atlas of European breeding birds.* Durham University, The RSPB and Lynx Edicions, Barcelona.

water recirculation systems and integrated catchment management are among a range of practical techniques increasingly used to retain water availability for wetlands. Alongside these measures, wetland creation is targeted in areas where climate projections indicate ample rainfall in the future.

Ecological knowledge is key to successful ecosystem adaptation measures. Research has been instrumental in defining the correct adaptation response to the threat, from sea level rise on England's east coast, to the stronghold of the UK's bittern population. Scientific studies have been central to identifying: the core sites for dispersal; the timescale of threats to those sites; dispersal abilities to inform locations for new sites; and ecological requirements guiding habitat creation. The threat to bitterns, as an iconic species, has focused action and funding for a programme of reedbed creation, with a range of associated ecological and eco-systems services benefits.

Intertidal habitats often provide good examples of ecosystem-based adaptation, combining valuable biodiversity areas with flood control and amenity benefits. The RSPB has created multi-benefit intertidal habitats through breaching sea walls at several locations in the UK, and at one site by an innovative regulated tidal exchange floodgate. These projects reduce the costs of flood defence and help to offset habitat loss from sea level rise.

Ecosystem-based adaptation can also embrace the landscape scale, for example to reduce habitat fragmentation, or to restore basic land condition. The Sustainable Catchment Management Programme (ScaMP) in northern England is joint project for the RSPB and water company United Utilities, encompassing some 40 upland farms and 20,000 hectares. The project aims to stabilise eroding peat soils to benefit water quality, a range of upland habitats and sustainable, economic farming. ScaMP has also produced a vibrant partnership of cross-sector interests with a common interest in sustainable, ecosystem-based solutions.

All land management must respond and develop adaptation to climate change, and the experience gained on nature reserves is valuable and readily transferable. As focal points for biodiversity in landscapes, nature reserves are also a key element in the development of landscape scale adaptation and ecosystem services. They can provide practical examples and management experience for a range of ecosystem-based adaptation measures, with both strategic and practical approaches and experience that are widely applicable in other locations. And they are also, of course, vital for the strength and continuity of biodiversity in a changing climate, which is perhaps the greatest resource for developing ecosystem-based adaptation: the maintenance of biodiversity and their ecosystems themselves, for both intrinsic and a range of societal values and benefits.

ENCA Workshop

"Developing ecosystem-based adaptation to climate change - why, what and how"

June 23-24, 2009

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ENCA Workshop

"Developing ecosystem-based adaptation to climate change - why, what and how"

June 23-24, 2009

Programme

Monday, 22.06.2009

Arrival of the participants at the Isle of Vilm

18.30 Dinner

20.30 Horst Korn and Caroline Cowan
Welcome of the participants
Opening of the meeting, Introduction

Tuesday, 23.06.2009

08.00 Breakfast

I Overview on current research findings

09.00 Monika Bertzky (UNEP-WCMC)
Ecosystem based adaptation: the recent literature

09.15 Oliver Schweiger (Helmholtz-Zentrum für Umweltforschung)
The Climate and Biodiversity Risk Atlas (ALARM)

09.30 James Paterson (Oxford University)
Outcomes of the MACIS Project

II International and regional policy processes

09.45 Cordula Epple (BfN)
Selected outcomes of the CBD AHTEG on biodiversity and climate change

10.00 Hannah Hoffmann (UNFCCC-Secretariat)- INVITED
Overview on recent negotiations on ecosystem based adaptation under the UNFCCC

10.15 Karin Zaunberger (European Commission-DG Environment)
Strategy Paper on Biodiversity & Ecosystems, Ecosystem Services and Climate Change currently developed by the EU Ad Hoc Expert Working Group on Biodiversity and Climate Change

10.30 Coffee / Tea break

11.00 Jan Plesnik (Czech Agency for Nature Conservation and Landscape Protection)
The Bern Convention: more than wildlife and habitats

11.15 Yves de Soye (IUCN-Regional Office for Pan-Europe)
The IUCN Ecosystem based Adaptation Report

11.30 Discussion of first set of presentations; determination of audience and key messages for the workshop report

12.30 Lunch

14.00 Guided tour in the nature reserve of the Isle of Vilm

15.30 Coffee / Tea break

III Presentation of case studies (part 1)

16.00 Elena Ojea (Basque Centre for Climate Change)
Estimating the Cost of Adaptation Measures: Forest Ecosystems in India

16.15 Raffael Kratzer (University of freiburg)
German Forestry and Climate Change: Silvicultural adaption strategies with focus on nature conservation aspects

16.30 Franziska Tanneberger (Michael Succow Foundation)
Restoring Peatlands and applying concepts for sustainable management in Belarus - climate change mitigation with economic and biodiversity benefits

16.45 Sergiy Moroz (WWF)
Lessons learnt from WWF adaptation projects - with a specific focus on The Lower Danube

17.00 Coffee / Tea break

17.30 Discussion
Principles of Ecosystem based adaptation

18.30 Reception at the invitation of the German Federal Agency for Nature Conservation

Wednesday, 24.06.2009

08.00 Breakfast

III Presentation of case studies (part 2)

09.00 Yabanex Batista (The Nature Conservancy)
The Role of Ecosystems in Adaptation Strategies: Islands' on the Water Experiences and Initiatives

09.15 Olly Watts (Royal Society for the Protection of Birds)
Adaptation action at RSPB nature reserves

09.30 Yves de Soye (IUCN-Regional Office for Pan-Europe)
Selected outcomes of a study on Climate change impacts on biodiversity and the Natura2000 network in the EU

09.45 Clive Walmsley (Countryside Council for Wales)
Addressing the threat of climate change on the Welsh coast – experience from Natura 2000 sites

10.00 Rania Spyropoulou (European Environment Agency)
Sites, species, habitat types of European interest: Restoration OR adaptation?

10.15 D.C.J. van der Hoek (Netherlands Environmental Assessment Agency)
Adapting the landscape to climate change - Examples of climate corridors for several ecosystems

10.30 Coffee / Tea break

IV Plenary

11.00 Additional examples from plenary, discussion and determining structure of report

12.30 Lunch

14.00 Drafting groups for final report

15.30 Coffee / Tea break

16.00 Final discussion
Finalization of the workshop report

18.30 Dinner

20.30 Plenary: Finalization of the workshop report

Thursday, 25.06.2009

08.00 Breakfast

09.20 Departure of the participants